Fundamentals of INFORMATION SYSTEMS

Eighth Edition

Ralph M. Stair | George W. Reynolds

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Fundamentals of Information Systems, Eighth Edition
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For Lila and Leslie

—RMS

To my grandchildren: Michael, Jacob, Jared, Fievel, Aubrey, Elijah, Abrielle, Sofia, Elliot, Serena, and Kendall

—GWR

Brief Contents

Contents

Preface

We are proud to publish the eighth edition of *Fundamentals of Information Systems.* This edition builds on the success of the previous editions in meeting the need for a concise introductory information text. We have listened to feedback from the previous edition's adopters and manuscript reviewers and incorporated many suggestions to refine this new edition. We hope you are pleased with the results.

Like the previous editions, the overall goal of the eighth edition is to develop an outstanding text that follows the pedagogy and approach of our flagship text, *Principles of Information Systems*, with less detail and content. The approach in developing *Fundamentals of Information Systems* is to take the most valuable material from *Principles of Information Systems* and condense it into a text containing nine chapters. So, our most recent edition of *Principles of Information Systems* is the foundation from which we built this new edition of *Fundamentals of Information Systems*.

We have always advocated that education in information systems (IS) is critical for employment in almost any field. Today, information systems are used for business processes from communications to order processing to data analysis for decision making and in almost all business functions ranging from marketing and human resources to product development and manufacturing to accounting and finance. Regardless of your future occupation, even if you are an entrepreneur, you need to understand what information systems can and cannot do and be able to use them to help you accomplish your work. You will be expected to suggest new uses of information systems and participate in the design of solutions to business problems employing information systems. You will be challenged to identify and evaluate IS options. To be successful, you must be able to view information systems from the perspective of business and organizational needs. For your solutions to be accepted, you must identify and address their impact on coworkers. For these reasons, a course in information systems is essential for students in today's high-tech world.

Fundamentals of Information Systems, Eighth Edition, continues the tradition and approach of previous editions. Our primary objective is to provide the best information systems text and accompanying materials for the first information systems course required for all business students. We want you to learn to use information systems to ensure your personal success in your

current or future role and to improve the success of your organization. Through surveys, questionnaires, focus groups, and feedback that we have received from current and past adopters, as well as others who teach in the field, we have been able to develop the highest-quality set of teaching materials available to help you achieve these goals.

Fundamentals of Information Systems, Eighth Edition, stands proudly at the beginning of the IS curriculum offering the basic information systems concepts that every business student must learn to be successful. This text has been written specifically for the introductory course in the IS curriculum. *Fundamentals of Information Systems, Eighth Edition*, addresses the appropriate computer and IS concepts while also providing a strong managerial emphasis on meeting business and organizational needs.

APPROACH OF THIS TEXT

Fundamentals of Information Systems, Eighth Edition, offers the traditional coverage of computer concepts, but places the material within the context of meeting business and organizational needs. Placing information systems concepts within this context and taking a management perspective has always set this text apart from other computer texts, thus making it appealing not only to MIS majors but also to students from other fields of study. The text is not overly technical, but rather deals with the role that information systems play in an organization and the key principles a manager or technology specialist needs to grasp to be successful. The principles of IS are brought together and presented in a way that is understandable, relevant, and interesting. In addition, the text offers an overview of the entire IS discipline, while giving students a solid foundation for further study in more advanced IS courses such as programming, systems analysis and design, project management, database management, data communications, Web site design and development, electronic and mobile commerce, decision support, and informatics. As such, it serves the needs of both general business managers and those who aspire to become IS professionals.

The overall vision, framework, and pedagogy that made the previous editions so popular have been retained in the eighth edition, offering a number of benefits to students and instructors. While the fundamental vision of this market-leading text remains unchanged, the eighth edition more clearly highlights established principles and draws on new ones that have emerged as a result of business, organizational, technological, and societal changes.

IS Principles First, Where They Belong

Exposing students to fundamental IS principles is an advantage even for those students who take no IS courses beyond the introductory IS course. Since most functional areas of the business rely on information systems, an understanding of IS principles helps students in their other course work. In addition, introducing students to the Fundamentals of Information Systems helps future business managers and entrepreneurs employ information systems successfully and avoid mishaps that often result in unfortunate consequences. Furthermore, presenting IS concepts at the introductory level creates interest among students who may later choose information systems as their field of concentration.

Author Team

Ralph Stair and George Reynolds have decades of academic and business experience. Ralph Stair brings years of writing, teaching, and academic experience to this text. He wrote numerous books and many articles while at Florida State University. George Reynolds brings a wealth of information systems and business experience to the project, with more than 30 years of experience

working in government, institutional, and commercial IS organizations. He has written over two dozen IS texts and has taught the introductory IS course at the University of Cincinnati, Mount St. Joseph University, and Strayer University. The Stair and Reynolds team brings a solid conceptual foundation and practical IS experience to students.

GOALS OF THIS TEXT

Because *Fundamentals of Information Systems, Eighth Edition*, is written for business majors, we believe that it is important not only to present a realistic perspective on IS in business but also to provide students with the skills they can use to be effective business leaders in their organizations. To that end, *Fundamentals of Information Systems, Eighth Edition*, has three main goals:

1. To provide a set of core of IS principles that prepares students to function more efficiently and effectively as workers, managers, decision makers, and organizational leaders
2. To provide insights into the challenging and changing role of the IS professional so that students can better appreciate the role of this key individual
3. To show the value of the IS discipline as an attractive field of specialization so that students can evaluate this as a potential career path

IS Principles

Fundamentals of Information Systems, Eighth Edition, although comprehensive, cannot cover every aspect of the rapidly changing IS discipline. The authors, having recognized this, provide students an essential core of guiding IS principles to use as they strive to use IS systems in their academic and work environment. Think of principles as basic truths or rules that remain constant regardless of the situation. As such, they provide strong guidance for tough decision making. A set of IS principles is highlighted at the beginning of each chapter. The application of these principles to solve real-world problems is driven home from the opening vignettes to the dozens of real world examples of organizations applying these principles to the end-of-chapter material. The ultimate goal of *Fundamentals of Information Systems, Eighth Edition* is to develop effective, thinking, action-oriented students by instilling them with principles to help guide their decision making and actions.

Survey of the IS Discipline

Fundamentals of Information Systems, Eighth Edition not only offers the traditional coverage of computer concepts but also builds a broad framework to provide students with a solid grounding in the business uses of technology, the challenges of successful implementation, the necessity for gaining broad adoption of information systems, and the potential ethical and societal issues that may arise. In addition to serving general business students, this book offers an overview of the entire IS discipline and solidly prepares future IS professionals for advanced IS courses and careers in the rapidly changing IS discipline.

Changing Role of the IS Professional

As business and the IS discipline have changed, so too has the role of the IS professional. Once considered a technical specialist, today the IS professional operates as an internal consultant to all functional areas of the organization, being knowledgeable about their needs and competent in bringing the power of information systems to bear throughout the entire organization. The IS

professional must view issues through a global perspective that encompasses the entire enterprise and the broader industry and business environment in which it operates.

The scope of responsibilities of an IS professional today is not confined to just his or her employer but encompasses the entire interconnected network of employees, suppliers, customers, competitors, regulatory agencies, and other entities, no matter where they are located. This broad scope of responsibilities creates a new challenge: how to help an organization survive in a highly interconnected, highly competitive global environment. In accepting that challenge, the IS professional plays a pivotal role in shaping the business itself and ensuring its success. To survive, businesses must strive for the highest level of customer satisfaction and loyalty through innovative products and services, competitive prices, and ever improving product and service quality. The IS professional assumes a critical role in helping the organization to achieve both its overall cost and quality objectives and therefore plays an important role in the ongoing growth of the organization. This new duality in the role of the IS worker—a professional who exercises a specialist's skills with a generalist's perspective—is reflected throughout *Fundamentals of Information Systems, Eighth Edition*.

IS as a Field of Study

Despite the continuing effects of a slowed economy and outsourcing, business administration/management, and computer and information sciences were both listed in the 2014 Princeton Review of top-ten college majors. A 2014 U.S. News & World Report study placed software developer, computer systems analyst, and Web developer as three of the top ten "best jobs for 2014." The U.S. Bureau of Labor Statistics forecasts information security analyst as one of the fastest growing occupations for the period 2013 to 2022. Clearly, the long term job prospects for skilled and business-savvy information systems professionals are good. Employment of such workers is expected to grow faster than the average for all occupations through the year 2022. Upon graduation, IS graduates at many schools are among the highest paid of all business graduates.

A career in IS can be exciting, challenging, and rewarding! It is important to show the value of the discipline as an appealing field of study and that the IS graduate is no longer a technical recluse. Today, perhaps more than ever before, the IS professional must be able to align IS and organizational goals and to ensure that IS investments are justified from a business perspective. The need to draw bright and interested students into the IS discipline is part of our ongoing responsibility. Throughout this text, the many challenges and opportunities available to IS professionals are highlighted and emphasized.

CHANGES IN THE EIGHTH EDITION

A number of exciting changes have been made to the text based on user feedback on how to align the text even more closely with the changing IS needs and capabilities of organizations. Here is a summary of those changes:

- **All new opening vignettes.** All chapter-opening vignettes are new and continue to provide a preview of the issues to be covered from the perspective of national and multinational organizations. The global aspect of information systems continues to be a major theme of the text. Many instructors use these vignettes as the basis for interesting and lively class discussions.
- **All updated Information Systems @ Work special interest boxes.** Highlighting current topics and trends in today's headlines, these boxes

show how information systems are used in a wide variety of career areas. All boxes have been updated with the latest information available and with new critical thinking and discussion questions. These boxes can be used as the basis for a class discussion or as additional cases that may be assigned as individual or team exercises.

- **All updated Ethical and Societal Issues special interest boxes.** Focusing on ethical issues that today's professional face, these boxes illustrate how information systems professionals confront and react to ethical dilemmas. All boxes have been updated with the latest information available and with new critical thinking and discussion questions. These boxes can also be used as the basis for a class discussion or as additional cases that may be assigned as individual or team exercises.
- **All updated case studies.** Two end-of-chapter case studies for each chapter provide a wealth of practical information for students and instructors. Each case explores a chapter concept or problem that a real-world organization has faced. The cases can be assigned as individual or team homework exercises or serve as the basis for class discussion. Again, all cases have been updated with the latest information available and with new critical thinking and discussion questions.
- **Updated summary linked to objectives.** Each chapter includes a detailed summary, with each section of the summary updated as needed and tied to an associated information system principle.
- **Updated end-of-the chapter questions and exercises.** More than half of all of the extensive end-of-chapter exercises (Self-Assessment Test, Review Questions, Discussion Questions, Problem-Solving Exercises, Team Activities, Web Exercises, and Career Exercises) are new.
- **Extensive changes and updates in each chapter.** This text provides the latest information available on a wide range of IS-related topics including more than 340 new examples of organizations and individuals illustrating the principles presented in the text. In addition, a strong effort was made to update the art work and figures with more than 110 new figures and photos. The extensive amount of change makes it impractical to provide a detailed list of all the updates; however, the following table summarizes the changes by chapter.

Chapter	New Company Examples	New Figures	Most Significant New or Expanded Topics
1 An Introduction to Information Systems in Organizations	39	22	• Impact of doubling amount of digital data every two years • 5th generation wireless communications • Information literacy • Types of innovation • Use of several organizational change models to improve the successful implementation of Information Systems • Financial evaluation of projects using IRR and NPV
2 Hardware and Software	45	18	• New solutions to growing storage needs • Infrastructure as a service • Building energy-efficient data centers • Mobile operating systems • Cloud computing services • Types of software licenses
3 Database Systems and Applications	31	9	• Big data, Hadoop, and NoSQL databases • In-memory databases • ACID properties of SQL databases

Chapter	New Company Examples	New Figures	Most Significant New or Expanded Topics
4 Telecommunications and Networks	38	9	• Various network topologies • Future of municipal Wi-Fi networks and 5G wireless communications • Software defined networking • Cloud computing • Web services and Web design framework • Social networking within an organization
5 Electronic and Mobile Commerce and Enterprise Systems	42	6	• Global growth of e-commerce • E-commerce issues and challenges • Emergence of Tier I, II, and II ERP vendors • Product lifecycle management strategies and systems • Overcoming the challenges of implementing enterprise systems
6 Information and Decision Support Systems	33	8	• Structured, semistructured, and unstructured decisions • Activities supported by Marketing MIS • Decision-making approaches including Delphi, brainstorming, group consensus, nominal group, and multivoting
7 Knowledge Management and Specialized Information Systems	35	11	• Communities of practice • Assistive technology systems • Informatics
8 Systems Development	26	12	• JAD and functional decomposition • Project steering committee and project sponsor • Leadership required to overcome resistance to change and achieve a successful system introduction • Prototype, Agile, mobile app, end-user development • Tips to avoid project failure
9 The Personal and Social Impact of Computers	53	15	• Hacking of smartphones • Use of computers to recover stolen property, monitor criminals, and assess crime risk • Current strategies and tools to prevent computer crime including identity theft

ONLINE SOLUTIONS

MindTap™

MindTap for Stair/Reynolds *Fundamentals of Information Systems, 8e*, is a truly innovative and personalized learning experience with assignments that guide students to analyze, apply, and improve thinking! Relevant readings, multimedia, and activities are designed to move students up the levels of learning, from basic knowledge to analysis and application. Embedded within the eReader, **ConceptClips** focus on the challenge of understanding complicated IS terminology and concepts. Student-tested and approved, the videos are quick, entertaining, and memorable visual and auditory representations of challenging topics. Also embedded within the MindTap eReader, animated figures and graphs provide a visual and at times interactive and auditory

enhancement to previously static text examples. MindTap allows instructors to measure skills and outcomes with ease. Personalized teaching becomes yours through a Learning Path built with key student objectives and the ability to control what students see and when they see it. Analytics and reports provide a snapshot of class progress, time in course, engagement, and completion rates.

Aplia™

Engage, prepare, and educate your students with this ideal online learning solution. The original assignments ensure that students grasp the skills and concepts presented in their course. Aplia is an auto-graded solution that improves learning by increasing student effort without additional work from the instructor. Aplia's management solution ensures that students stay on top of their coursework with regularly scheduled homework assignments and automatic grading with detailed, immediate feedback. Instructors can post announcements, upload course materials, email students, and manage the gradebook. Instructors can easily download, save, manipulate, print, and import student grades into a current grading system. Aplia works independently or in conjunction with other course management systems.

STUDENT RESOURCES

Accessible through CengageBrain.com, the student companion Web site contains the following study tools (and more!) to enhance one's learning experience:

PowerPoint Slides

Direct access is offered to PowerPoint presentations that cover the key points of each chapter.

Classic Cases

Adopters frequently request a broader selection of cases to choose from. To meet this need, a set of more than 200 cases from the seventh, eighth, ninth, tenth, and eleventh editions of the *Principles of Information Systems* text are included here. These are the author's choices of the "best cases" from these editions and span a broad range of profit, nonprofit, small, medium, and large organizations in a broad range of industries.

INSTRUCTOR RESOURCES

The teaching tools that accompany this text offer many options for enhancing a course. And, as always, we are committed to providing the best teaching resource packages available in this market.

Test Bank and Cengage Learning Testing Powered by Cognero

New! Cognero is a full-featured, online-assessment system that allows instructors to manage test bank content; quickly create multiple test versions; deliver tests in several forms including from an LMS; and create test banks anywhere with Internet access!

To access Cognero, log into your Cengage Learning SSO account at http://login.cengage.com. Add this title to the bookshelf. Once the title is properly added to the bookshelf, a link to access Cognero will appear alongside the link to the instructor companion site. Technical questions, guides, and tutorials are hosted on Cengage Learning Technical Support Web site – http://support.cengage.com.

The Teaching Tools that Accompany this Text Offer Many Options for Enhancing a Course

As always, we are committed to providing the best teaching resource packages available in this market. All instructor materials can be found on the password-protected Web site at http://login.cengage.com. Here you will find the following resources:

- **Instructor's Manual** The comprehensive manual provides valuable chapter overviews, highlights key principles and critical concepts; offers sample syllabi, learning objectives, and discussion topics; and features possible essay topics, further readings, cases, and solutions to all of the end-of-chapter questions and problems, as well as suggestions for conducting the team activities.
- **Sample Syllabus** A sample syllabus for both a quarter and semester-length course are provided with sample course outlines to make planning your course that much easier.
- **PowerPoint Presentations** A set of impressive Microsoft PowerPoint slides is available for each chapter. These slides are included to serve as a teaching aid for classroom presentation, to make available to students for chapter review, or to be printed for classroom distribution. The goal of the presentations is to help students focus on the main topics of each chapter, take better notes, and prepare for examinations. Instructors can add their own slides for additional topics they introduce to the class.
- **Figure Files** Figure files allow instructors to create their own presentations using figures taken directly from the text.

ACKNOWLEDGEMENTS

Creation of a text of this scope takes a strong team effort. We would like to thank all of our fellow teammates at Cengage Learning for their dedication and hard work. We would like to thank Joe Sabatino, our product director, for his overall leadership and guidance on this effort. Special thanks to Anne Merrill, our Associate Content Developer, for all her efforts in overseeing and pulling together all the many components of this text and its auxiliary materials. Much credit is due to Lisa Ruffolo of The Software Resource Publications for her tireless effort in editing the text and keeping track of the various revisions and changes. Our appreciation goes out to all the many people who worked behind the scenes to bring this effort to a successful conclusion including art direction, research, manufacturing and permissions, namely Arul Joseph Raj, Jennifer Feltri-George, and Jennifer Ziegler, our Content Project Managers, who shepherded the text through the production process and kept us on track.

We would also like to thank Kristen Maxwell of Evil Cyborg Productions for creating the ConceptClips videos that so humorously bring many key terms found in the text to life.

We would especially like to thank Naomi Freidman for her outstanding work in writing and revising the opening vignettes, IS @ Work, and Ethical & Societal Issues boxes, and the cases for this edition.

We are extremely grateful to Senior Marketing Manager, Eric La Scola, and the salesforce at Cengage Learning whose outstanding effort in marketing this text and supporting our adopters make this all worthwhile.

OUR COMMITMENT

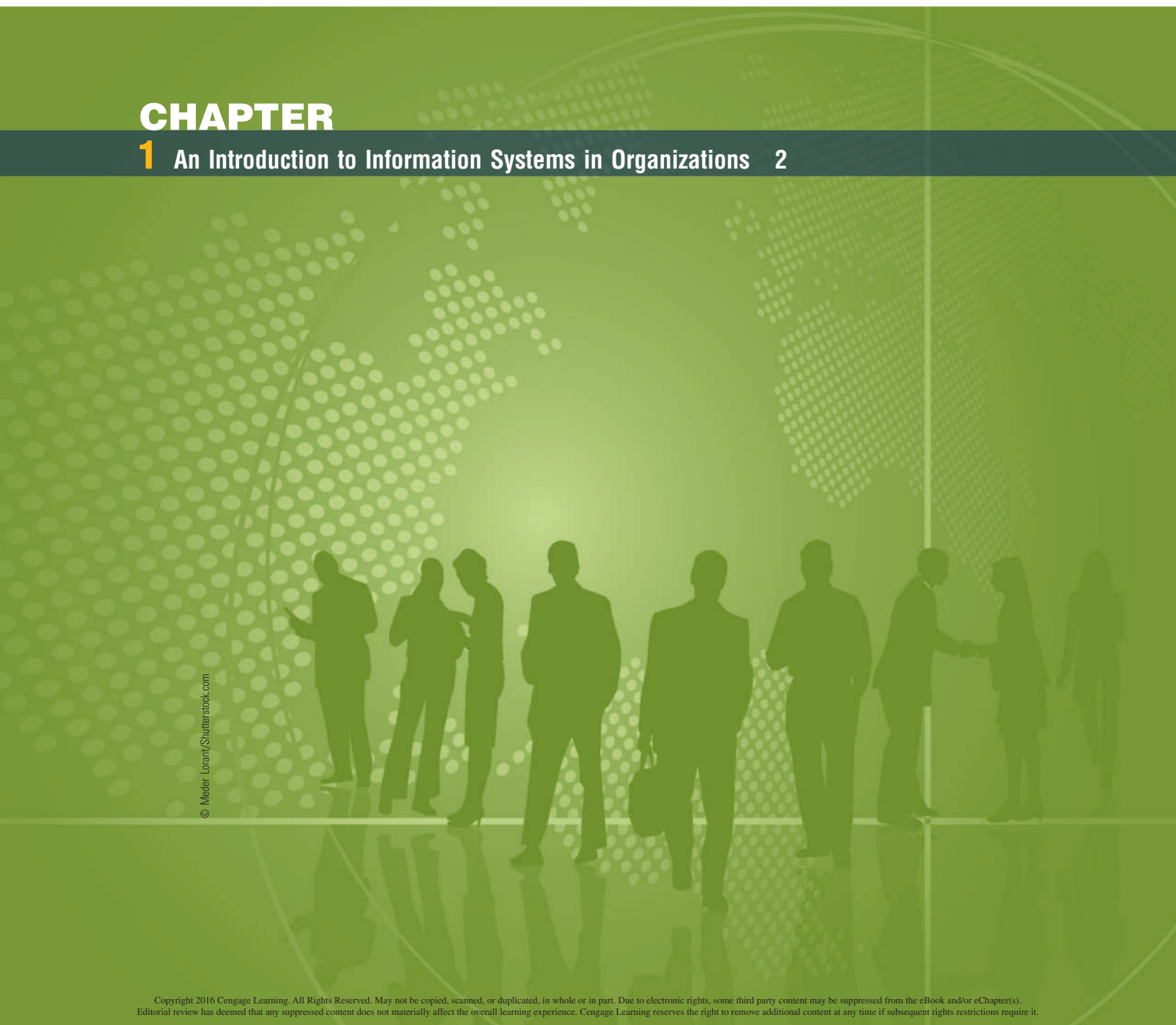
We are committed to listening to our adopters and readers in order to develop creative solutions to meet their needs. The field of IS continually evolves, and

we strongly encourage your participation in helping us provide the freshest, most relevant information possible.

We welcome your input and feedback. If you have any questions or comments regarding *Fundamentals of Information Systems, Eighth Edition,* please contact us through your local representative.

Information Systems in Perspective

CHAPTER



1 An Introduction to Information Systems in Organizations

Principles	Learning Objectives
• Knowing the potential impact of information systems and having the ability to put this knowledge to work can result in a successful personal career, organizations that reach their goals, and a society with a higher quality of life.	• Identify the basic types of business information systems and discuss who uses them, how they are used, and what kinds of benefits they deliver.
• Information systems must be applied thoughtfully and carefully so that society, business, and industry around the globe can reap their enormous benefits.	• Identify key issues and challenges that must be overcome to be successful in the global marketplace. • Identify significant benefits as well as problems and issues associated with information systems.
• Information systems must be implemented in such a manner that they are accepted and work well within the context of an organization and support its fundamental business goals and strategies.	• Define the term value chain and describe the role that information systems play in an organization's supply chain. • Identify and briefly describe two change models that can be used to increase the likelihood of successfully introducing a new information system into an organization.
• Because information systems are so important, businesses need to be sure that improvements or completely new systems help lower costs, increase profits, improve service, or achieve a competitive advantage.	• Define the term "competitive advantage" and identify the factors that lead firms to seek competitive advantage. • Describe three methods for assessing the financial attractiveness of an information system project.
• The information system worker functions at the intersection of business and technology and designs, builds, and implements solutions that allow organizations to effectively leverage information systems.	• Define the types of roles, functions, and careers available in the field of information systems.

Information Systems in the Global Economy

WILLSON, CANADA

At 90 and Counting, Willson Sees Continuous Innovation as Key to Success

© Wilson International. www.wilsonintl.com/logistics.aspx

In 1918, William F. Willson opened the first office of Willson International at a ferry landing in Fort Eire in Ontario, Canada, to help broker the import and export of goods coming from Buffalo, New York. Since that year, Willson International has dedicated itself to continuous improvement, constantly seeking ways to improve business processes and adding value to products and services.

"When people talk about length of service—you've been around for about a hundred years, what people are afraid of is that you're not innovating, you're not up-to-date, you're not paying attention to what's going on, and you're slow to react," explains CEO Peter Willson.

The corporation has relied heavily on information technology to put this worry to rest. Willson has kept a careful eye on technology, incorporating personal computers when they first became available in the 1980s. Willson expanded and began offering international freight forwarding services. In 1990, Tim Burton invented the World Wide Web and Willson unveiled its first electronic processing system of entries and transmissions to customs. In 2005, Willson launched its first customer portal, which today allows customers to upload their shipment information for transmission to the U.S. Customs and Border Protection or the Canadian Border Services Agency.

In 2008, Willson acquired a logistics company to add trucking, warehousing, and distribution services. However, with this growth came the need to innovate and reengineer business processes.

"Customs requires all information about a shipment two hours before the truck crosses, but sometimes we may only receive the information from our customer two hours and five minutes before the crossing. That means we have five minutes to process the information and get it to customs," explains Arik Kalinisky, vice president of information technology.

But many customers relying on Willson's new services still used faxes. Willson employed a small army to manually key data from faxes into the database. One paper copy of this shipment paperwork had to be sent to the customer and one had to be stored off-site.

"Each of our 12 branch locations had three or four fax machines spitting out paper around the clock," Kalinisky remembers.

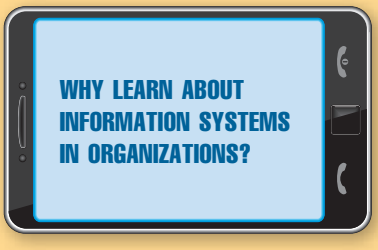
Willson deployed Microsoft Office SharePoint Server, a Web application platform for intranet content management. They used the platform to convert incoming faxes to electronic files, improving efficiency by 25 percent. The new system allowed Willson to reduce costs and errors by automating the process and eliminating the need to store millions of paper documents off site.

The company then developed an intranet solution to connect the information systems from every department. Import analysts, event handlers, and employees from other departments can now collaborate more easily using Willson's online systems. Willson released an eBilling solution generating invoices and email confirmations automatically.

Through these ongoing and continuous improvement efforts, Willson has been able to attain its ultimate goal—to improve customer service and to prove that a ninety-plus year old company can still be innovative.

As you read this chapter, consider the following:

- How has Willson used information systems to achieve continuous improvement?
- What challenges have forced Willson to reengineer its business processes?
- How was Willson constricted by its customers' use of paper-based communication?



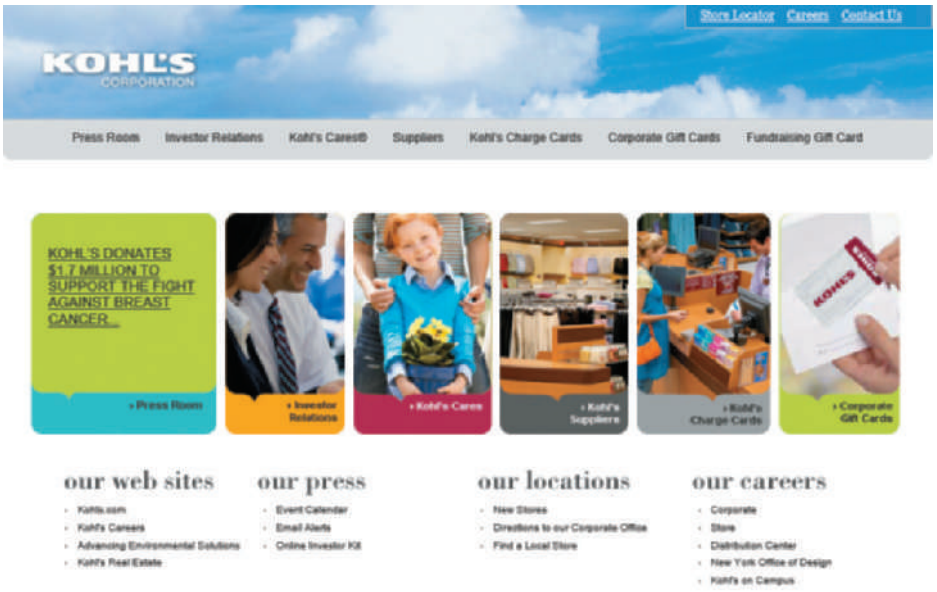
Information systems are used in almost every imaginable profession. Entrepreneurs and small business owners use information systems to reach customers around the world. Sales representatives use information systems to advertise products, communicate with customers, and analyze sales trends. Managers use them to make multimillion-dollar decisions, such as whether to build a manufacturing plant or research a cancer drug. Financial advisors use information systems to advise their clients to help them save for their children's education and retirement. From a small music store to huge multinational companies, businesses of all sizes cannot survive without information systems to perform accounting and finance operations. Regardless of your college major or chosen career, information systems are indispensable tools to help you achieve your career goals. Learning about information systems can help you land your first job, earn promotions, and advance your career.

Why learn about information systems in organizations? What is in it for you? Learning about information systems will help you achieve your goals. Let's get started by exploring the basics of information systems.

information system (IS): A set of interrelated components that collect, manipulate, store, and disseminate data and information and provide a feedback mechanism to meet an objective.

People and organizations use information every day. The components that are used are often called an information system. An **information system (IS)** is a set of interrelated components that collect, manipulate, store, and disseminate data and information and provide a feedback mechanism to meet an objective. It is the feedback mechanism that helps organizations achieve their goals, such as increasing profits or improving customer service. This book emphasizes the benefits of an information system, including speed, accuracy, increased revenues, and reduced costs. For example, Kohl's considers the effective use of information systems strategic to help drive sales, satisfy customers, and make key business decisions in the extremely competitive and constantly changing retail market. See Figure 1.1. The firm is constantly striving to recruit the most talented information system specialists to keep ahead of its competition.[1]

Today, we live in an information economy. Information itself has value, and commerce often involves the exchange of information rather than tangible goods. Systems based on computers are constantly being used to create, store, and transfer information. Using information systems, investors make multimillion-dollar decisions, financial institutions transfer billions of dollars around the world electronically, and manufacturers order supplies and distribute goods faster than ever before. Computers and information systems will continue to change businesses and the way we live. To prepare for these innovations, you need to be familiar with fundamental information concepts.



www.kohlscorporation.com

FIGURE **1.1**

Information systems are everywhere

Kohl's department stores offer products and services, and an information system tracks sales to identify popular merchandise. The information system coordinates the suppliers and inventory so that Kohl's can offer enough of the goods customers want to buy.

INFORMATION CONCEPTS

Information is a central concept of this book. The term is used in the title of the book, in this section, and in almost every chapter. To be an effective manager in any area of business, you need to understand that information is one of an organization's most valuable resources. This term, however, is often confused with *data*.

Data, Information, and Knowledge

data: Raw facts, such as an employee number, total hours worked in a week, inventory part numbers, or sales orders.

information: A collection of facts organized and processed so that it has additional value beyond the value of the individual facts.

Data consists of raw facts, such as an employee number, total hours worked in a week, an inventory part number, or the number of units produced on a production line. As shown in Table 1.1, several types of data can represent these facts. **Information** is a collection of data organized and processed so that it has additional value beyond the value of the individual facts. A sales manager may want individual sales data summarized to see the total sales for the month. Providing information to customers can also help companies increase revenues and profits. For example, social shopping Web site Kaboodle brings shoppers and sellers together electronically so they can share information and make recommendations while shopping online. The free exchange of information stimulates sales and helps ensure shoppers find better values.[2]

TABLE 1.1 Types of data

Data	Represented by
Alphanumeric data	Numbers, letters, and other characters
Image data	Graphic images and pictures
Audio data	Sounds, noises, or tones
Video data	Moving images or pictures

Data represents real-world things. Hospitals and health care organizations, for example, maintain patient medical data, which represents actual patients with specific health situations. However, data—raw facts—has little

value beyond its existence. Today, hospitals and other health care organizations are investing millions of dollars into developing medical records programs to store and use the vast amount of medical data that is generated each year. Medical records systems can be used to generate critical health-related information, which in turn can save money and lives.

In addition, integrating information from different sources is an important capability for most organizations. Expedia CruiseShipCenters is a seller of cruise vacations and services, which relies on 60 monthly email marketing campaigns to reach more than 1 million subscribers. It collects, integrates, and analyzes consumer behavioral data from each contact to maximize the revenue potential of future customer interactions. "We wanted to find a way to get a better understanding of the data we were sitting on," said Dave Mossop, manager of interactive marketing, Expedia CruiseShipCenters. Through data integration and analysis, "we gained a holistic view into our customers' interests and are able to apply those insights to match relevant content with the right people at the right time. This has dramatically increased our Web site inquiries and positively impacted sales conversions."[3]

Here is another way to conceive of the difference between data and information. Consider data as pieces of railroad track in a model railroad kit. Each piece of track has limited inherent value as a single object. However, if you define a relationship among the pieces of the track, they gain value. By arranging the pieces in a certain way, a railroad layout begins to emerge (see Figure 1.2a, top). Data and information work the same way. Rules and relationships can be set up to organize data into useful, valuable information.

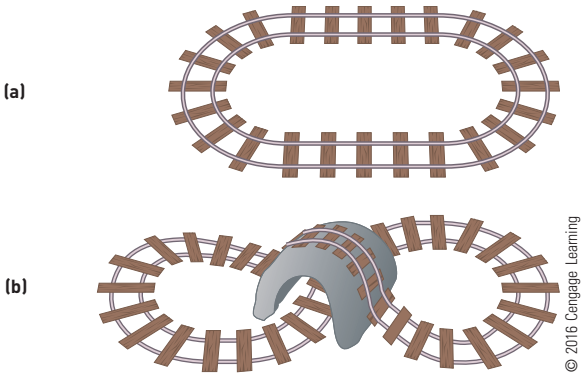


FIGURE **1.2**

Data and information

Defining and organizing relationships among data creates information.

The type of information created depends on the relationships defined among existing data. For example, you could rearrange the pieces of track to form different layouts. Adding new or different data means you can redefine relationships and create new information. For instance, adding new pieces to the track can greatly increase the value—in this case, variety and fun—of the final product. You can now create a more elaborate railroad layout (see Figure 1.2b, bottom). Likewise, a sales manager could add specific product data to sales data to create monthly sales information organized by product line. The manager could use this information to determine which product lines are the most popular and profitable.

process: A set of logically related tasks performed to achieve a defined outcome.

knowledge: The awareness and understanding of a set of information and the ways that information can be made useful to support a specific task or reach a decision.

Turning data into information is a **process**, or a set of logically related tasks performed to achieve a defined outcome. The process of defining relationships among data to create useful information requires knowledge. **Knowledge** is the awareness and understanding of a set of information and the ways that information can be made useful to support a specific task or reach a decision. Having knowledge means understanding relationships in information. Part of the knowledge you need to build a railroad layout, for instance, is the understanding of how much space you have for the layout,

how many trains will run on the track, and how fast they will travel. Selecting or rejecting facts according to their relevancy to particular tasks is based on the knowledge used in the process of converting data into information. Therefore, you can also think of information as data made more useful through the application of knowledge. *Knowledge workers (KWs)* are people who create, use, and disseminate knowledge and are usually professionals in science, engineering, business, and other areas. *Knowledge management* is a strategy by which an organization determinedly and systematically gathers, organizes, stores, analyzes, and shares its collective knowledge and experience. The goal is to deal with issues and problems in an effective manner by unleashing the collective value of the organization's best thinking.

In some cases, people organize or process data mentally or manually. In other cases, they use a computer. Where the data comes from or how it is processed is less important than whether the data is transformed into results that are useful and valuable. This transformation process is shown in Figure 1.3.

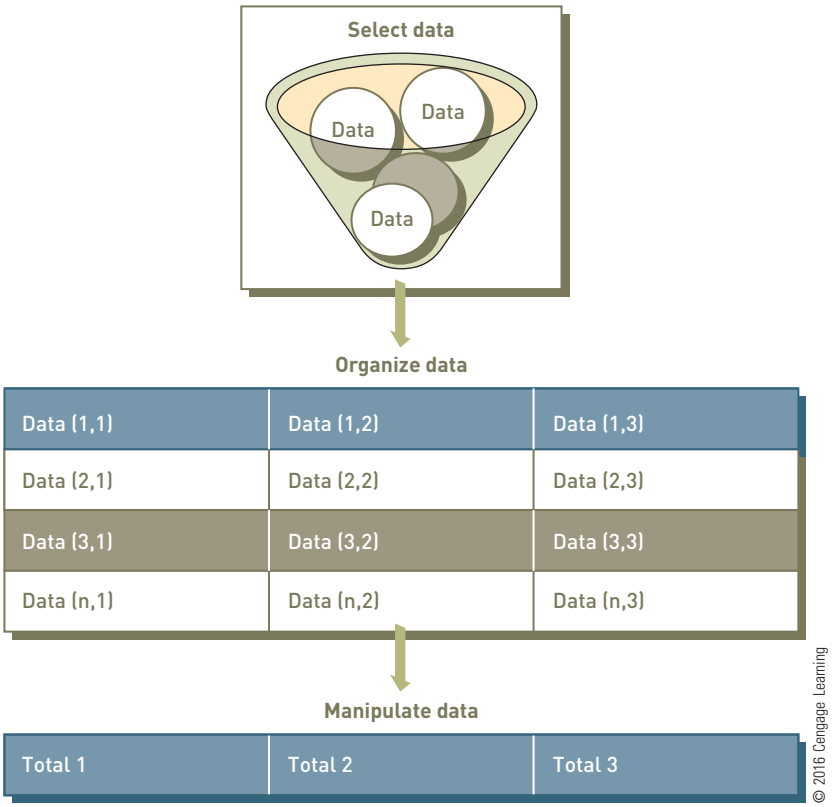


FIGURE **1.3**

Process of transforming data into information

Transforming data into information starts by selecting data, then organizing it, and finally manipulating the data.

Characteristics of Valuable Information

The value of information is directly linked to how it helps decision makers achieve their organization's goals. Valuable information can help people in their organizations perform tasks more efficiently and effectively. Many businesses assume that reports are based on correct, quality information, but unfortunately, that is not always true. A recent study of the current state of data management in the United Kingdom found that the average organization believes 17 percent of its total data (from which its information is derived) is inaccurate. Such lack of data quality has serious repercussions. Nearly one-third of the respondents (29 percent) claimed that poor data quality led to the loss of potential new customers and one-quarter (26 percent) felt it reduced customer satisfaction.[4]

Table 1.2 lists many of the characteristics frequently associated with valuable data. Quality information can vary widely in the value of each of these attributes depending on the situation and the kind of decision you are trying to make. For example, with market intelligence data, some inaccuracy and incompleteness is acceptable, but timeliness is essential. Market intelligence data may alert you that a competitor is about to make a major price cut. The exact details and timing of the price cut may not be as important as being warned far enough in advance to plan how to react. On the other hand, accuracy and completeness are critical for data used in accounting for the management of company assets such as cash, inventory, and equipment.

TABLE 1.2 Characteristics of valuable information

Characteristics	Definitions
Accessible	Information should be easily accessible by authorized users so they can obtain it in the right format and at the right time to meet their needs.
Accurate	Accurate information is error free. In some cases, inaccurate information is generated because inaccurate data is fed into the transformation process. This is commonly called garbage in, garbage out (GIGO).
Complete	Complete information contains all the important facts. For example, an investment report that does not include all important costs is not complete.
Economical	Information should also be relatively economical to produce. Decision makers must always balance the value of information with the cost of producing it.
Flexible	Flexible information can be used for a variety of purposes. For example, information on how much inventory is on hand for a particular part can be used by a sales representative in closing a sale, by a production manager to determine whether more inventory is needed, and by a financial executive to determine the total value the company has invested in inventory.
Relevant	Relevant information is important to the decision maker. Information showing that lumber prices might drop might not be relevant to a computer chip manufacturer.
Reliable	Reliable information can be trusted by users. In many cases, the reliability of the information depends on the reliability of the data-collection method. In other instances, reliability depends on the source of the information. A rumor from an unknown source that oil prices might go up might not be reliable.
Secure	Information should be secure from access by unauthorized users.
Simple	Information should be simple, not complex. Sophisticated and detailed information might not be needed. In fact, too much information can cause information overload, whereby a decision maker has too much information and is unable to determine what is really important.
Timely	Timely information is delivered when it is needed. Knowing last week's weather conditions will not help when trying to decide what coat to wear today.
Verifiable	Information should be verifiable. This means that you can check it to make sure it is correct, perhaps by checking many sources for the same information.

WHAT IS AN INFORMATION SYSTEM?

As mentioned previously, an information system (IS) is a set of interrelated elements or components that collect (input), manipulate (process), store, and disseminate (output) data and information, and that provide a corrective reaction (feedback mechanism) to meet an objective. See Figure 1.4. The feedback mechanism is the component that helps organizations achieve their goals, such as increasing profits or improving customer service.

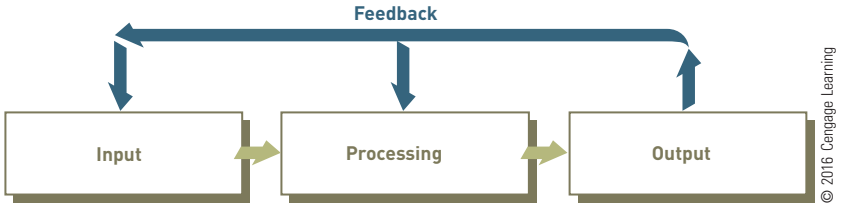


FIGURE **1.4**

Components of an information system

Feedback is critical to the successful operation of a system.

Input

input: The activity of gathering and capturing raw data.

In information systems, **input** is the activity of gathering and capturing raw data. In producing paychecks, for example, the number of hours every employee works must be collected before paychecks can be calculated or printed. In a university grading system, instructors must submit student grades before a summary of grades can be compiled and sent to students.

Processing

processing: Converting or transforming data into useful outputs.

In information systems, **processing** means converting or transforming data into useful outputs. Processing can involve making calculations, comparing data and taking alternative actions, and storing data for future use. Processing data into useful information is critical in business settings.

Processing can be done manually or with computer assistance. In a payroll application, the number of hours each employee worked must be converted into net, or take-home, pay. Other inputs often include employee ID number and department. The processing can first involve multiplying the number of hours worked by the employee's hourly pay rate to get gross pay. If weekly hours worked exceed 40, overtime pay might also be included. Then deductions—for example, federal and state taxes or contributions to insurance or savings plans—are subtracted from gross pay to get net pay.

After these calculations and comparisons are performed, the results are typically stored. *Storage* involves keeping data and information available for future use, including output, discussed next.

Output

output: Production of useful information, usually in the form of documents and reports.

In information systems, **output** involves producing useful information, usually in the form of documents and reports. Outputs can include paychecks for employees, reports for managers, and information supplied to stockholders, banks, government agencies, and other groups. In some cases, output from one system can become input for another. For example, output from a system that processes sales orders can be used as input to a customer billing system. When output is not accurate or not available when needed, it can cause major disruptions in organization work processes. For example, a system-wide computer failure forced Southwest Airlines to ground some 250 flights for one night. The computer glitch impaired the airline's ability to conduct check-ins, print boarding passes, and monitor the weight of each aircraft.[5]

Feedback

feedback: Information from the system that is used to make changes to input or processing activities.

In information systems, **feedback** is information from the system that is used to make changes to input or processing activities. For example, errors or problems might make it necessary to correct input data or change a process. Consider a payroll example. Perhaps the number of hours an employee worked was entered as 400 instead of 40. Fortunately, most information systems check to make sure that data falls within certain ranges. For number of hours worked, the range might be from 0 to 100 because it is unlikely that an employee would work more than 100 hours in a week. The information system would determine that 400 hours is out of range and provide feedback. The feedback is used to check and correct the input on the number of hours worked to 40. If undetected, this error would result in a very high net pay!

Ford Motor Company implemented a system that uses feedback data from plant operations to improve production efficiency and reduce downtime. The system collects data on production rates and equipment failure rates to identify those operation bottlenecks that most affect productivity. Maintenance is then planned to eliminate these bottlenecks. Workers are trained and equipped with the necessary tools to solve the problem and the required spare parts are made available. If something does go wrong, production downtime is held to a minimum.[6]

forecasting: Predicting future events to avoid problems.

In addition to feedback, a computer system can predict future events to avoid problems. This concept, often called **forecasting**, can be used to estimate future sales and order more inventory before a shortage occurs. Forecasting is also used to predict the strength and landfall sites of hurricanes (see Figure 1.5), future stock market values, and the winner of a political election.

FIGURE **1.5**

Forecasting

Forecasting systems can help meteorologists predict the strength and path of hurricanes.

COMPUTER-BASED INFORMATION SYSTEMS

computer-based information system (CBIS): A single set of hardware, software, databases, telecommunications, people, and procedures that are configured to collect, manipulate, store, and process data into information.

As discussed earlier, an information system can be manual or computerized. A **computer-based information system (CBIS)** is a single set of hardware, software, databases, telecommunications, people, and procedures that are configured to collect, manipulate, store, and process data into information. Increasingly, companies are incorporating computer-based information systems into their products and services. Fidelity Investments, as well as most other investment companies, offers its customers a wide range of powerful investment tools and access to extensive online research.[7] Automobiles are available with advanced navigation systems that not only guide you to your destination but also incorporate the latest weather and traffic conditions to help you avoid congestion and traffic delays. Digital cameras, mobile phones, music players, and other devices rely on CBISs to bring their users the latest and greatest features.

technology infrastructure: All the hardware, software, databases, telecommunications, people, and procedures that are configured to collect, manipulate, store, and process data into information.

The components of a CBIS are illustrated in Figure 1.6. *Information technology (IT)* refers to hardware, software, databases, and telecommunications. A business's **technology infrastructure** includes all the hardware, software, databases, telecommunications, people, and procedures that are configured to collect, manipulate, store, and process data into information. The technology infrastructure is a set of shared IS resources that form the foundation of each computer-based information system.

FIGURE **1.6**

Components of a computer-based information system

Hardware, software, telecommunications, people, and procedures are part of a business's technology infrastructure.

Hardware

hardware: Computer equipment used to perform input, processing, storage, and output activities.

Hardware consists of computer equipment used to perform input, processing, storage, and output activities. Input devices include keyboards, mice and other pointing devices, automatic scanning devices, and equipment that can read magnetic ink characters. Processing devices include computer chips that contain the central processing unit and main memory. Advances in chip design allow faster speeds, less power consumption, and larger storage capacity, which means the computer can perform more efficiently. For example, the Haswell computer chip from Intel will deliver a major improvement in computing performance while using minimal power to extend battery life, features that are critical to laptop computer users.[8]

Processor speed also determines how quickly a computer can perform tasks. In June 2013, the supercomputer Tianhe-2, capable of operating at a rate of 33.86 petaflops per second (33.86×10^{15} floating point operations per second), was ranked as the world's fastest computing system. It was developed by China's National University of Defense Technology and cost 100 million U.S. dollars. Li Nan, deputy head of the Tianhe-2 Project, said that complex projects like the design of new autos used to take two to three years; but the use of powerful supercomputers enable the job to be completed in as little as three months.[9] At the other end of the speed and cost spectrum is the Raspberry Pi computer, which is about the size

of a credit card that comes with no monitor or keyboard but costs under $50.[10]

The many types of output devices include printers and computer screens. Some touch-sensitive computer screens, for example, can be used to execute functions or complete programs, such as connecting to the Internet or running a new computer game or word-processing application. Many special-purpose hardware devices have also been developed. Computerized event data recorders (EDRs) are now being placed into vehicles. Like an airplane's black box, EDRs record vehicle speed, possible engine problems, driver performance, and more.

While all types of personal computers have their own advantages and disadvantages, many people favor the mobility, functionality, and cost associated with tablet computers. See Figure 1.7. This is reflected in the growth of tablet sales and the corresponding decline in desktop and laptop sales. Global tablet shipments exceeded laptop computer shipments in 2013. This trend is expected to continue so that by 2017, tablet computers are expected to represent nearly 75 percent of the combined global tablet-laptop market.[11] The new, advanced-capability tablet computers, including the iPad, Samsung Galaxy, and others, provide computing and communications services whenever and wherever the user wants them.[12] In addition, tens of thousands of applications are designed to run on tablet computers. These applications include games, special-purpose applications to support a wide range of uses, and personal productivity applications (such as word processing, spreadsheet, presentation, and graphics).

FIGURE **1.7**

Tablet computer

Hardware consists of computer equipment used to perform input, processing, and output activities. The trend in the computer industry is to produce smaller, faster, and more mobile hardware, such as tablet computers.

Software

software: The computer programs that govern the operation of the computer.

Software consists of the computer programs that govern the operation of the computer. There are two primary types of software. System software, such as Microsoft Windows, coordinates basic computer operations such as start-up, controls access to system resources, and manages computer memory and

files. Application software, such as Microsoft Excel, allows you to accomplish specific tasks including editing text documents, creating graphs, and playing games. Both system software and application software are needed for all types of computers, from small handheld computers to large supercomputers. The Android operating system by Google, for example, is an operating system mainly for touch screen mobile devices such as smartphones and tablet computers. See Figure 1.8. As of July 2013, 777,094 applications were available for devices that run under the Android operating system.[13] Although most software can be installed from CDs or DVDs, most of today's software packages can be downloaded through the Internet.

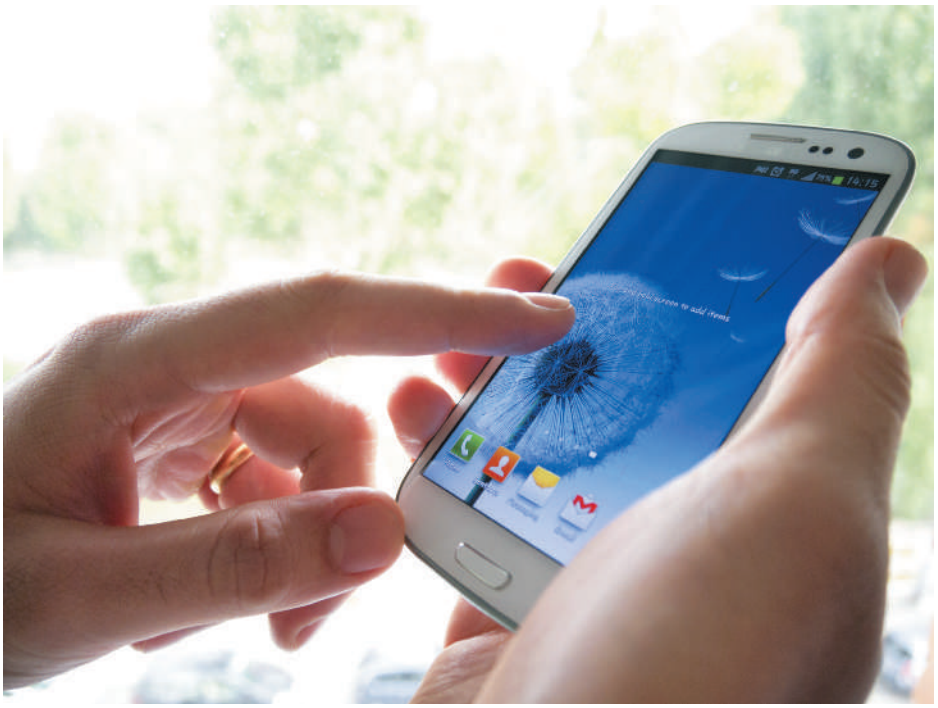


FIGURE **1.8**

Smartphone running Android

Android is an operating system designed mainly for touch screen mobile devices such as smartphones and tablet computers.

Databases

database: An organized collection of facts and information, typically consisting of two or more related data files.

A **database** is an organized collection of facts and information, typically consisting of two or more related data files. An organization's database can contain facts and information on customers, employees, inventory, competitors' sales, online purchases, and much more.

Carfax maintains an enormous vehicle history database with over 11 billion vehicle records accessible to buyers and sellers. Data is gathered from over 75,000 sources across North America such as U.S. and Canadian motor vehicle departments, service and repair facilities, insurance companies, and police departments. Millions of consumers and 30,000 dealerships use Carfax information every year to help them buy and sell cars with confidence.[14]

Scientists estimated that in 2011 there was 1.8 zettabytes of digital data in the world and that the amount of data was doubling every two years.[15] See Figure 1.9. (One zettabyte is 10^{21} characters of data, equivalent to the amount of digital information created by every man, woman, and child on earth

tweeting continuously for 100 years).[16] The increase in digital data means a huge increase in database storage needs, which will require more storage devices, more space to house the additional storage devices, and additional electricity to operate them. The big question is, how will organizations meet the increased demand for data storage? Another important issue for any organization is how to keep a vast database secure and safe from the prying eyes of outside individuals and groups.

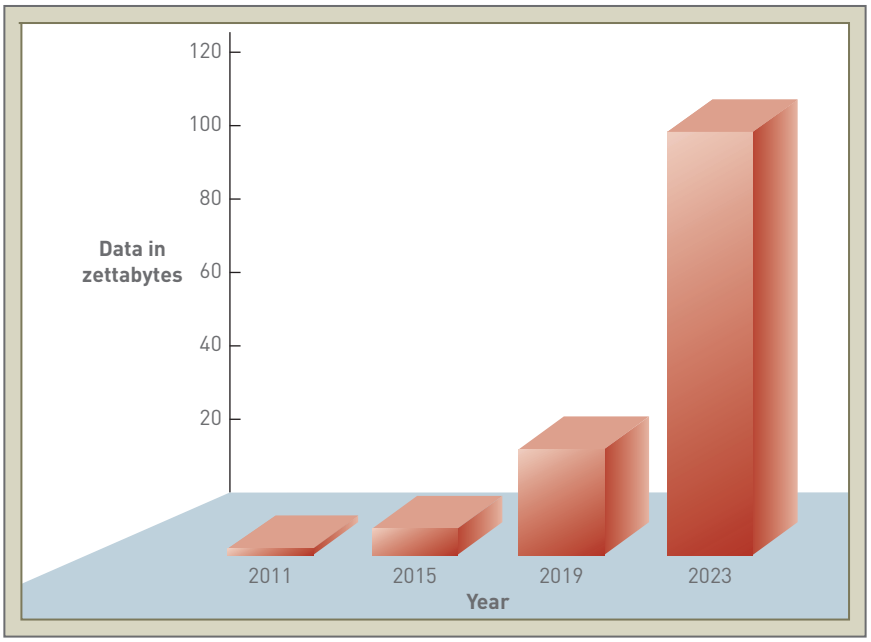


FIGURE **1.9**

Growth in data

The amount of digital data is expected to double every two years.

Telecommunications, Networks, and the Internet

telecommunications: The electronic transmission of signals for communications that enables organizations to carry out their processes and tasks through effective computer networks.

Telecommunications is the electronic transmission of signals for communications, which enables organizations to carry out their processes and tasks through effective computer networks. Telecommunications can take place through wired, wireless, and satellite transmissions. The Associated Press was one of the first users of telecommunications in the 1920s, sending news over 103,000 miles of wire in the United States and over almost 10,000 miles of cable across the ocean. In these early days of news gathering, reporters raced to telephones to call in their reports, while cameramen shot footage and then rushed back to studios to edit their film. Video of what was happening in the world could take several hours, even days to reach the public. Satellite communication networks have eliminated delays in news reporting and made it possible for people to see the news live as it is unfolding. News vans can be deployed quickly to almost anywhere in the world to cover a breaking news event. These vehicles are equipped with audio and video transmitters and antennas that can be aimed accurately at telecommunication satellites, providing coverage of the entire earth. Reporters and cameramen can edit and transmit their footage immediately and report live as their signals are relayed from the van to a satellite, and then beamed back to earth from the satellite to a broadcast network control room.[17]

Today, telecommunications is used by people and organizations of all sizes around the world. With telecommunications, people can work at home or while traveling. This approach to work, often called "telework" or "telecommuting," allows someone living in England to send work to the United States, China, or any location with telecommunications capabilities. Telecommunications also enables the use of virtual teams of people working on a project to meet and communicate without ever physically being in the same place.

network: Computers and equipment that are connected in a building, around the country, or around the world to enable electronic communications.

Networks connect computers and equipment in a building, around the country, or around the world to enable electronic communication. Wireless transmission networks enable the use of mobile devices such as smartphones and portable computers. Samsung and other telecommunications companies are now working on fifth-generation wireless communications that will enable transmission speeds 100 times faster than currently available, perhaps by the year 2020. Such technology will be needed to support the increased demand for faster transfer of data and video.[18]

Internet: The world's largest computer network, consisting of thousands of interconnected networks, all freely exchanging information.

The **Internet** is the world's largest computer network, consisting of thousands of interconnected networks, all freely exchanging information. People use the Internet to research information, buy and sell products and services, make travel arrangements, make investments, conduct banking, download music and videos, read books, and listen to radio programs, among other activities.

cloud computing: A computing environment in which software and data storage are provided by the Internet ("the cloud"); the services are run on another organization's computer hardware and both software and data are easily accessed.

Workers in many organizations operate in a **cloud computing** environment in which software and data storage are provided by the Internet ("the cloud"); the services are run on another organization's computer hardware and both software and data are easily accessed. See Figure 1.10. This represents a significant change in how data is stored, accessed, and transferred, and it raises many security concerns. The unmanaged employee use of cloud services (e.g., the use of a file-sharing Web site to transfer large documents to clients or suppliers) represents a significant risk. Information systems and business managers should provide employees with a list of validated cloud services to avoid potential issues.[19]

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FIGURE **1.10**

Cloud computing

With cloud computing, software and data storage are provided by the Internet ("the cloud") and services are run on another organization's computer hardware; both software and data are easily accessed.

Internet sites such as Facebook, LinkedIn, Pinterest, and Google+ have become popular places to connect with friends and colleagues. People can also send one another short messages up to 140 characters using Twitter. The Internet has also given rise to citizen journalism where individuals who witness a newsworthy event post their opinions and observations online for others to read. In the aftermath of the Boston Marathon bombings, citizen journalists broke much of the news and captured unique photos of the events. However, in some cases the information reported was wrong, including falsely accusing suspects.[20]

This increased use of the Internet is not without its risks. Some people fear that increased usage can lead to problems, including loss of privacy and security, with criminals hacking into an organization's data via the Internet to gain access to sensitive company and customer information.

World Wide Web (WWW or Web): A network of links on the Internet to documents containing text, video, and sound.

The **World Wide Web (WWW)**, or the Web, is a network of links on the Internet to documents containing text, graphics, video, and sound. Information about the documents and access to them are controlled and provided by tens of thousands of special computers called Web servers. The Web is one of many services available over the Internet and provides access to millions of documents. New Internet technologies and increased Internet communications and collaboration are collectively called Web 2.0.

intranet: An internal network based on Web technologies that allows people within an organization to exchange information and work on projects.

The technology used to create the Internet is also being applied within organizations to create **intranets**, which allow people in an organization to exchange information and work on projects. Accorda is a biotechnology company that develops therapeutic neurological treatments. It launched its Synapse intranet after spending months interviewing employees to discover their needs. According to Mike Russo, senior director of corporate digital strategy and innovation, employees had three major needs: quick access to work resources, collaboration, and fun. Russo's team built the new intranet from the ground up, including social tools such as one very similar to Twitter.[21]

extranet: A network based on Web technologies that allows selected outsiders, such as business partners and customers, to access authorized resources of a company's intranet.

An **extranet** is a network based on Web technologies that allows selected outsiders, such as business partners and customers, to access authorized resources of a company's intranet. Many people use extranets every day without realizing it—to track shipped goods, order products from their suppliers, or access customer assistance from other companies. Federal Express (FedEx) was one of the first large companies to empower customers to serve themselves at their convenience through the use of a corporate extranet. A fundamental FedEx belief is that the information it provides customers about its services is more important than the services themselves.[22] Customers can access the FedEx extranet to obtain a full range of shipping, billing, and tracking services. See Figure 1.11.

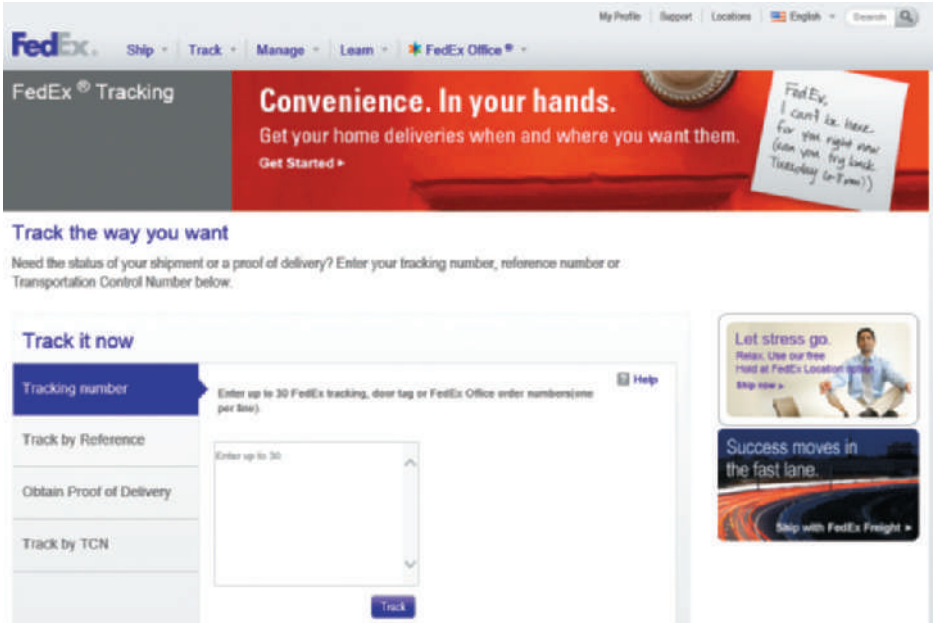

FIGURE **1.11**

Extranets

When you sign in to the FedEx site (*www.fedex.com*) to check the status of a package, you are using an extranet.

People

Jim Collins, in his book *Good to Great*, said, "Those who build great companies understand that the ultimate throttle on growth for any great company is not markets, or technology, or competition, or products. It is one thing above all others: the ability to get and keep enough of the right people."[23] Thus it comes as no surprise that people are the most important element in computer-based information systems.

Good systems can enable ordinary people to produce extraordinary results. They can also boost job satisfaction and worker productivity.[24] Information systems personnel include all the people who manage, run, program, and maintain the system, including the chief information officer (CIO), who manages the IS department. See Figure 1.12. End users are people who work directly with information systems to get results. They include financial executives, marketing representatives, and manufacturing operators.

FIGURE **1.12**

Chief information officer (CIO)

The CIO manages the Information Systems department, which includes all the people who manage, run, program, and maintain a computer-based information system.

Procedures

procedures: The strategies, policies, methods, and rules for using a CBIS.

A **procedure** defines the steps to follow in order to achieve a specific end result such as enter a customer order, pay a supplier invoice, or request a current inventory report. Good procedures describe how to achieve the desired end result; who does what and when; and what to do in the event that something goes wrong. When people are well trained and follow effective procedures, they can get work done faster, cut costs, make better use of people resources, and enable people to adapt to change. When procedures are well documented, they can greatly reduce training costs and shorten the learning curve.[25]

Now that we have looked at computer-based information systems in general, we will briefly examine the most common types used in business today. These IS types are covered in more detail in Part 3.

BUSINESS INFORMATION SYSTEMS

The most common types of information systems used in business organizations are those designed for electronic and mobile commerce, transaction processing, management information, and decision support. In addition, some organizations employ special-purpose systems, such as virtual reality, that not every organization uses. Although these systems are discussed in separate sections in this chapter and explained in more detail later, they are often integrated in one product and delivered by the same software package. See Figure 1.13. For example, some business information systems process transactions, deliver information, and support decisions. Figure 1.14 shows a simple timeline of the development of important business information systems discussed in this section. In addition to owning a complete business information system including hardware, software, databases, telecommunications, and

Internet capabilities, companies can rent business information systems from others. Amazon Web Services allows people and companies to pay for the business information systems they use. This approach avoids huge outlays of money to purchase expensive equipment and facilities.

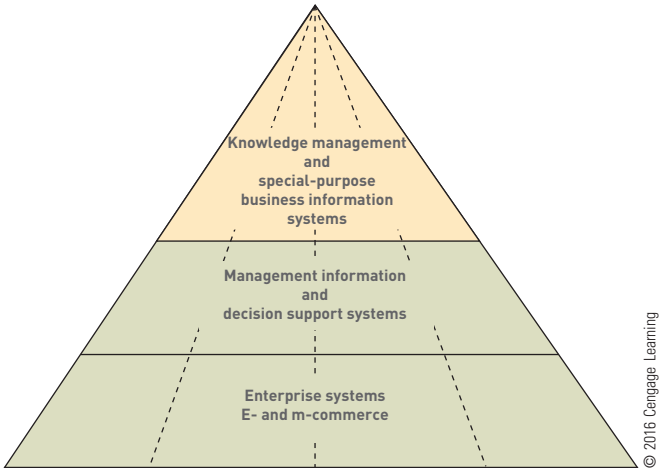

FIGURE **1.13**

Business information systems

Business information systems are often integrated into one product and can be delivered by the same software package.

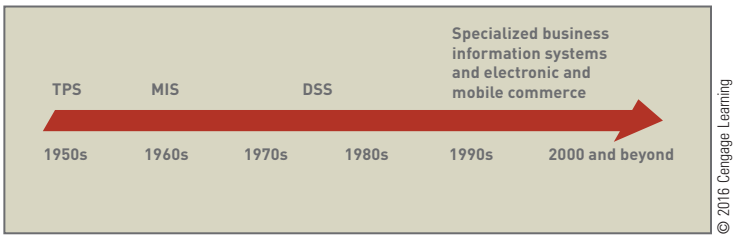

FIGURE **1.14**

Business information systems timeline

Business information systems were introduced in the 1950s and changed significantly in most decades after that.

Electronic and Mobile Commerce

Electronic commerce (e-commerce) involves any business transaction executed electronically between companies (business-to-business, or B2B), companies and consumers (business-to-consumer, or B2C), consumers and other consumers (consumer-to-consumer, or C2C), business and the public sector, and consumers and the public sector. E-commerce offers opportunities for businesses of all sizes to market and sell at a low cost worldwide, allowing them to enter the global market. The American Red Cross spent months redesigning its internal processes and converting many of them to e-commerce systems to improve its effectiveness and help more people, faster. The new e-commerce platform enables the Red Cross to better support local charters and more quickly recruit volunteers and blood donors. It also began testing to identify changes to Web pages that increase its total site donation revenues.[26]

electronic commerce (e-commerce): Any business transaction executed electronically between companies (business-to-business), companies and consumers (business-to-consumer), consumers and other consumers (consumer-to-consumer), business and the public sector, and consumers and the public sector.

Mobile commerce (m-commerce) is the use of mobile, wireless devices to place orders and conduct business. M-commerce relies on wireless communications that managers and corporations use to place orders and conduct business with handheld computers, portable phones, laptop computers connected to a network, and other mobile devices.

mobile commerce (m-commerce): The use of mobile, wireless devices to place orders and conduct business.

Two retailers that have recognized the need to improve the mobile shopping experience are Sephora and Amazon.com. Makeup retailer Sephora has gone so far as to build two apps for mobile shoppers, one for shoppers with smartphones (see Figure 1.15) and one for shoppers with tablet computers. Each app provides consumers with very different experiences. The strategy seems to be paying off with mobile orders increasing by 167 percent during the 2012 holiday season. Amazon.com generated about $4 billion in mobile

sales last year, about 8 percent of total sales. The company is working on making its mobile shopping app extremely fast and easy. Its goal is to speed up the buying process so that the time from consumers deciding to buy something until completing their purchase is as short as 30 seconds.[27]

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FIGURE **1.15**

Mobile commerce (m-commerce)

With m-commerce, people can use smartphones to pay for goods and services anywhere, anytime.

E-commerce offers many advantages for streamlining work activities. Figure 1.16 provides a brief example of how e-commerce can simplify the process of purchasing new office furniture from an office supply company. In the manual system, a corporate office worker must get approval for a purchase that exceeds a certain amount. That request goes to the purchasing department, which generates a formal purchase order to procure the goods from the approved vendor. Business-to-business e-commerce automates the entire process. Employees go directly to the supplier's Web site, find the item in a catalog, and order what they need at a price set by their company. If management approval is required, the manager is notified automatically. As the use of e-commerce systems grows, companies are phasing out their traditional systems. The resulting growth of e-commerce is creating many new business opportunities.

In addition to e-commerce, business information systems use telecommunications and the Internet to perform many related tasks. Electronic procurement (e-procurement), for example, involves using information systems and the Internet to acquire parts and supplies. **Electronic business (e-business)** goes beyond e-commerce and e-procurement by using information systems and the Internet to perform all business-related tasks and functions, such as accounting, finance, marketing, manufacturing, and human resource activities. E-business also includes working with customers, suppliers, strategic partners, and stakeholders. Compared to traditional business strategy, e-business strategy is flexible and adaptable. See Figure 1.17.

electronic business (e-business): Using information systems and the Internet to perform all business-related tasks and functions.

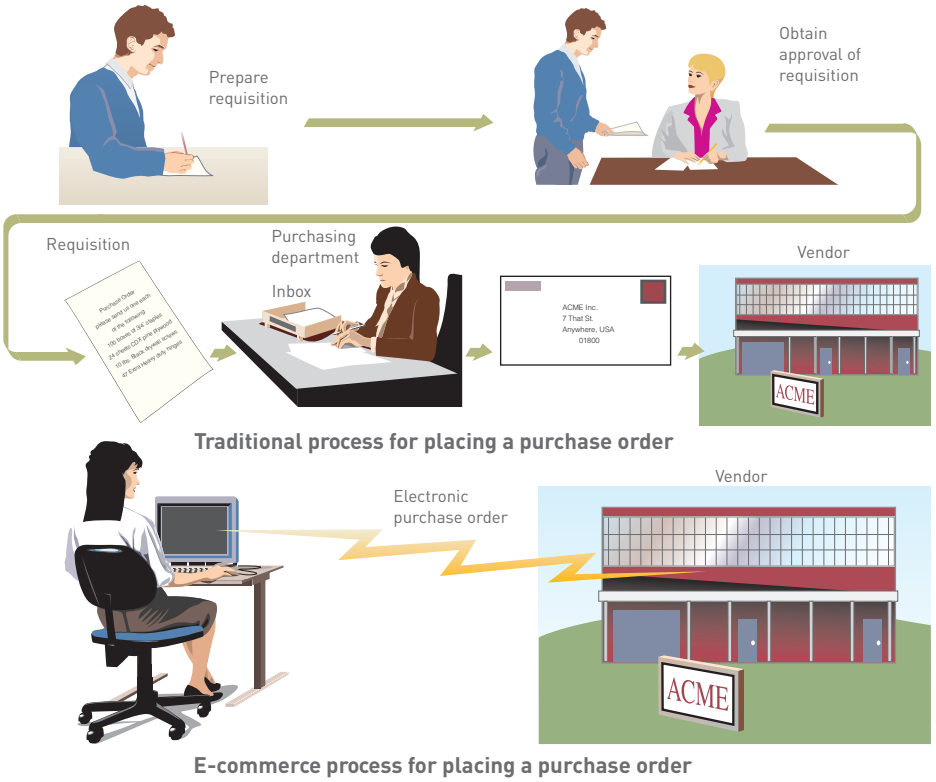

FIGURE **1.16**

Electronic commerce (e-commerce)

E-commerce greatly simplifies purchasing.

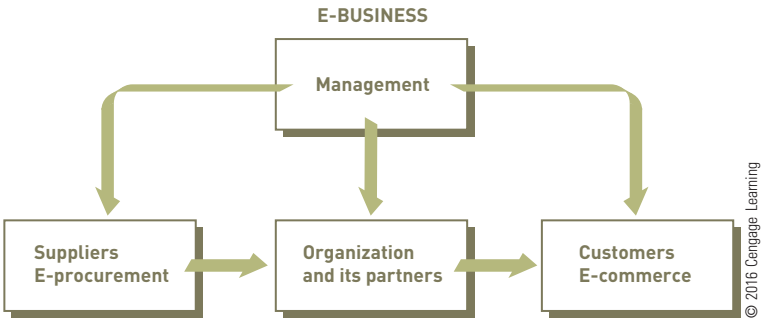

FIGURE **1.17**

Electronic business (e-business)

E-business goes beyond e-commerce to include using information systems and the Internet to perform all business-related tasks and functions, such as accounting, finance, marketing, manufacturing, and human resources activities.

Enterprise Systems

Enterprise systems that process daily transactions have evolved over the years and offer important solutions for businesses of all sizes. Traditional transaction processing systems (TPSs) are still being used today, but increasingly, companies are turning to enterprise resource planning (ERP) systems.

Transaction Processing Systems

Since the 1950s, computers have been used to perform common business applications. Many of these early systems were designed to reduce costs by automating routine, labor-intensive business transactions. A **transaction** is any business-related exchange such as payments to employees, sales to customers, or payments to suppliers. Processing business transactions was the first computer application developed for most organizations. A **transaction processing system (TPS)** is an organized collection of people, procedures, software, databases, and devices used to perform and record business transactions. If you understand a transaction processing system, you understand basic business operations and functions.

transaction: Any business-related exchange such as payments to employees, sales to customers, and payments to suppliers.

transaction processing system (TPS): An organized collection of people, procedures, software, databases, and devices used to perform and record business transactions.

One of the first business systems to be computerized was the payroll system. The primary inputs for a payroll TPS are the number of employee hours

worked during the week and the pay rate. The primary output consists of paychecks. Early payroll systems produced employee paychecks and related reports required by state and federal agencies, such as the Internal Revenue Service. Other routine applications include sales ordering, customer billing and customer relationship management, and inventory control. Airlines and travel agencies use online transaction processing reservation systems to enable travelers to select and book their own flights. Using one of these systems, passengers can choose their destinations and flight dates, compare costs on alternate flight dates, book their seats, and generate electronic tickets. Such online reservation systems are at the center of a whole collection of transaction processing systems employed by airlines. See Figure 1.18.

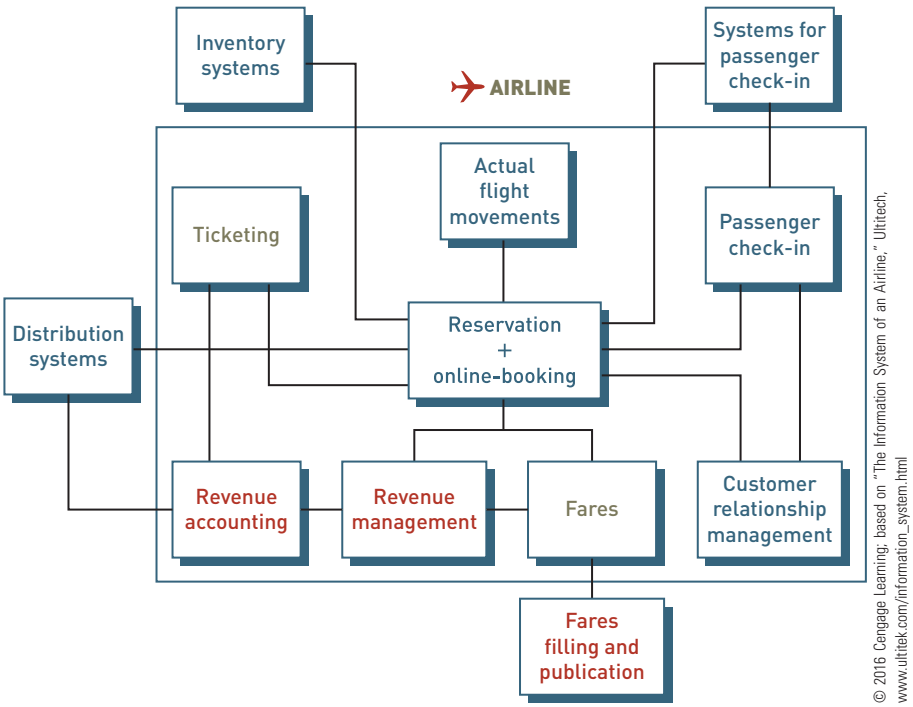

FIGURE **1.18**

Integrated transaction processing system

The online reservation system is at the center of a collection of information systems used by airlines.

Enterprise Resource Planning

enterprise resource planning (ERP) system: A set of integrated programs that manages the vital business operations for an entire multisite, global organization.

An **enterprise resource planning (ERP) system** is a set of integrated programs that manages the vital business operations for an entire multisite, global organization. An ERP system can replace many applications with one unified set of programs, making the system easier to use and more effective. Today, using ERP systems and getting timely reports from them can be done using cell phones and mobile devices.

Although the scope of an ERP system might vary from company to company, most ERP systems provide integrated software to support manufacturing and finance. Many ERP systems also have a purchasing subsystem that orders the needed items. In addition to these core business processes, some ERP systems can support functions such as customer service, human resources, sales, and distribution. The primary benefits of implementing an ERP system include easing adoption of improved work processes and increasing access to timely data for decision making.

Information and Decision Support Systems

The benefits provided by an effective TPS or ERP, including reduced processing costs and reductions in needed personnel, are substantial and justify their associated costs in computing equipment, computer programs, and specialized personnel and supplies. Companies soon realize that they can use the

INFORMATION SYSTEMS @ WORK

With ERP Access, Small Companies Are Reaching for the Skies

You probably don't think of cleaning washrooms and high-tech software at the same time. That means you don't usually think of CIBS.

CIBS, a division of CI (originally Clean Interiors) Business Services, provides a complete range of washroom and pest control services. Founded more than 20 years ago in the United Kingdom, CIBS is now an award-winning cleaning and hygiene services provider.

In its early years, managers at CIBS scheduled services using a combination of spreadsheets, paper files, and small business software. As the company grew, however, the managers reevaluated this method. General Manager Julia Kulinski explains that "because data was scattered across spreadsheets and paper files, it was difficult for us to get an integrated view of our customers, which we needed to service them properly. For example, when customers called in regarding errors or other service-related issues, service representatives couldn't find the information needed to resolve the issues on the first call."

Other problems affected revenue and expenses. Because invoicing was a manual process, the staff prepared and sent invoices only once a month, and invoices based on paper records often had errors. Management wasn't aware of cost overruns until it was too late to correct them. Further, it wasn't practical to motivate employees by moving to performance-based pay methods, which was a business objective. Finally and most importantly, CIBS couldn't grow.

CIBS evaluated its options and selected an integrated ERP (enterprise resource planning) system from the German firm SAP. Although most ERP users are large organizations, smaller companies are also taking advantage of ERP systems. With 200 employees, CIBS is a medium-sized company. It too wanted the benefits that an ERP system offers, including a single shared database to store its information and coordinate its operations. As Kulinski puts it, they wouldn't be able to grow otherwise: "For the business to scale, we needed a centralized database, automated processes, and real-time reporting." Small companies need these as much as large ones do.

In fact, ERP use is growing more quickly among small companies than large ones. According to Albert Pang in the *Apps Run the World* blog, total annual revenue of all ERP vendors is growing at 5.6 percent per year for customers with 100 or fewer employees, dropping steadily to an annual growth rate of 2.4 percent among companies with 5,000 or more employees. The reason is that early ERP systems required expensive hardware, which only the largest organizations could afford.

Today, not only is hardware far less expensive, but many ERP vendors are moving into the cloud. This means that many companies that are even smaller than CIBS can "rent" the hardware through the vendor and access the ERP software through their personal computers. Businesses wind up paying as little as $10 per month for ERP cloud-based services.

Kulinski maintains that the move to ERP software solved business problems at CIBS and helped the company grow. She evaluates the financial benefits this way: "I look at the running costs of SAP software—which for us is the equivalent of one full-time employee—and then at the value the software delivers to the business. There's no way one person could deliver this much value to the business."

In the final analysis, delivering value to the business is what information systems are about.

Discussion Questions

1. This case is about an SAP customer and is based in part on SAP materials. However, other software firms also offer ERP software. The two largest vendors in the small company segment are Oracle and Microsoft. Compare their ERP offerings.
2. What advantages did SAP's ERP system offer CIBS?

Critical Thinking Questions

1. List the five problems that CIBS had with its earlier spreadsheet- and paper-based system. Rank them by their importance to CIBS. Justify your rankings. If you disagree with Kulinski's top ranking of limited growth potential, explain why.
2. Consider the challenges of an e-commerce Web site run by one or two people. How would such a small business make use of ERP offerings?

SOURCES: CIBS Web site, *www.ci-bs.co.uk*, and subsidiaries' Web sites, *www.cibshygiene.com* and *www.cibsfacilities.com*, accessed January 17, 2012; SAP, "CIBS: Enabling Growth and Exceptional Service Quality with SAP Software," *http://download.sap.com/uk/download.epd?context=A8700D6A2BB022BCF7C1BA6D4FFF4D1837ACD9F06DE9B34FF8945FE34BEA4AE61EA46CBB6C5EA8DAE21568331B293774E37074837BC3CE5D*, March 2011, downloaded January 16, 2012; Pang, A., "Infor's Daring Move to Buy Lawson, Shake Up ERP MidMarket," *Apps Run the World* blog, *www.appsruntheworld.com/blogs/?p=370*, March 13, 2011, accessed January 17, 2012; Gaskin, James E., How Small Is Too Small a Company for ERP Software? Inside-ERP, May 9, 2013, *www.inside-erp.com/articles/inside-erp-blog/how-small-is-too-small-a-company-for-erp-software-55821*, accessed July 22, 2013.

data stored in these systems to help managers make better decisions, whether in human resource management, marketing, or administration. Satisfying the needs of managers and decision makers continues to be a major factor in developing information systems.

Management Information Systems

management information system (MIS): An organized collection of people, procedures, software, databases, and devices that provides routine information to managers and decision makers.

A **management information system (MIS)** is an organized collection of people, procedures, software, databases, and devices that provides routine information to managers and decision makers. Manufacturing, marketing, production, finance, and other functional areas of an organization are supported by MISs and share a common database. MISs typically provide standard reports generated with data and information from the TPS or ERP. See Figure 1.19.

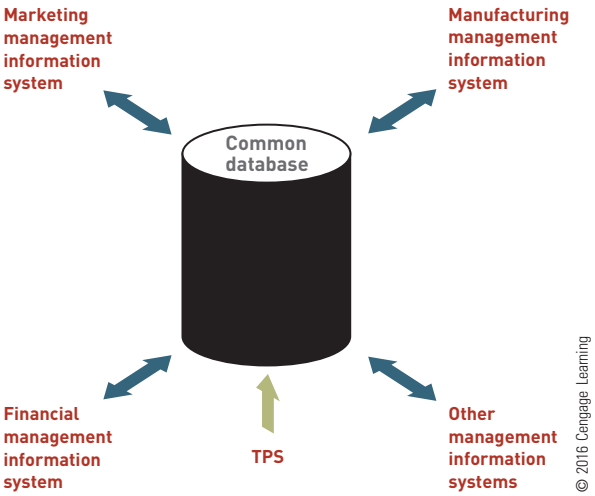

FIGURE **1.19**

Management information system

Functional management information systems draw data from the organization's transaction processing system.

Decision Support Systems

decision support system (DSS): An organized collection of people, procedures, software, databases, and devices used to support problem-specific decision making.

A **decision support system (DSS)** is an organized collection of people, procedures, software, databases, and devices that support problem-specific decision making. The focus of a DSS is on making effective decisions. Whereas an MIS helps an organization "do things right," a DSS helps a manager "do the right thing."

Subway uses a DSS to evaluate various initiatives such as implementing bundled meal offers or price promotions. The DSS is able to predict what impact the initiative will have on revenues, profits, and market share. It can also help to design a rollout program that maximizes returns. The president and CEO of the Subway Franchisee Advertising Fund Trust says: "It helps us to be maximally creative and risk taking. We can test any exciting but risky idea before we roll it out and rapidly roll out the ones that work."[28]

A DSS can include a collection of models used to support a decision maker or user (model base), a collection of facts and information to assist in decision making (database), and systems and procedures (user interface or dialogue manager) that help decision makers and other users interact with the DSS. See Figure 1.20. Software called the database management system (DBMS) is often used to manage the database, and software called the model management system (MMS) is used to manage the model base. Not all DSSs have all of these components.

In addition to DSSs for managers, other systems use the same approach to support groups and executives. A group support system includes the DSS elements just described as well as software, called groupware, to help groups make effective decisions. An executive support system, also called an executive information system, helps top-level managers, including a firm's president, vice presidents, and members of the board of directors, make better decisions.

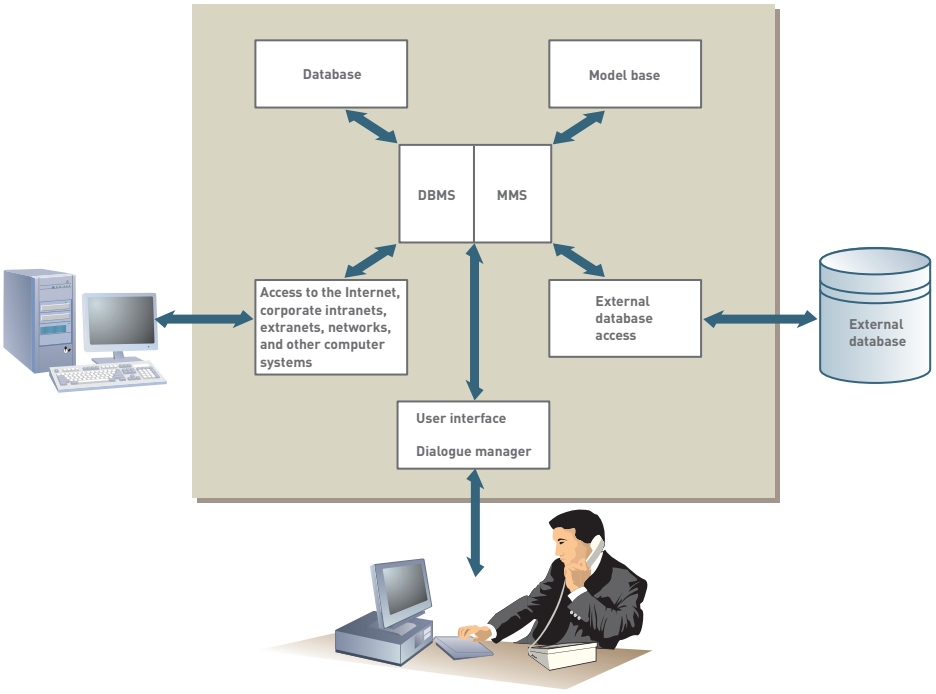

FIGURE **1.20**

Essential DSS elements

A DSS typically includes a model base, database, and user interface.

Specialized Business Information Systems

In addition to ERPs, MISs, and DSSs, organizations often rely on specialized systems. A *knowledge management system* is an organized collection of people, procedures, software, databases, and devices that stores and retrieves knowledge, improves collaboration, locates knowledge sources, captures and uses knowledge, or in some other way enhances the knowledge management process as shown in Figure 1.21. Consulting firms often use a KMS to capture and provide the collective knowledge of its consultants to one another. This makes each consultant much more valuable and avoids "re-inventing the wheel" to solve similar problems for different clients.

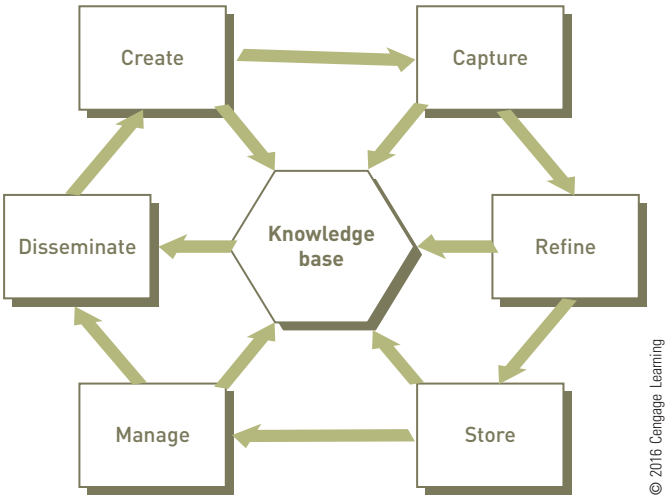

FIGURE **1.21**

Knowledge management process

Managing knowledge means an organization can capture and retain specialized knowledge for future use.

Artificial Intelligence

artificial intelligence (AI): A field in which the computer system takes on the characteristics of human intelligence.

In addition to knowledge management, companies use other types of specialized systems. Some are based on the notion of **artificial intelligence (AI)** in which the computer system takes on the characteristics of human intelligence. Artificial intelligence allows computers to beat human champions in games, helps doctors make medical diagnoses, and enables cars to drive hundreds of miles without a human behind the wheel.

The field of artificial intelligence includes several subfields (see Figure 1.22), which are discussed in the following sections.

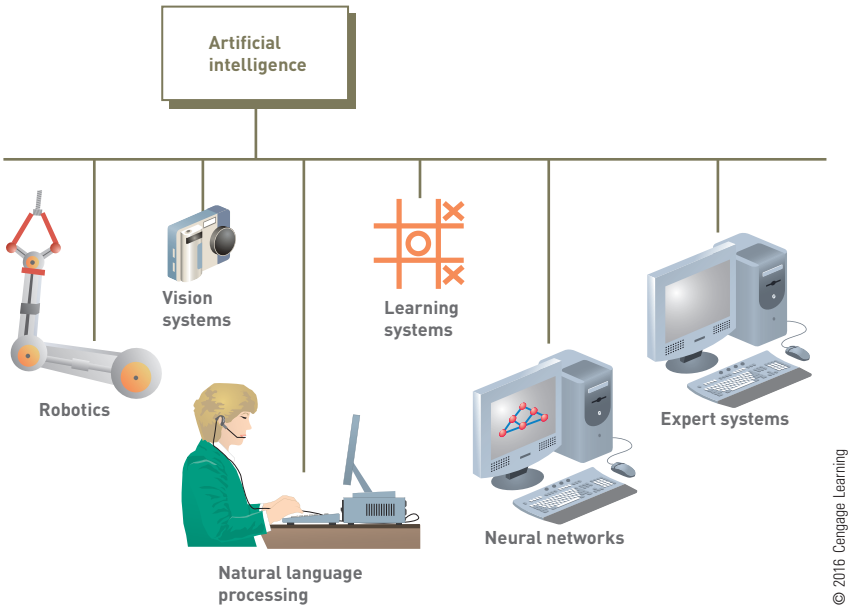

FIGURE **1.22**

Major branches of artificial intelligence

The field of AI includes several branches, including robotics and learning systems.

Robotics

Robotics is an area of artificial intelligence in which machines take over complex, dangerous, routine, or boring tasks, such as welding car frames or moving pallets of products around in a warehouse. Industries are turning to the use of robots to increase production and quality while decreasing waste and costs. Ford puts all its North American Ford trucks through a strenuous set of durability tests before they are approved for customer use. For health and safety reasons, human drivers are only allowed to drive certain rigorous courses once a day. To accelerate testing, reduce costs, and increase safety, Ford replaces the human driver with a robot control module that controls vehicle steering, acceleration, and braking on the more dangerous tests. The vehicle's position is monitored by cameras in a central control room and is GPS accurate to ±1 inch. This allows Ford to run many more tests per day than with human drivers alone.[29]

Vision Systems

Vision systems allow robots and other devices to "see," store, and process visual images. Researchers have developed a vision-enabled snake robot that provides a way to view hard-to-reach or radioactively contaminated areas of power plants inaccessible to people. First tested in a nuclear power plant in Austria, the snake can twist and turn as it moves through or over pipes and provide video to a control station.[30]

Natural Language Systems

Natural language processing involves the computer understanding, analyzing, manipulating and/or generating natural languages. It encompasses three main application areas: (1) computer translation of speech or text from one language to another, (2) dialogue systems that enable a human to communicate with a computer using a natural language, and (3) information extraction that transforms unstructured text into structured data that can be searched and browsed in flexible ways. Natural language processing is opening exciting new possibilities for how humans interact with computers and how we access the vast amount of data available in electronic form.[31]

Learning Systems

Learning systems allow computers to learn from past mistakes or experiences, such as playing games or making business decisions. Watson is the artificially intelligent computer system with natural language processing and learning capabilities that first demonstrated its prowess by defeating two former Jeopardy champions in 2011. Now Watson is learning to provide physicians with evidence-based treatment options for lung cancer patients. To do so, Watson was fed a wealth of information about lung cancer including physician notes, lab results, and clinical research from 1,500 patient cases. In addition, Watson absorbed more than 2 million pages of text from 42 medical journals and clinical trials in the area of oncology research.[32]

Neural Networks

Neural networks allow computers to recognize and act on patterns or trends. Some successful stock, options, and futures traders use neural networks to spot trends and improve the profitability of their investments. Edwin Welch, the director of institutional research and associate registrar at Taylor University, is investigating the use of neural networks in an attempt to identify patterns or trends among students who drop out after their freshman year.[33]

Expert Systems

expert system: A system that gives a computer the ability to make suggestions and function like an expert in a particular field.

knowledge base: The collection of data, rules, procedures, and relationships that must be followed to achieve value or the proper outcome.

Expert systems give the computer the ability to make suggestions and function like an expert in a particular field, helping enhance the performance of the novice user. The unique value of expert systems is that they allow organizations to capture and use the wisdom of experts and specialists. Therefore, years of experience and specific skills are not completely lost when a human expert dies, retires, or leaves for another job. The collection of data, rules, procedures, and relationships that must be followed to achieve value or the proper outcome is contained in the expert system's **knowledge base**. Japan Airlines developed an expert system for crew scheduling of its 100 wide-body aircraft and 2,200 flight crew members. The expert system provided much better schedules in many fewer hours compared to the old manual process, which took 25 people 20 days to complete.[34]

Virtual Reality and Multimedia

virtual reality: An artificial three-dimensional environment created by hardware and software and experienced through sensory stimuli (primarily sight and sound, but sometimes through touch, taste, and smell) and within which an individual can interact to affect what happens in the environment.

Virtual reality is an artificial three-dimensional environment created by hardware and software and experienced through sensory stimuli (primarily sight and sound, but sometimes through touch, taste, and smell) and within which an individual can interact to affect what happens in the environment. Virtual reality has long been used by the military for training pilots. Students have likely encountered virtual reality on gaming boxes such as Xbox 360 or the Wii. Jaguar Land Rover and four of the leading universities in the United Kingdom formed a five-year, £10 million partnership to develop new advanced virtual reality tools to enable manufacturers to deliver advanced vehicles designs in less time and at a reduced cost by lessening the need to build physical prototypes.[35]

Augmented reality is a form of virtual reality that has the potential to superimpose digital data over real photos or images. Wikitude is a mobile-based augmented reality application that enables you to overlay many dynamic content sources onto an image captured by a smartphone video camera. See Figure 1.23. For example, you could point your phone camera down a city street and request that the location of any restaurant be displayed on the image. You could then request that the address, phone, directions, and even reviews be overlaid on the image displayed by your phone.[36]

A variety of input devices, such as head-mounted displays, data gloves, joysticks, and handheld wands, allow the user to navigate through a virtual environment and to interact with virtual objects. Directional sound, tactile and force feedback devices, voice recognition, and other technologies enrich the immersive experience. Because several people can share and interact in

www.wikitude.com

FIGURE **1.23**

Wikitude app

You can use Wikitude to augment images displayed on your smartphone with updated content, such as locations of restaurants or transit stations.

the same environment, virtual reality can be a powerful medium for communication, entertainment, and learning.

Multimedia is a natural extension of virtual reality. It can include photos and images, the manipulation of sound, and special 3D effects. Once used primarily in movies, 3D technology can be used by companies to design products, such as motorcycles, jet engines, and bridges. Autodesk, for instance, makes exciting 3D software that companies can use to design large skyscrapers and other buildings. The software can also be used by Hollywood animators to develop action and animated movies.

SYSTEMS DEVELOPMENT

systems development: The activity of creating or modifying information systems.

Systems development is the activity of creating or modifying information systems. Systems development projects can range from small to very large and are conducted in fields as diverse as nuclear science research and video game development. Systems development is initiated for many reasons including to reduce the cost and effort associated with operating an existing system; to meet a new business need caused by an organizational change such as a merger, acquisition, or formation of a new department; to meet a new government requirement; to provide a new or improved customer service; or to take advantage of new technology development such as the expanding use of smartphones and tablets to replace personal computers. Over the next few years, it is expected that systems developers will concentrate on projects that apply analytics to large amounts of business data, take advantage of cloud computing, and create more mobile applications for their businesses and organizations.[37]

Company employees can develop systems, or companies may hire an outside company (outsource) to perform some or all of a systems development project. Outsourcing allows a company to focus on what it does best and delegate software development to companies that have world-class development capabilities. No matter who does the work, throughout the entire system development process, the project team must constantly strive to gain the support of top-level managers and the people who will actually use the system. The project team must focus on developing a system that achieves significant business goals.

One strategy for improving the results of a systems development project is to divide it into several steps, each with a well-defined goal and set of tasks to accomplish. See Figure 1.24. These steps are summarized next.

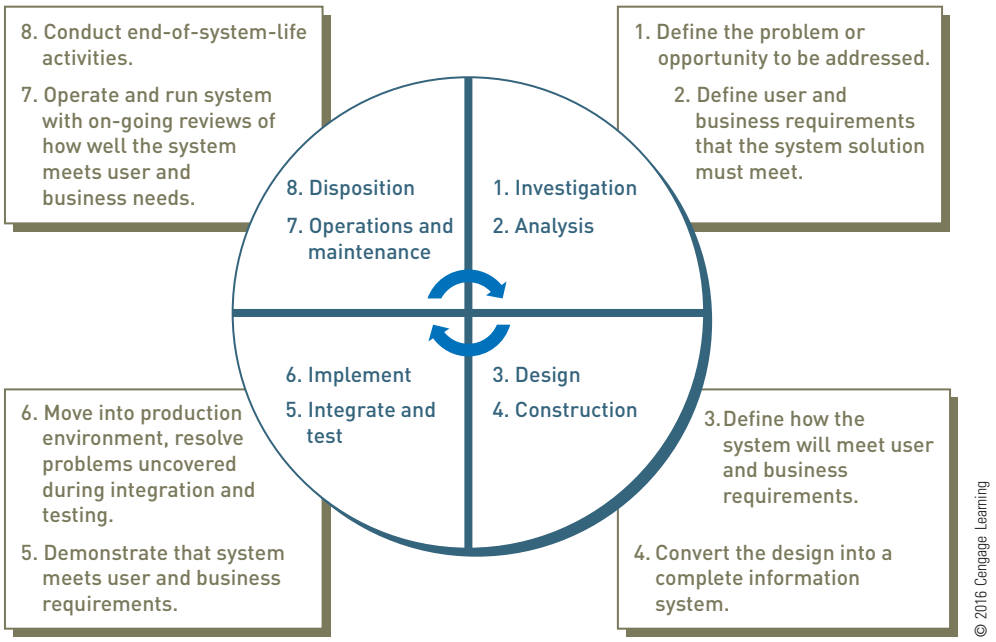

FIGURE **1.24**

Systems development life cycle

Systems development involves several well-defined stages.

Investigation, Analysis, and Design

The first steps of systems development are systems investigation, analysis, and design. The goal of the systems investigation is to gain a clear understanding of the specifics of the problem to be solved or the opportunity to be addressed. What is the scope of the problem? Who is affected and how? How often does this occur? After an organization understands the problem, the next question is, "Is the problem worth addressing?" Given that organizations have limited resources—people and money—this question deserves careful consideration. If the decision is to continue addressing the problem, the next step, systems analysis, involves studying the existing system to uncover its strengths and weaknesses and interviewing those who will use the new system to identify what the system must do to meet their needs and the needs of the organization. This is called defining the system requirements. Systems design determines how the new system must work, what inputs are required, and what outputs must be produced to meet the business needs defined during systems analysis.

Construction, Integration and Testing, Implementation, Operation and Maintenance, and Disposition

Construction involves converting the system design into an operational information system. Tasks include acquiring and installing hardware and software, coding and testing software programs, creating and loading data into databases, and performing initial program testing. Integration and testing is a process of linking together all the components of the system to demonstrate that the system as a whole does indeed meet the user and business requirements. Testing is done by both the technical members of the project team and by trained end users. Implementation involves installing the new system into the actual production computer environment in which it is expected to run and resolving any problems uncovered in integration and testing. Operation and maintenance involves the ongoing running of the system and identifying and making necessary changes to the system due to errors or new user or business requirements. Disposition involves those activities at the end of the useful life of the system.

Often this requires that data from the system's database be extracted and converted into a new format for use in the replacement system. Companies often hire outside companies to do their development, integration and testing, implementation, and operation and maintenance work.

ORGANIZATIONS AND INFORMATION SYSTEMS

organization: A formal collection of people and other resources established to accomplish a set of goals.

An **organization** is a formal collection of people and other resources established to accomplish a set of goals.

An organization constantly uses money, people, materials, machines and other equipment, data, information, and decisions. As shown in Figure 1.25, resources such as materials, people, and money serve as inputs to the organizational system from the environment; they go through a transformation mechanism; and then outputs are produced to the environment. The outputs from the transformation mechanism are usually goods or services, which are of higher relative value than the inputs alone. Through adding value or worth, organizations attempt to increase performance and achieve their goals.

value chain: A series (chain) of activities that an organization performs to transform inputs into outputs in such a way that the value of the input is increased.

Providing value to a stakeholder—customer, supplier, partner, shareholder, or employee—is the primary goal of any organization. The value chain, first described by Michael Porter in a 1985 Harvard Business Review article titled "How Information Gives You Competitive Advantage," reveals how organizations can add value to their products and services. The **value chain** is a series (chain) of activities that an organization performs to transform inputs into outputs in such a way that the value of the input is increased. An organization may have many value chains and different organizations in different industries will have different value chains.

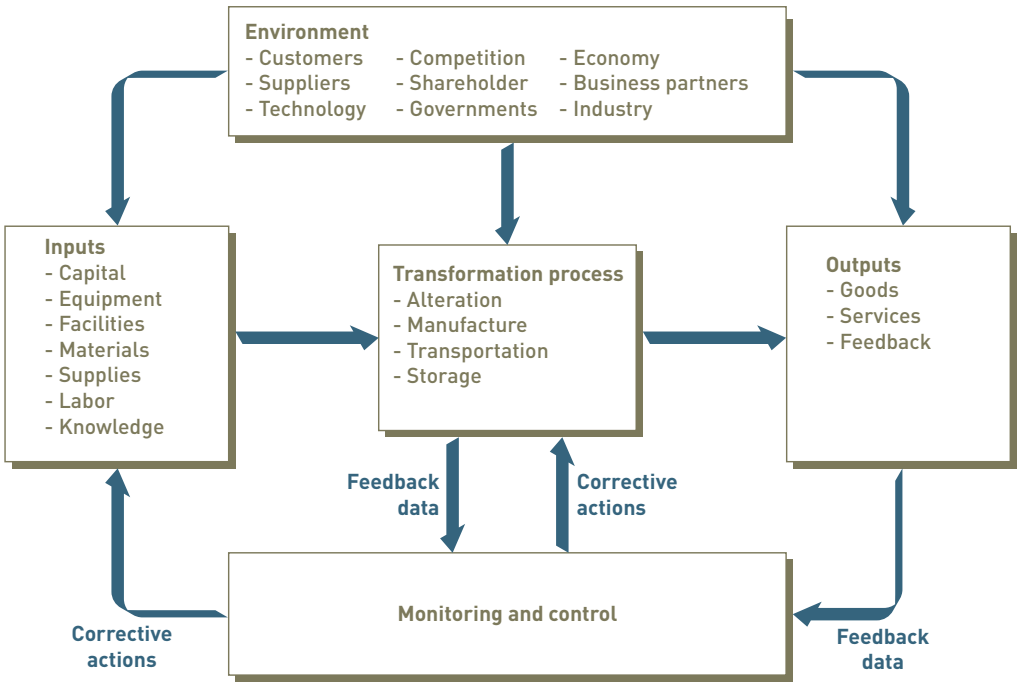

FIGURE **1.25**

General model of an organization

Information systems support and work within the automated portions of an organizational process.

In a manufacturing organization, the supply chain is a key value chain whose primary activities include inbound logistics, operations, outbound logistics, marketing and sales, and service. See Figure 1.26. These primary activities

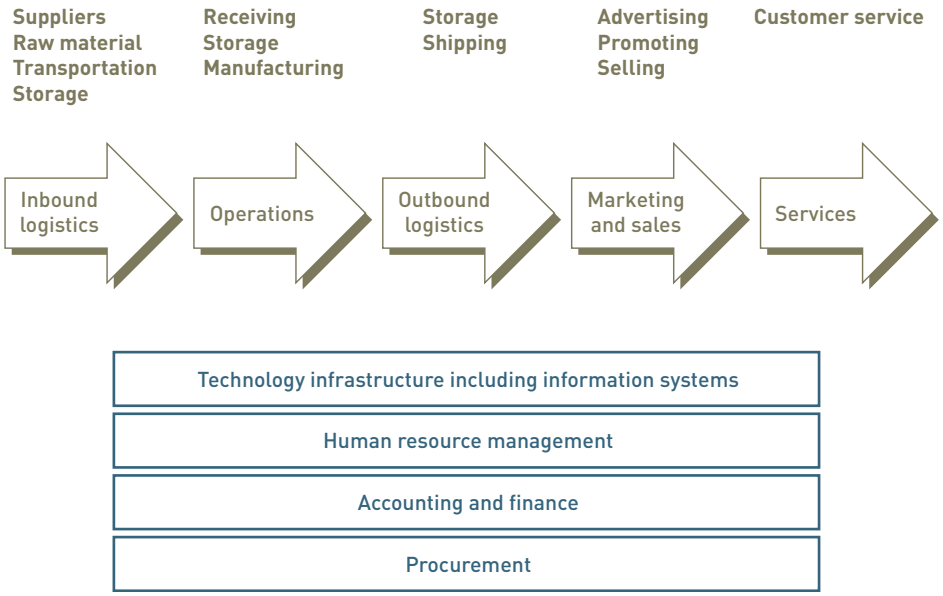

FIGURE **1.26**

Supply chain

The primary and support activities of the manufacturing supply chain are concerned with creating or delivering a product or service.

are directly concerned with the creation and/or delivery of the product or service. The four main areas of support activities include the following: technology infrastructure, human resource management, accounting and finance, and procurement. (Technology infrastructure includes not only research and development, but information systems hardware, software, and networks).

The concept of value chain is just as important to companies that don't manufacture products, such as tax preparers, restaurants, book publishers, legal firms, and other service providers. By adding a significant amount of value to their products and services, companies ensure their success.

What role do information systems play in supply chain management activities and other organizational activities? A traditional view of information systems holds that organizations use them to control and monitor processes and ensure effectiveness and efficiency. In this view, information systems are external to the supply chain management process and serve to monitor or control it. A more contemporary view, however, holds that information systems are often so intimately involved that they are *part of* the process itself. From this perspective, the information system plays an integral role in the process, whether providing input, aiding product transformation, or producing output.

Coles is the second largest supermarket chain in Australia. It has improved its supply chain by employing advanced analytics to improve consumer demand forecasting systems. It uses sophisticated customer loyalty analysis tools to deepen its understanding of customer buying patterns to plan effective marketing programs. Coles has also taken strong measures to improve online data exchange and collaboration with its more than 3,000 suppliers. All these actions have gone a long way toward reducing the number one complaint from Coles' customers—item stock-outs. They have also paved the way for improved inventory management and better supplier relationships.[38]

Innovation

Innovation is the catalyst for the growth and success of any organization. It can build and sustain profits, create new challenges for the competition, and provide added value for customers. Innovation and change are absolutely required in today's highly competitive global environment or the organization

is at risk of losing its competiveness and becoming obsolete. Various authors and researchers have identified many ways of classifying innovation. A simple classification developed by Clayton Christensen, a leading researcher in this field, is to think of two types of innovation—sustaining and disruptive.[39]

Sustaining innovation results in enhancements to existing products, services, and ways of operating. Such innovations are important as they enable an organization to continually increase profits, lower costs, and gain market share. Procter & Gamble has poured hundreds of millions of dollars into making sustaining innovations to its leading laundry detergent, Tide, which was first introduced in 1946. These innovations have made it possible for Tide to get whites whiter and brights brighter, empowered Tide to work in cold water as well as hot, created concentrated Tide, which reduces packaging and distribution costs, and added scented Tide, which makes clothes smell fresher. These innovations have kept Tide as one of the leading detergents with over $4.5 billion in annual sales.

A *disruptive innovation* is one that initially provides a lower level of performance than the marketplace has grown to accept. Over time, however, the disruptive innovation is improved to provide some new performance characteristics and becomes more attractive to users in a new market. As it continues to improve and begins to provide a higher level of performance, it eventually displaces the former product or way of doing things. The cell phone is a good example of a disruptive innovation. The first commercial handheld cell phone weighed 2.5 pounds, had a battery life of less than 30 minutes, cost over $3,000, and had extremely poor sound quality.[40] Compare that with today's ubiquitous cell phones that have one-tenth the weight, one-fifteenth the cost, 25 times longer battery life, and not only are capable of placing calls but serving as a camera, video recorder, and handheld computer that can run applications and access the Internet.

Diffusion of Innovation Theory

diffusion of innovation theory: A theory developed by E.M. Rogers to explain how a new idea or product gains acceptance and diffuses (or spreads) through a specific population or subset of an organization.

The **diffusion of innovation theory** was developed by E.M. Rogers to explain how a new idea or product gains acceptance and diffuses (or spreads) through a specific population or subset of an organization. A key point of this theory is that adoption of any innovation does not happen all at once for all members of the targeted population; rather, it is a drawn out process with some people quicker to adopt the innovation than others. See Figure 1.27. Rogers defined five categories of adopters, shown in Table 1.3, each with different attitudes toward innovation. When promoting an innovation to a target

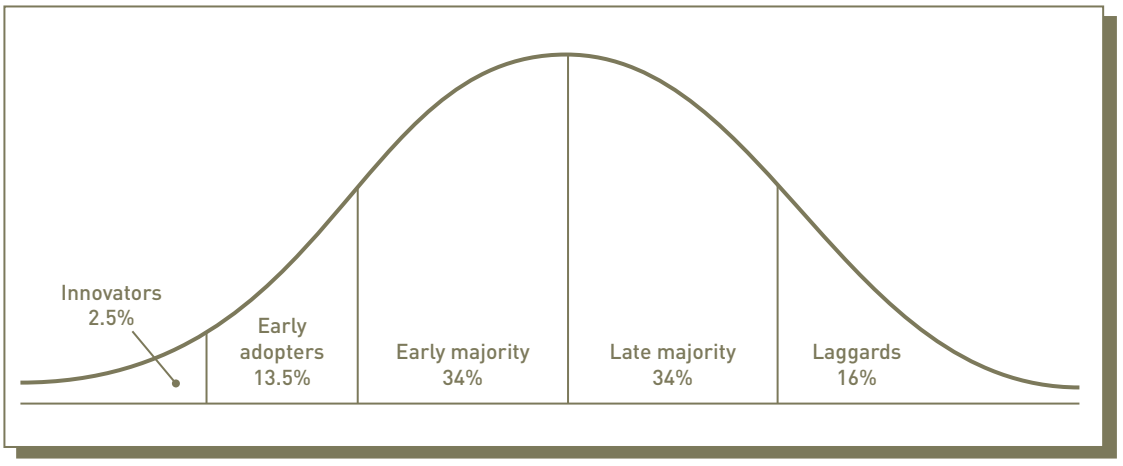

FIGURE **1.27**

Innovation diffusion

Adoption of any innovation does not happen all at once for all members of the targeted population; rather it is a drawn out process with some people quicker to adopt the innovation than others.

Source: Everett Rogers, *Diffusion of Innovations*

population, it is important to understand the characteristics of the target population that will help or hinder adoption of the innovation and then to apply the appropriate strategy. This theory can be useful in planning the rollout of a new information system.

TABLE 1.3 Five categories of innovation adopters

Adopter Category	Characteristics	Strategy to Use
Innovator	Risk takers, always the first to try new products and ideas	Simply provide them with access to the new system and get out of their way
Early adopter	Opinion leaders whom others listen to and follow, aware of the need for change	Provide them assistance getting started
Early majority	Listen to and follow the opinion leaders	Provide them with evidence of the system's effectiveness and success stories
Late majority	Skeptical of change and new ideas	Provide them data on how many others have tried this and have used it successfully
Laggards	Very conservative and highly skeptical of change	Have their peers demonstrate how this change has helped them and bring pressure to bear from other adopters

Organizational Change

organizational change: How for-profit and nonprofit organizations plan for, implement, and handle change.

Mark Twain said, "It's not the progress I mind, it's the change I don't like." **Organizational change** deals with how organizations successfully plan for and implement change. Change can be caused by internal factors, such as those initiated by employees at all levels, or by external factors, such as those wrought by competitors, stockholders, federal and state laws, community regulations, natural occurrences (such as hurricanes), and general economic conditions. Organizational change also occurs when two or more organizations merge. When organizations merge, integrating their information systems can be critical to future success.

Leavitt's diamond: A theory that proposes that every organizational system is made up of four main components: people, tasks, structure, and technology with an interaction among the four components so that any change in one of these elements will necessitate a change in the other three elements.

Leavitt's diamond is an organizational change model that is helpful in successfully implementing change. **Leavitt's diamond** proposes that every organizational system is made up of four main components: people, tasks, structure, and technology. The four components interact so that any change in one element will necessitate a change in the other three elements. Thus, to successfully implement a new information system, appropriate changes must be made to the people, structure, and tasks affected by the new system. See Figure 1.28.

COMPETITIVE ADVANTAGE

competitive advantage: A significant and ideally long-term benefit to a company over its competition.

A **competitive advantage** is a significant and ideally long-term benefit to a company over its competition and can result in higher-quality products, better customer service, and lower costs. Many companies consider their IS staff a key competitive weapon against other companies in the marketplace, especially if they have employees with training in the development and use of mobile devices, Internet applications, social networks, and collaborative tools. Firms that gain a competitive advantage often emphasize the alignment of organizational goals and IS goals. In other words, these organizations make sure that their IS departments are totally supportive of the broader goals and strategies of the organization.

Factors that Lead Firms to Seek Competitive Advantage

five-forces model: A widely accepted model that identifies five key factors that can lead to attainment of competitive advantage, including (1) the rivalry among existing competitors, (2) the threat of new entrants, (3) the threat of substitute products and services, (4) the bargaining power of buyers, and (5) the bargaining power of suppliers.

A number of factors can lead to attaining a competitive advantage. Michael Porter, a prominent management theorist, proposed a now widely accepted competitive forces model, also called the **five-forces model**. The five forces include (1) the rivalry among existing competitors, (2) the threat of new entrants, (3) the threat of substitute products and services, (4) the bargaining

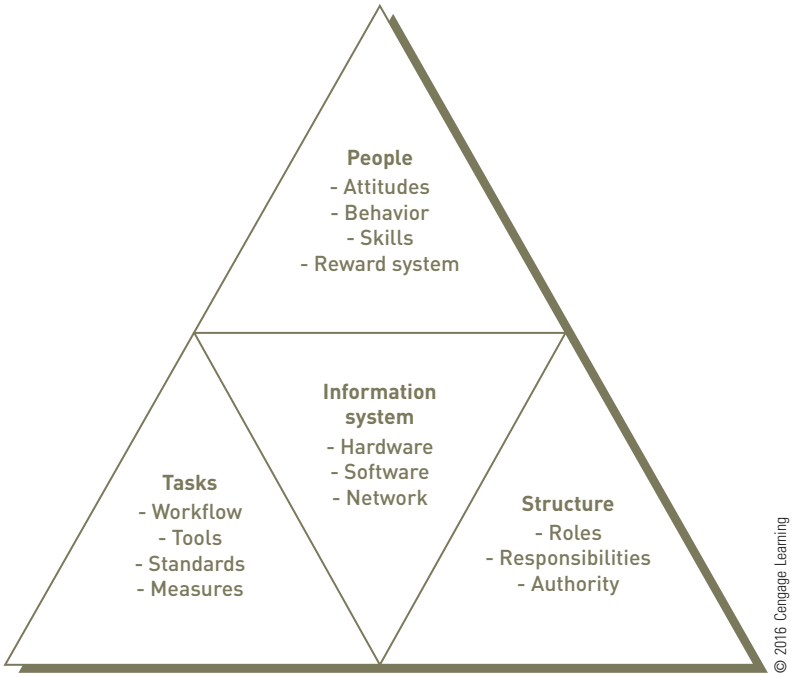

FIGURE **1.28**

Leavitt's diamond

Any change in technology, people, task, or structure will necessitate a change in the other three elements.

power of buyers, and (5) the bargaining power of suppliers. The more these forces combine in any instance, the more likely firms will seek competitive advantage and the more dramatic the results of such an advantage will be.

Rivalry among Existing Competitors

Typically, highly competitive industries are characterized by high fixed costs of entering or leaving the industry, low degrees of product differentiation, and many competitors. To gain an advantage over competitors, companies constantly analyze how they use their resources and assets. This resource-based view is an approach to acquiring and controlling assets or resources that can help the company achieve a competitive advantage. For example, a transportation company might decide to invest in radio-frequency technology to tag and trace products as they move from one location to another.

Threat of New Entrants

A threat appears when entry and exit costs to an industry are low and the technology needed to start and maintain a business is commonly available. For example, a small restaurant is threatened by new competitors. Owners of small restaurants do not require millions of dollars to start the business, food costs do not decline substantially for large volumes, and food processing and preparation equipment is easily available. When the threat of new market entrants is high, the desire to seek and maintain competitive advantage to dissuade new entrants is also usually high. See Figure 1.29.

Threat of Substitute Products and Services

Companies that offer one type of goods or services are threatened by other companies that offer similar goods or services. The more consumers can obtain similar products and services that satisfy their needs, the more likely firms are to try to establish competitive advantage. For example, consider the photographic industry. When digital cameras became popular, traditional film companies had to respond to try to stay competitive and profitable.

Bargaining Power of Customers and Suppliers

Large customers tend to influence a firm, and this influence can increase significantly if the customers threaten to switch to rival companies. When customers have a lot of bargaining power, companies increase their competitive

FIGURE **1.29**

Restaurant industry

In the restaurant industry, competition is fierce because entry costs are low. Therefore, a small restaurant that enters the market can be a threat to existing restaurants.

advantage to retain their customers. Similarly, when the bargaining power of suppliers is strong, companies need to improve their competitive advantage to maintain their bargaining position. Suppliers can also help an organization gain a competitive advantage. Some suppliers enter into strategic alliances with firms and eventually act as a part of the company.

Strategic Planning for Competitive Advantage

To be competitive, a company must be fast, nimble, flexible, innovative, productive, economical, and customer oriented. It must also align its IS strategy with general business strategies and objectives. Given the five market forces previously mentioned, Porter and others have proposed a number of strategies to attain competitive advantage, including cost leadership, differentiation, niche strategy, altering the industry structure, creating new products and services, and improving existing product lines and services.

- **Cost leadership.** Deliver the lowest possible cost for products and services. Walmart, Costco, and other discount retailers have used this strategy for years. See Figure 1.30. Cost leadership is often achieved by reducing the costs of raw materials through aggressive negotiations with suppliers, becoming more efficient with production and manufacturing processes, and reducing warehousing and shipping costs. Some companies use outsourcing to cut costs when making products or completing services.
- **Differentiation.** Deliver different products and services. This strategy can involve producing a variety of products, giving customers more choices, or delivering higher-quality products and services. Many car companies make different models that use the same basic parts and components, giving customers more options. Other car companies attempt to increase perceived quality and safety to differentiate their products and appeal to consumers who are willing to pay higher prices for these features. Companies that try to differentiate their products often strive to uncover and eliminate counterfeit products produced and delivered by others.
- **Niche strategy.** Deliver to only a small, niche market. Porsche, for example, doesn't produce inexpensive economy cars. It makes high-performance sports cars and SUVs. See Figure 1.31. Rolex only makes high-quality, expensive watches. It doesn't make inexpensive, plastic watches.
- **Altering the industry structure.** Change the industry to become more favorable to the company or organization. The introduction of low-fare

FIGURE **1.30**

Costco uses cost leadership strategy

Costco and other discount retailers have used a cost leadership strategy to deliver the lowest possible price for products and services.

FIGURE **1.31**

Porsche implements niche strategy

Porsche is an example of a company with a niche strategy, producing only high-performance sports cars and SUVs.

airline carriers, such as Southwest Airlines, has forever changed the airline industry, making it difficult for traditional airlines to make high profit margins. See Figure 1.32. Creating strategic alliances can also alter the industry structure. A **strategic alliance**, also called a **strategic partnership**, is an agreement between two or more companies that involves the joint production and distribution of goods and services.

strategic alliance (or strategic partnership): An agreement between two or more companies that involves the joint production and distribution of goods and services.

- **Creating new products and services.** Introduce new products and services periodically or frequently. This strategy always helps a firm gain a competitive advantage, especially in the computer industry and for other high-tech businesses. If an organization does not introduce new products and services every few months, the company can quickly stagnate, lose market share, and decline. Companies that stay on top are constantly developing new products and services. Apple Computer, for example, introduced the iPod, iPhone, and iPad as new products.

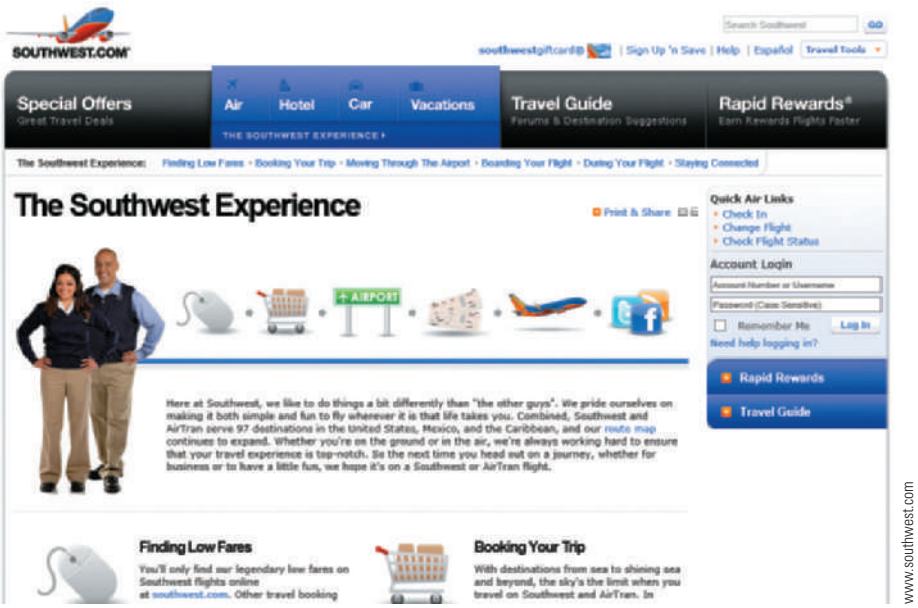

FIGURE **1.32**

Southwest Airlines

Low-fare airline carriers such as Southwest Airlines altered the structure of the airline industry.

- **Improving existing product lines and services.** Make real or perceived improvements to existing product lines and services. Manufacturers of household products are always advertising new and improved products. In some cases, the improvements are more perceived than actual refinements; usually, only minor changes are made to the existing product, such as reducing the amount of sugar in a breakfast cereal.
- **Innovation.** Innovation is another competitive strategy. Natural Selection, a San Diego-based company, has used an optimization technique called evolutionary computation to model optimal ramp metering for freeways in Southern California. Its software is able to rapidly adapt to incidents as they occur using sensor information gathered in real time.[41]
- **Other strategies.** Some companies seek strong *growth in sales*, hoping that it can increase profits in the long run due to increased sales. Being the *first to market* is another competitive strategy. Apple Computer, for example, was one of the first companies to offer complete and ready-to-use personal computers. Some companies offer *customized* products and services to achieve a competitive advantage. Dell, for example, builds custom PCs for consumers. *Hire the best people* is another example of a competitive strategy. The assumption is that the best people will determine the best products and services to deliver to the market and the best approach to deliver these products and services. Having *agile* information systems that can rapidly change with changing conditions and environments can be a key to information systems success and a competitive advantage. Companies can also combine one or more of these strategies. In addition to customization, Dell attempts to offer low-cost computers (cost leadership) and top-notch service (differentiation).

FINANCIAL EVALUATION OF INFORMATION SYSTEM PROJECTS

Most organizations have an entire portfolio of potential projects including information system projects from which to choose. To determine if a specific information system project is even worth pursuing, organizations perform a financial analysis. Two methods for performing a financial analysis will be discussed shortly. First, you should understand the concept of **cash flow**, which is used in all these methods, and the time value of money, which is used in one of the methods.

cash flow: Takes into account all the increases and decreases in cash flow associated with the project.

The cash flow associated with a specific project takes into account all the increases and decreases in cash flow associated with the project. Some of these are identified in Table 1.4.

TABLE 1.4 Examples of increases and decreases in cash flow associated with a project

Type	Examples (not exhaustive)
Increases in cash flow	Any new revenue, such as additional sales generated and capture of income earned but not collected under the old methods. This would also include any acceleration in cash flow due to the speeding up of cash generating or cash collection processes or a reduction in the time required to get new products to market.
	Any cost savings associated with the project, such as savings from reduction in staff, equipment rental fees, and outsourcing fees
	Tax reduction generated from depreciation associated with any capital expenditures
Decreases in cash flow	Any capital investment required to buy equipment, software, or office space
	All ongoing operating costs such as equipment rental, software, office space, additional staff required to operate or support the system, and training of personnel
	All ongoing maintenance costs for equipment and software

time value of money: Takes into account the fact that a dollar today is worth more than a dollar paid in the future.

The **time value of money** takes into account the fact that a dollar today is worth more than a dollar paid in the future. Why? Because if you have a dollar today, you can invest it and earn a return on that dollar. The rate of return that can be earned on this money is the firm's opportunity cost. Suppose the firm's opportunity cost is 6%. If the firm has an additional $1 million today, it could invest it so that in one year it would have $1 million $\times$ $(1 + .06)$, or $1.06 million. In two years, it would have $1 million $\times$ (1.06) $\times$ (1.06) or 1.124 million. So the value of future dollars earned must be discounted to determine their value in present day dollars. One million dollars to be received in three years is worth $1 million$/(1.06)^3$ or $839,619 in today's dollars.

Two methods for performing a financial analysis of a potential information systems project involve calculating the payback period and the internal rate of return.

Payback Period

payback period: Takes into account all the increases and decreases in cash flow associated with the project.

The **payback period** is the number of years required to recover the initial cost of an investment. The shorter the payback period, the more attractive is the project. A payback period of three years or less is usually considered good.

Assume that an information system project requires an initial investment of $150,000 and it generates net savings of $25,000; $50,000; $75,000; $100,000; and $100,000 over five years of operation. This system has a payback period of three years.

There are two problems with this evaluation method. First, it does not take into account the time value of money. Second, it fails to include cash flows beyond the payback period (years four and five in this example). Consider a project that requires an initial investment of $150,000 and generates net savings of $0; $0; $150,000; $0; $0. It also has a payback period of three years but is not as financially attractive as the first example.

Internal Rate of Return

internal rate of return: The rate of return that makes the net present value of all cash flows (benefits and costs) generated by a project equal to zero.

The **internal rate of return** of an investment is the rate of return that makes the net present value of all *after-tax* cash flows (benefits and costs) generated by a project equal to zero. The higher the internal rate of return, the more attractive the project is from a financial standpoint. Most organizations set a "hurdle rate" for evaluating projects. If the project does not exceed the hurdle rate, it is not acceptable from a financial standpoint.

The equation for determining the internal rate of return looks like this.

$$\text{Net present value} = \sum_{n=0}^{N} C_n/(1+r)^n = 0$$

Where N is the total number of periods for which there are cash flow estimates

- C_n is the net after-tax cash flow for period n
- r is the internal rate of return
- $C_n/(1 + r)^n$ represents the present day value of net cash flow (C_n) in the nth year.

Online calculators can be found that determine the internal rate of return. Some spreadsheet programs (e.g., Excel's IRR formula in the Financial group on the Formulas tab) calculate the internal rate of return. Also, more expensive calculators have this function. See Table 1.5.

TABLE 1.5 Cash flow model for calculating payback period and internal rate of return

	Years					
	1	2	3	4	5	Total
Initial capital investment	−$2.00					−$2.00
Decreases in cash flow						
Ongoing operating costs		−$0.95	−$0.75	−$0.75	−$0.75	−$3.20
Ongoing maintenance costs		−$0.20	−$0.20	−$0.20	−$0.20	−$0.80
Total costs		−$1.15	−$0.95	−$0.95	−$0.95	−$4.00
Increases in cash flow						$0.00
Additional new revenue		$1.00	$1.25	$1.35	$1.45	$5.05
Savings generated from project		$0.50	$0.75	$0.75	$0.75	$2.75
Total benefits		$1.50	$2.00	$2.10	$2.20	$7.80
Cash flow before taxes	−$2.00	$0.35	$1.05	$1.15	$1.25	$3.80
Accumulated cash flow	−$2.00	−$1.65	−$0.60	$0.55	$1.80	
Change in income						
Depreciation expense		−$0.45	−$0.40	−$0.35	−$0.30	−$1.50
Total costs		−$1.15	−$0.95	−$0.95	−$0.95	−$4.00
Total benefits		$1.25	$1.75	$2.00	$2.25	$7.25
Net change in income		−$0.35	$0.40	$0.70	$1.00	$1.75
Net income tax (assume 40% tax rate)		−$0.14	$0.16	$0.28	$0.40	$0.70
Cash flow after taxes	−$2.00	$0.49	$0.89	$0.87	$0.85	$3.10
Discount factor for time value of money (assume 6% cost of money)	1	1.06	$(1.06)^2$	$(1.06)^3$	$(1.06)^4$	
Discounted cash flow (after tax)	−$2.00	$0.46	$0.79	$0.73	$0.67	$0.66
Financial analysis:						
Payback period	4.5 yrs					
Net present value	$0.54					
Internal rate of return	19%					

Regardless of the difficulties, organizations must attempt to evaluate the contributions that potential new information systems can make to assess their contribution to the organization's future profit. This will ensure that scarce human resources, cash, and other resources are dedicated to the most appropriate projects.

GLOBAL CHALLENGES IN INFORMATION SYSTEMS

What do Amazon, Coca-Cola, Facebook, Google, Hewlett Packard, IBM, Pepsi Cola, Procter & Gamble, and Unilever along with dozens of other large companies all have in common? They are looking at how and from where they are going to attract their next billion customers. Those billion new customers are not going to come from the Western or developed markets. They will come from emerging markets and will be much different from the first billion in terms of culture, education, income, language, and life style.[42] Success in global markets is imperative today. Global opportunities, however, introduce numerous obstacles and issues, including challenges involving culture and language.

A good example of a company facing global challenges is VF, the world's largest apparel manufacturing company with $11 billion in annual revenues generated from its over 30 brands including Wrangler, Lee, North Face, Vans, Timberland, and Eagle Creek. These brands are sold in more than 150 countries through 47,000 retailers, including more than 1,100 retail stores owned and operated by VF itself. Many of its brands are sold directly to consumers over the Internet. It manufactures some 450 million items annually at more than 1,900 facilities, and employs some 57,000 employees working around the world.[43] Because continued global operations and expansion are critical to its future success, VF is working to overcome many global issues including the following challenges:

- **Cultural challenges**: China does not have a strong tradition of outdoor participation, so The North Face brand is trying to build one. Much of the brand's marketing budget for China is invested in events to encourage consumers to get outside and experience the spirit of the brand firsthand. One event was a contest to recruit people for an expedition to climb China's legendary Haba Mountain, a feat accomplished by only 500 people in history.[44]
- **Time and distance challenges**: VF is working to shorten the lead times required to get new products to market by bringing product designers and supply chain experts together to enable face-to-face collaboration in a shared spirit of experimentation and to build new communications tools that make it easier for everyone to work together.[45]
- **State, regional, and national laws**: Uzbekistan, one of the world's largest exporters of cotton, permits forced child labor. VF has pledged to ensure that forced child labor does not find its way into its products.[46]

Competing in such a challenging global environment defines the type of information systems initiatives that VF makes. For example, VF worked to develop new human capital management systems and processes so it could build a global talent pool of internal and external candidates to fill key positions, support business expansion, simplify the recruitment process, and improve the quality of its new hires.[47] It also implemented information systems to support sales development by determining which customers were shopping in which stores and use this data to make related decisions about product placement.[48] Initiatives such as these are helping VF to continue to expand globally and be successful.

INFORMATION SYSTEMS IN BUSINESS AND SOCIETY

Information systems have been developed that bring significant benefits to business and society in terms of increased profits, improved goods and services, and an improved quality of life. Indeed information systems have become such an ingrained part of our life that it is difficult to imagine our life without them. However, along with these many positive aspects, there are also problems and issues including computer waste and mistakes, computer crime, privacy issues, work environment issues, and a host of ethical issues.

ETHICAL & SOCIETAL ISSUES

Facebook Has User Privacy Problems

On Christmas 2012, Randi Zuckerberg posted a photo of her family onto her private Facebook page. Unfortunately, the privacy settings on Facebook can confuse even the company's top executives. Randi, the sister of Facebook founder Mark Zuckerberg and a former senior Facebook executive, soon found that her photo had leaked to the general public and been tweeted to thousands of people. Randi tweeted Callie Schweitzer, director of marketing at VOX Media, who had first posted the photo to Twitter: "Not sure where you got this photo. I posted it to friends only on FB. You reposting it to Twitter is way uncool."

This incident came only 11 days after Facebook had released new privacy controls meant to help Facebook users understand who is able to see the content they post. A new shortcuts toolbar allowed users to control "Who can see my stuff" without having to go to a new page. The new release also offered in-product education. Messages explained how content that users hide in their timelines could still appear in their news feed and on other pages. Evidently, these controls did not go far enough to protect Randi Zuckerberg's privacy.

In fact, since it was launched, Facebook has had ongoing issues with addressing the privacy concerns of its users. In late 2011, Facebook settled a suit by the Federal Trade Commission (FTC) that charged Facebook with deceiving its customers about privacy issues since 2009. (The FTC regulates companies that take credit card information from consumers.) Facebook claimed that it would not share personal information with advertisers, that third-party applications would only be given the information they needed to function properly, that no one could access photos or videos from deleted accounts, and—perhaps most relevant to Randi Zuckerberg's experience—that information posted to an individual's Friends List would remain private. The FTC found that the company had not delivered on any of these claims. As part of the settlement, Facebook agreed to stop these practices until it had a better disclaimer and opt-out procedure. Mark Zuckerberg also issued a statement saying that, over the course of the previous 18 months, Facebook had introduced 20 new tools to address these and other privacy-related concerns.

However, by August 2012, the FTC had launched a new investigation into Facebook privacy practices. Facebook had partnered with Datalogix—a company that collects credit card purchasing information, such as where users are shopping and what they buy. Facebook users were included in Datalogix advertising research although they were not informed of this. Moreover, if Facebook users did, in fact, find out about the use of their private data, they could only opt out of the research by going to the Datalogix homepage.

Facebook has also had privacy problems arise with its subsidiaries. In September 2012, Facebook acquired Instagram, is a social media application that allows users to upload photos to the Instagram site for long-term storage and sharing. The product boasted a user-base of 100 million users. On December 17, 2012, Instagram posted a privacy notice claiming the right to sell all photographs posted to its site without compensation to the user. The company further claimed that it could sell any other metadata associated with the photo, such as usernames, gender, addresses, mobile phone number, and email addresses—all information users had had to provide when setting up an account. Instagram asked users who did not agree with the notice to remove their accounts within a few weeks. The new policy would go into effect for all users who accessed their accounts after January 19, 2013.

The announcement garnered a great deal of public resentment. On December 18, 2012, Instagram cofounder Kevin Systrom clarified that, despite the notice, the company had no current plans to sell users' photos. He explained that the company would be redrafting the privacy notice. In the meantime, competitors like Flickr, have picked up a larger market share as a result of Instagram's privacy misstep.

Facebook is a powerful tool for communicating and reconnecting with friends and family. The service it provides is so valuable that users continue to flock to it. However, with every step forward, Facebook seems to be taking one or two steps backward in its protection of user privacy. Whether at the hands of the FTC or the competition, Facebook will no doubt continue to face repercussions for its decisions.

Although Randi Zuckerberg may have blamed Callie Schweitzer for poor online manners, it is likely that most of the billion Facebook users would prefer to rely on some mechanism beyond social media etiquette to protect their photographs and private information.

Discussion Questions

1. Do you think that Facebook or careless, uninformed users should be held responsible for privacy issues related to using Facebook? Explain.
2. What additional measures should Facebook take to protect user privacy? What additional actions are required on the part of Facebook users to maintain adequate privacy?

Critical Thinking Questions

1. Describe a privacy issue so serious that it would cause you to stop using Facebook.
2. Develop a privacy policy for a student musical organization with roughly 50 members. This Web site stores members' contact information and information about their musical training, abilities, and interests. Who outside the organization might want to use that information and for what purposes? Should the organization allow them to use the information?

SOURCES: Schwartz, Terri, "Randi Zuckerberg's Family Photo Leaks Because of Confusing Facebook Settings," *Zap2it*, December 27, 2012, *http://blog.zap2it.com/pop2it/2012/12/randi-zuckerbergs-family-photo-leaks-because-of-confusing-facebook-settings.html*; Donston-Miller, Debra, "Facebook's New Privacy Policies: The Good News," *InformationWeek*, December 14, 2012, *www.informationweek.com/thebrainyard/news/social_networking_consumer/240144443/facebooks-new-privacy-policies-the-good-news*; Claburn, Thomas "Facebook Settles FTC Charges, Admits Mistakes," *InformationWeek*, November 29, 2011, *www.informationweek.com/security/privacy/facebook-settles-ftc-charges-admits-mist/232200385*; Goldman, Jeff, "Privacy Concerns Raised Over Facebook-Datalogix Partnership," *eSecurity Planet*, September 25, 2012, *www.esecurityplanet.com/network-security/privacy-concerns-raised-over-facebook-datalogix-partnership.html*; Arthur, Charles "Facebook Forces Instagram Users to Allow It To Sell Their Uploaded Photos," *The Guardian*, December 18, 2012, *www.guardian.co.uk/technology/2012/dec/18/facebook-instagram-sell-uploaded-photos*; "Humbled Instagram Backs Down on Controversial Changes to Serve User Photos as Ads," *Independent.ie*, December 21, 2012, *www.independent.ie/business/technology/humbled-instagram-backs-down-on-controversial-changes-to-serve-user-photos-as-ads-3333391.html*.

CAREERS IN INFORMATION SYSTEMS

Today, most organizations cannot function or compete effectively without computer-based information systems. Indeed, organizations often attribute their productivity improvement, superior customer service, or competitive advantage in the marketplace to their information systems. The information

system worker functions at the intersection of business and technology and designs and builds the solutions that allow organizations to effectively leverage information technology.

Successful information system workers must enjoy working in a fast-paced, dynamic environment where the underlying technology changes all the time. They must be comfortable with meeting deadlines and solving unexpected challenges. They need good communication skills and often serve as translators between business needs and technology-based solutions. They must have solid analytical and decision-making skills and be able to translate ill-defined business problems and opportunities into effective technology-based solutions. They must develop effective team and leadership skills and be adept at implementing organization change. Last, but not least, they need to be prepared to engage in life-long learning in a rapidly changing field.

Specific technical skills that some experts believe are important for IS workers to have include the following, all of which are discussed in the chapters throughout this book:

- Mobile applications for smartphones, tablet computers, and other mobile devices
- Program and application development
- Help desk and technical support
- Project management
- Networking
- Business intelligence
- Security
- Web 2.0
- Data center
- Telecommunications

Technology is one of the fastest growing areas in the United States economy and information systems professionals are in high demand. The Association for Computing Machinery forecasts 150,000 new computing jobs per year from 2012 to 2020. Meanwhile, the unemployment rate among U.S. information system workers is significantly lower than the overall unemployment rate (3.3% compared to 7.8% overall in the fourth quarter of 2012). One drawback of a career in this field is that as reliance on technology increases, organizations have increasing expectations of their information system workers. According to a Computerworld survey of information systems workers, 68% of the respondents said they felt more pressure over the past year to increase productivity and 75% felt pressure to take on new tasks. Of those, only 12% reported that their salaries had been adjusted to reflect the added workload.[49]

The U.S. Department of Labor's Bureau of Labor Statistics (*www.bls.gov*) publishes a list of the fastest-growing occupations. Figure 1.33 identifies the occupations that the BLS predicts to be the fastest growing IS positions and typical salary in 2013 for people in these positions with one to five years of experience.[50]

Opportunities in information systems are also available to people from foreign countries. The U.S. H-1B and L-1 visa programs seek to allow skilled employees from foreign lands into the United States. Opportunities in these programs, however, are limited and are usually in high demand. The L-1 visa program is often used for intracompany transfers for multinational companies. The H-1B program can be used for new employees. The number of H-1B visas offered annually can be political and controversial, with some fearing that the program is being abused to replace high-paid U.S. workers with less expensive foreign workers. Indeed, some believe that companies pretend to seek U.S. workers while actually seeking less expensive foreign workers. Others, however, believe the H-1B program and similar programs are invaluable to the U.S. economy and its competitiveness. The top five countries of birth for H-1B

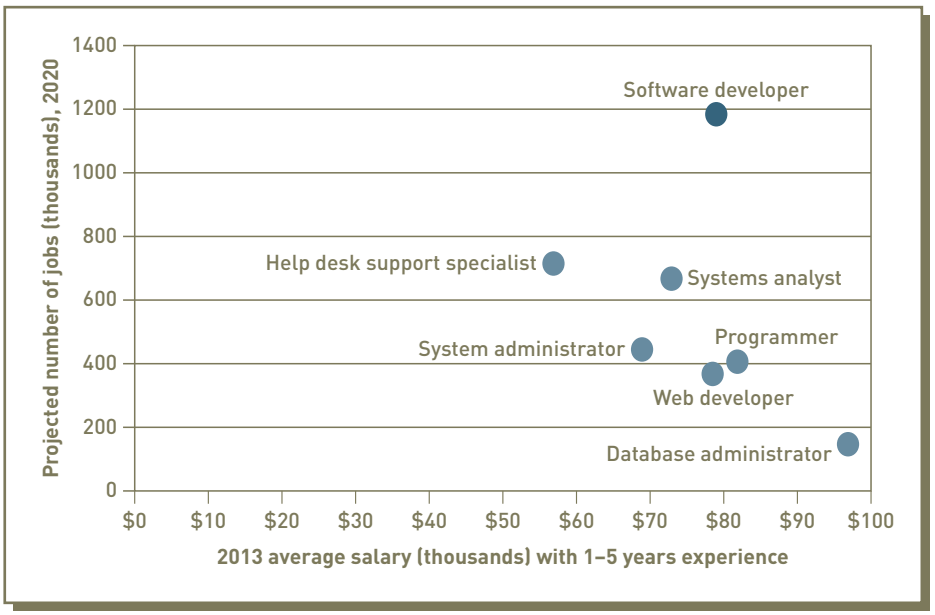

FIGURE **1.33**

Occupational outlook for selected information systems positions

This chart shows the typical salary for IS positions in 2013 and the IS positions that BLS predicts will be among the fastest growing in the near future.

workers in 2011 were India with 58 percent of all approved H-1B petitions, China (9%), Canada (4%), the Philippines (3%), and South Korea (3%).[51]

Roles, Functions, and Careers in IS

IS offers many exciting and rewarding careers. Professionals with careers in information systems can work in an IS department or outside a traditional IS department as Web developers, computer programmers, systems analysts, computer operators, and many other positions. In addition to technical skills, IS professionals need skills in written and verbal communication, an understanding of organizations and the way they operate, and the ability to work with people and in groups. At the end of every chapter, you will find career exercises that will help you explore careers in IS and career areas that interest you.

Most medium to large organizations manage information system resources through an IS department. In smaller businesses, one or more people might manage information resources, with support from outsourced services. As shown in Figure 1.34, the typical IS organization is divided into three main functions: operations, development, and support.

Typical IS Titles and Functions

The organizational chart shown in Figure 1.34 is a simplified model of an IS department in a typical medium-sized or large organization. The following sections provide a brief description of these roles. Smaller firms often combine these into fewer formal positions.

Chief Information Officer

The role of the CIO is to employ an IS department's equipment and personnel to help the organization attain its goals. CIOs also understand the importance of finance, accounting, and return on investment. They can help companies avoid damaging ethical challenges by monitoring how their firms are complying with a large number of laws and regulations. The high level of the CIO position reflects the fact that information is one of an organization's most important resources. A good CIO is typically a visionary who provides leadership and direction to the IS department to help an organization achieve its goals. CIOs need technical, business, and personal skills.

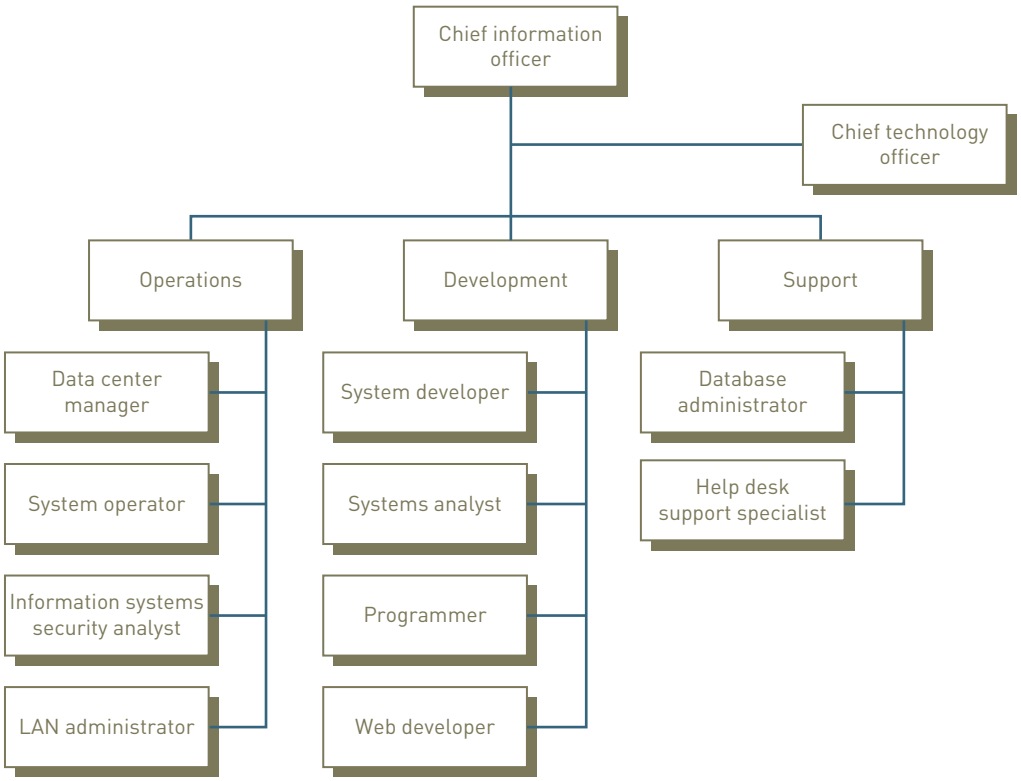

FIGURE **1.34**

Three primary functions of the information systems organization

Each of these functions—operations, development, and support—encompass several different IS roles.

Senior IS Managers

A large organization may have several people employed in senior IS managerial levels with job titles such as vice president of information systems, manager of information systems, and chief technology officer (CTO). A central role of all these people is to communicate with other areas of the organization to determine changing business needs. Managers outside the IS organization may be part of an advisory or steering committee that helps the CIO and other IS managers make decisions about the use of information systems. Together, they can best decide what information systems will support corporate goals. The CTO, for example, typically works under a CIO and specializes in networks and related equipment and technology.

Operations Roles

The operations group is responsible for the day to day running of IS hardware to process the organization's information systems workload. It must also do capacity planning to expand and upgrade equipment to meet changing business needs. It is constantly looking for ways to reduce the overall cost and increase the reliability of the organization's computing. This group is also responsible for protecting the company's IS systems and data from unauthorized access. Professionals in the operations group include data center managers, system operators, information system security analysts, and LAN administrations.

Development Roles

The development group is responsible for implementing the new information systems required to support the organization's existing and future business

needs. Importantly, they must also modify existing information systems as the needs of the organization evolve and change. They are constantly on the watch for ways in which to use information systems to improve the competitiveness of the firm. Professionals in the development group include software developers, systems analysts, programmers, and Web developers. See Figure 1.35.

FIGURE **1.35**

Web developers

Web developers create and maintain company Web sites.

Support

The support group provides customer service for the employees, customers, and business partners that rely on the firm's information systems and service to accomplish their work. They respond to queries from these constituents and attempt to be proactive in eliminating problems before they occur. They often develop and provide training to users to enable them to better use information systems services and equipment. Professionals in the support group include database administrators and help desk support specialists. See Figure 1.36.

FIGURE **1.36**

Help desk personnel

Help desk personnel respond to inquiries from computer users regarding hardware, software, networking, or other IS-related problems or needs

Certification

certification: A process for testing skills and knowledge, which results in a statement by the certifying authority that confirms an individual is capable of performing particular tasks.

Often, the people filling IS roles have completed some form of certification. **Certification** is a process for testing skills and knowledge resulting in an endorsement by the certifying authority that an individual is capable of performing particular tasks or jobs. Certification frequently involves specific, vendor-provided or vendor-endorsed coursework. Popular certification programs include Microsoft Certified Systems Engineer, Certified Information Systems Security Professional (CISSP), Oracle Certified Professional, Cisco Certified Security Professional (CCSP), and many others. Getting certified from a software, database, or network company may open the door to new career possibilities or result in an increase in pay. Some certifications result in even bigger pay increases. Not all certifications, however, provide this financial incentive.

IS Careers in Technology Organizations

In addition to working for an IS department in an organization outside of the technology field, IS personnel can work for large software, hardware, or system services firms, such as Accenture, Dell, Google, IBM, Intel, Hewlett-Packard, Microsoft, and others. Such a career enables an individual to work on the cutting edge of technology, which can be challenging and exciting. Related career opportunities include computer training, computer and computer-equipment sales, computer repair and maintenance, and many others.

As some computer companies cut their services to customers, new companies are being formed to fill the need. With names such as Speak with a Geek and Geek Squad, these companies are helping people and organizations with their computer-related problems that computer vendors are no longer solving.

Working in Teams

Most IS careers involve working in project teams that can consist of many of the positions and roles discussed earlier. Thus, it is always good for IS professionals to have good communications skills and the ability to work with other people. Many colleges and universities have courses in information systems and related areas that require students to work in project teams. At the end of every chapter in this book are "team activities" that require teamwork to complete a project. You may be required to complete one or more of these team-oriented assignments.

Finding a Job in IS

Traditional approaches to finding a job in the information systems area include attending on-campus visits from recruiters and referrals from professors, friends, and family members. Many colleges and universities have excellent programs to help students develop résumés and conduct job interviews. Developing an online résumé can be critical to finding a good job. Many companies accept résumés only online and use software to search for key words and skills used to screen job candidates. Consequently, having the right key words and skills can mean the difference between getting or not getting a job interview. Some corporate recruiters, however, are starting to actively search for employees rather than sifting through thousands of online resumes or posting jobs on their Web sites.[52] Instead, these corporate recruiters do their own Internet searches and check with professional job sites such as *www.linkedin.com*, *www.branchout.com*, and others.[53] Other companies hire college students to help them market products and services to students.[54] In addition to being paid, students can get invaluable career experience. In some cases, it can help them get jobs after graduation. Increasingly, CIOs are becoming actively involved in hiring employees for their IS departments.[55] In the past, many CIOs relied on the company's human resources (HR) department to fill key IS jobs.

Students who use the Internet and other nontraditional sources to find IS jobs have more opportunities to land a job. Many Web sites, such as Monster, Career Builders, Indeed, Simply Hired, Snagged a Job, TheLadders.com, LinkedIn.com, and Computerjobs.com, post job opportunities for Internet careers and more traditional careers. Most large companies list job opportunities on their corporate Web sites. These sites allow prospective job hunters to browse job opportunities, locations, salaries, benefits, and other factors. In addition, some sites allow job hunters to post their résumés. Many people use social networking sites such as Facebook to help get job leads. Corporate recruiters also use the Internet or Web logs (blogs) to gather information on existing job candidates or to locate new job candidates. See Figure 1.37.

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FIGURE **1.37**

Finding an IS job

As with other areas in IS, many top-level administrative jobs, such as Internet systems developers and Internet programmers, are related to the Internet.

In addition, many professional organizations and user groups can be helpful in finding a job, staying current once employed, and seeking new career opportunities. These groups include the Association for Computer Machinery (ACM: *www.acm.org*), the Association of Information Technology Professionals (AITP: *www.aitp.org*), Apple User Groups (*www.apple.com/usergroups*), and Linux users groups located around the world.

Over 150 companies use Twitter to advertise job openings in the advertising/public relations, consulting, consumer products, education, and other industries. Several organizations in the Information Systems industry including Google (@googlejobs), Intel (@jobsatIntel), Microsoft (@Microsoft_Jobs), and (YahooEngRecruiter) also use Twitter to advertise job openings.[56]

People who have quit jobs or been laid off often use informal networks of colleagues or business acquaintances from their previous jobs to help find new jobs.

Students need to review and edit what is posted about them on social media sites as employers often search the Internet to get information about potential employees before they make hiring decisions. A 2012 survey found that 92 percent of respondents either use or plan to use some form of social media—such as Facebook, LinkedIn, or Twitter—in their recruiting.[57] This practice is more common in the hiring of people for law enforcement positions, such as police officers or 911 dispatchers, so that the interviewer can check for possible gang affiliations or any photos or discussion of illegal or questionable activity.[58]

SUMMARY

Principle:

Knowing the potential impact of information systems and having the ability to put this knowledge to work can result in a successful personal career, organizations that reach their goals, and a society with a higher quality of life.

Information systems are sets of interrelated elements that collect (input), manipulate and store (process), and disseminate (output) data and information. Input is the activity of capturing and gathering new data, processing involves converting or transforming data into useful outputs, and output involves producing useful information. Feedback is the output that is used to make adjustments or changes to input or processing activities.

The components of a computer-based information system (CBIS) include hardware, software, databases, telecommunications, people, and procedures.

The types of CBISs that organizations use can be classified into four basic groups: (1) e-commerce and m-commerce, (2) transaction processing and enterprise systems, (3) management information and decision support systems, and (4) specialized business information systems.

E-commerce involves any business transaction executed electronically between parties such as companies (business-to-business), companies and consumers (business-to-consumer), business and the public sector, and consumers and the public sector. E-commerce also offers opportunities for small businesses to market and sell at a low cost worldwide, thus allowing them to enter the global market right from start-up. M-commerce involves anytime, anywhere computing that relies on wireless networks and systems.

The most fundamental system is the transaction processing system (TPS). A transaction is any business-related exchange. The TPS handles the large volume of business transactions that occur daily within an organization. An enterprise resource planning (ERP) system is a set of integrated programs that can manage the vital business operations for an entire multisite, global organization.

A management information system (MIS) uses the information from a TPS to generate information useful for management decision making. A decision support system (DSS) is an organized collection of people, procedures, databases, and devices that help make problem-specific decisions. A DSS differs from an MIS in the support given to users, the emphasis on decisions, the development and approach, and the system components, speed, and output.

Specialized business information systems include knowledge management, artificial intelligence (AI), virtual reality systems, and multimedia systems. Knowledge management systems are organized collections of people, procedures, software, databases, and devices used to create, store, share, and use the organization's knowledge and experience. AI includes a wide range of systems in which the computer takes on the characteristics of human intelligence. Virtual reality is an artificial three-dimensional environment created by hardware and software and experienced through our senses and within which an individual can interact to affect what happens in the environment. Augmented reality, a newer form of virtual reality, has the potential to superimpose digital data over real photos or images. Multimedia is a natural extension of virtual reality. It can include photos and images, the manipulation of sound, and special 3D effects.

Principle:

Information systems must be applied thoughtfully and carefully so that society, business, and industry around the globe can reap their enormous benefits.

Systems development involves creating or modifying existing business systems. The major steps of this process and their goals include investigation

(gain a clear understanding of what the problem is), system analysis (understand the current system and identify the needs of the end users and the organization), system design (determine how the system must work to meet those needs), construction (convert the design into an operational information system), integration and testing (link together all the components of the system to demonstrate that the system meets the user and business requirements), implementation (install the system into a production environment in which it will operate), operation and maintenance (the ongoing running of the system and identifying and making necessary changes), and disposition (those activities at the end of the useful life of the system).

Effective information systems can have a major impact on corporate strategy and organizational success. Businesses around the globe are enjoying better safety and service, greater efficiency and effectiveness, reduced expenses, and improved decision making and control because of information systems. Individuals who can help their businesses realize these benefits will be in demand well into the future.

Success in global markets is imperative today. Global opportunities, however, introduce numerous obstacles and issues, including challenges involving culture and language.

Principle:

Information systems must be implemented in such a manner that they are accepted and work well within the context of an organization and support its fundamental business goals and strategies.

Organizations are systems with inputs, transformation processes, outputs, and feedback data used to monitor and control. Organizations affect and are affected by their environment.

Value-added processes increase the relative worth of the combined inputs on their way to becoming final outputs of the organization. The value chain is a series of activities that an organization performs to transform inputs into outputs in such a way that the value of the input is increased.

The supply chain is a key value chain whose primary activities include inbound logistics, operations, outbound logistics, marketing and sales, and service.

Information systems have transformed the nature of work and the shape of organizations themselves. They are often so intimately involved in the activities of the value chain that they are a part of the process itself.

Innovation is the catalyst for the growth and success of any organization. Innovation may be classified as sustaining or disruptive.

Organizational change deals with how organizations successfully plan for and implement change. The ability to introduce change effectively is critical to the success of any information system project.

Leavitt's diamond proposes that to successfully implement a new information system, appropriate changes must be made to the people, structure, and tasks affected by the new system.

The diffusion of innovation theory explains how a new idea or product gains acceptance and diffuses through a specific population or subset of an organization. A key point of this theory is that adoption of any innovation does not happen all at once for all people; rather it is a drawn out process with some people quicker to adopt the innovation than others. Organizations use information systems to support their goals.

Principle:

Because information systems are so important, businesses need to be sure that improvements or completely new systems help lower costs, increase profits, improve service, or achieve a competitive advantage.

Competitive advantage is a significant and ideally long-term benefit to a company over its competition and can result in higher-quality products, better customer service, and lower costs. Porter's five-forces model covers factors that lead firms to seek competitive advantage: the rivalry among existing competitors, the threat of new market entrants, the threat of substitute products and services, the bargaining power of buyers, and the bargaining power of suppliers. Strategies to address these factors and to attain competitive advantage include cost leadership, differentiation, niche strategy, altering the industry structure, creating new products and services, and improving existing product lines and services, as well as other strategies.

Financial analysis is performed to determine whether a specific information system project is worth doing. Two commonly used approaches include calculating the payback period and the internal rate of return, and calculating the net present value.

Principle:

The information system worker functions at the intersection of business and technology and designs, builds, and implements solutions that allow organizations to effectively leverage information systems.

Successful information system workers need to have a variety of personal characteristics and skills including working well under pressure, good communication skills, solid analytical and decision-making skills, effective team and leaderships, and adeptness at implementing organizational change.

Technology is one of the fastest growing areas in the United States economy, which has a strong demand for information system workers.

The IS organization has three primary functions: operations, development, and support.

Typical operations roles include data center manager, system operators, information system security analyst, and LAN administrator.

Typical development roles include software developer, systems analyst, programmer, and Web developer.

Typical support roles include help desk support specialist and database administrator.

Besides working for an IS department in an organization outside the technology field, IS personnel can work for a large software, hardware, or system services firms. Related career opportunities include computer training, computer and computer-equipment sales, and computer repair and maintenance.

KEY TERMS

artificial intelligence (AI)
cash flow
certification
cloud computing
competitive advantage
computer-based information system (CBIS)
data
database
decision support system (DSS)
diffusion of innovation theory
electronic business (e-business)
electronic commerce (e-commerce)
enterprise resource planning (ERP) system
expert system
extranet
feedback
five-forces model
forecasting
hardware
information
information system (IS)
input
internal rate of return
Internet

intranet
knowledge
knowledge base
Leavitt's diamond
management information system (MIS)
mobile commerce (m-commerce)
networks
organization
organizational change
output
payback period
procedures
process
processing
software
strategic alliance (or strategic partnership)
systems development
technology infrastructure
telecommunications
time value of money
transaction
transaction processing system (TPS)
value chain
virtual reality
World Wide Web (WWW or Web)

CHAPTER 1: SELF-ASSESSMENT TEST

Knowing the potential impact of information systems and having the ability to put this knowledge to work can result in a successful personal career, organizations that reach their goals, and a society with a higher quality of life.

1. Quality information can vary widely in the value of such attributes as accessibility, accuracy, completeness, and timeliness, depending on the situation and the kind of decision you are trying to make. True or False?
2. The _____ of information is directly linked to how it helps decision makers achieve their organization's goals.
3. Two types of software are _____.
   a. transaction processing and management information systems
   b. mobile and stationary
   c. batch processing and online
   d. operating systems and applications
4. Global laptop shipments are forecast to exceed tablet shipments in 2013. True or False?
5. _____ is an organized collection of people, procedures, software, databases, and devices used to create, store, share, and use the organization's experience and knowledge.
   a. TPS (transaction processing system)
   b. MIS (management information system)
   c. DSS (decision support system)
   d. KM (knowledge management)
6. A(n) _____ is a network based on Web technologies that allows selected outsiders, such as business partners and customers, to access authorized resources of a company's intranet.

Information systems must be applied thoughtfully and carefully so that society, business, and industry around the globe can reap their enormous benefits.

7. During the _____ step of the systems development process, it is determined how the system must work, what inputs are required, and what outputs must be produced to meet the defined business needs.
   a. investigation
   b. analysis
   c. design
   d. construction
8. Information systems bring not only many benefits but also many problems and issues. True or False?

Information systems must be implemented in such a manner that they are accepted and work well within the context of an organization and support its fundamental business goals and strategies.

9. Sustaining innovation results in enhancements to existing products, services, and ways of operating. True or False?
10. _____ is an organizational change model that proposes that every organizational system is made up of four main components: people, tasks, structure, and technology.
    a. The technology acceptance model
    b. The diffusion of innovation theory
    c. Leavitt's diamond
    d. Lewin's change model

Because information systems are so important, businesses need to be sure that improvements or completely new systems help lower costs, increase profits, improve service, or achieve a competitive advantage.

11. _____ is *not* one of Porter's five forces that lead firms to seek competitive advantage.
    a. The rivalry among existing competitors
    b. The threat of new market entrants
    c. The threat of government regulation
    d. The threat of substitute products and services
12. The payback method of financial analysis does not consider the time value of money. True or False?

The information system worker functions at the intersection of business and technology and designs, builds, and implements solutions that allow organizations to effectively leverage information systems.

13. The typical information systems organization is divided into three functions including operations, development, and _____.
14. _____ is a process for testing skills and knowledge resulting in an endorsement by the certifying authority that an individual is capable of performing particular tasks or jobs.

CHAPTER 1: SELF-ASSESSMENT TEST ANSWERS

1. True
2. value
3. d
4. False
5. d
6. extranet
7. b
8. True
9. True
10. c
11. c
12. True
13. support
14. Certification

REVIEW QUESTIONS

1. Identify six attributes of quality information.
2. How is data different from information? Information from knowledge?
3. What is knowledge management? How might it be used?
4. Identify the five basic components of any computer based information system.
5. Distinguish between a decision support system and an expert system.
6. What is the difference between an intranet and an extranet?
7. What is m-commerce? Give two examples of the use of m-commerce.
8. Identify the steps in the systems development process and state the goal of each.
9. Identify and briefly discuss several global challenges associated with information systems.
10. What is the difference between a value chain and a supply chain?
11. What is technology diffusion?
12. What are some general strategies employed by organizations to achieve competitive advantage?
13. List and describe popular job-finding Internet sites.
14. Describe the role of the CIO.

DISCUSSION QUESTIONS

1. Why is the study of information systems important to you? What do you hope to learn from this course that will make it worthwhile for you?
2. Describe how you might use information systems in a career area of interest to you.
3. What are the two basic types of software? Give several examples of software you use at school or home.
4. It is said that the amount of digital data is doubling every two years. Discuss some implications and issues associated with this rapid growth of data.
5. Which of your school's information systems is the most difficult for you to deal with? Describe an "ideal" system that would replace this one. Outline the steps that would be needed to implement this "ideal" system. What role might students play in this effort?
6. For an industry of your choice, describe how a CBIS could be used to reduce costs or increase profits.
7. Use your imagination and creativity to describe how virtual reality might be used to help students learn in one of your most challenging courses.
8. If you could have an expert system assist you with decision making in some facet of your life, what would it be? Do you think it would be possible to develop such a system? Defend your answer.

9. Identify several personal characteristics needed to be successful in an information system career. Do you feel that you possess any of these characteristics?
10. Your manager has asked for your input on ideas for how to improve the likelihood of successful adoption of a new information system that members of the company's finance department will use. What would you say?
11. You have been asked to participate in preparing your company's strategic plan. Specifically, your task is to analyze the competitive marketplace using Porter's five-forces model. Prepare your analysis, using your knowledge of a business you have worked for or have an interest in working for.
12. Based on the analysis you performed in Discussion Question 11, what possible strategies could your organization adopt to address these challenges? What role could information systems play in these strategies? Use Porter's strategies as a guide.
13. Describe the advantages and disadvantages of using the Internet to search for a job.
14. Assume you are the chairperson of a committee responsible for replacing the existing CIO of your organization's IS department. What characteristics would you want in a new CIO? How would you go about identifying qualified candidates?

PROBLEM-SOLVING EXERCISES

1. Prepare a data disk (such as a USB drive) and a backup disk for the problem-solving exercises and other computer-based assignments you will complete in this class. Create one folder for each chapter in the textbook (you should have nine folders). As you work through the problem-solving exercises and complete other work using the computer, save your assignments for each chapter in the appropriate folder.
2. Using a database or spreadsheet program, develop a table listing five popular Internet sites for a job search. The table should include columns on any costs of using the site, any requirements such as salary and job type, important features, advantages, and disadvantages.
3. Create a table that lists 10 or more possible career areas, annual salaries, and brief job descriptions, and rate how much you would like the career area on a scale from 1 (don't like) to 10 (like the most). Print the results. Sort the table according to annual salaries from high to low and print the resulting table. Sort the table from the most liked to least liked and print the results.

TEAM ACTIVITIES

1. Before you can do a team activity, you need a team! The class members may self-select their teams, or the instructor may assign members to groups. Once your group has been formed, meet and introduce yourselves to each other. You will need to find out the first name, hometown, major, and email address and phone number of each member. Find out one interesting fact about each member of your team, as well. Come up with a name for your team. Put the information on each team member into a database or spreadsheet and print enough copies for each team member and your instructor.
2. With the other members of your group, use word-processing software to write a summary of the members of your team, the courses each team member has taken, and the expected graduation date of each team member. Send the report to your instructor via email.
3. With your team, research a firm that has achieved a competitive advantage. Write a brief report that describes how the company was able to achieve its competitive advantage.

WEB EXERCISES

1. Throughout this book, you will see how the Internet provides a vast amount of information to individuals and organizations. We will stress the World Wide Web, or simply the Web, which is an important part of the Internet. The address of the Web site for the publisher of this text is *www.course.com*. You can gain access to the Internet through a browser, such as Internet Explorer or Firefox. Using an Internet browser, go to the Web site for this publisher. What did you find? Try to

obtain information on this book. You may be asked to develop a report or send an email message to your instructor about what you found.
2. Do research on the Web to find at least three years of global sales data for tablet computers vs. laptop and/or desktop computers. Use a graphics program to illustrate the sales figures. Write a brief summary of your findings.
3. Use the Internet to search for information about a company that has excellent or poor product quality in your estimation. You can use a search engine, such as Google, or a database at your college or university. Write a brief report describing what you found. What leads to higher quality products? How can an information system help a company produce higher quality products?

CAREER EXERCISES

1. In the Career Exercises found at the end of every chapter, you will explore how material in the chapter can help you excel in your college major or chosen career. Write a brief report on the career that appeals to you the most. Do the same for two other careers that interest you.
2. Do research on an entrepreneur that you admire. Write a brief description of how the individual was able to start a business. What challenges had to be overcome? Did the individual encounter failure before becoming a success?
3. Go to the U.S. Department of Labor's Bureau of Labor Statistics (*www.bls.gov*) Web site, which publishes a list of the fastest-growing occupations. Write a report identifying the five fastest growing occupations. What are the growth opportunities of three careers that are most appealing to you?

CASE STUDIES

Case One

Campbell Uses Technology to Reach Out to the Younger Generation

Soup. Canned soup. It's been around for ages. What could be said about it that hasn't been said? What could be done to improve soup that hasn't already been done—probably when your grandparents were in school?

Soup companies still find room for improvement. Your grandparents may not have cared about using less salt, but you do. Other opportunities for improvement, however, may not involve the product itself but the business processes used to produce and distribute it. Information systems can do a great deal to improve business processes. The challenge a company faces today is to find those opportunities for improvement. These opportunities are not in the same places that senior managers looked for them a decade or two ago.

Joseph Spagnoletti, senior vice president and CIO of Campbell's Soup, is the person who must figure out how to improve business processes at Campbell's. His challenge is to find opportunities for improvement and take advantage of them. Spagnoletti needs to select the most effective software applications for managing basic business processes, such as maintaining the quality of products, fulfilling orders, and shipping.

"The goal is to get the best outcome, for the lowest cost at the fastest speed, with the least amount of risk," says Spagnoletti. To achieve this goal, Campbell's CIO turned to cloud services that allow companies to spend less on buying and maintaining hardware. In 2013, he cut the amount of money he was spending to maintain the company's back-office hardware and software by 80 percent. Back-office software consists of the applications, such as accounting and inventory management, that do not interface with the customers. He invested these funds in consumers and innovation.

One major initiative is to make use of crowdsourcing. Crowdsourcing tools make use of contributions from a large group of people who are accessed through social media and Web and mobile technologies. For example, Spagnoletti contracted with Field Agent LLC, a company that posts assignments for approximately 240,000 consumers. These assignments include conducting price checks, snapping a photo of product display on a smart phone, answering polling questions, or whatever service a company would usually need field agents to perform. Spagnoletti hopes to cut costs and improve Campbell's understanding of their customer's needs.

Spagnoletti is also investing in fun, crowdsourcing marketing initiatives. He has teamed with the marketing department to launch Hack the Kitchen, a contest that invites computer programmers to write code for a Web or mobile tool that helps consumers find good recipes online. The winner receives $25,000 and a $25,000 contract to program for Campbell. By appealing to the online public at large, Campbell hopes to provide innovative online services and so boost its image.

Since assuming the role of Campbell's CEO in 2011, Denise Morrison has reversed declining sales and achieved a 9 percent sales growth in the fourth quarter of 2012. Morrison has introduced a new line of soup called Campbell's Go and new varieties of Campbell's Chunky soup. However, she has also charged Spagnoletti not only with maintaining the information systems necessary for basic business processes, but to develop the type of digital technologies that will appeal to the younger generation of consumers. Clearly, Campbell's sees information systems as vital to its future.

Discussion Questions

1. Spagnoletti received his undergraduate degree in computer science and spent his entire career in

information systems before being appointed Campbell's CIO in August 2008. Given his present responsibilities, do you think that career path is still appropriate for someone who wants to be a CIO today?
2. How is Campbell's making use of crowdsourcing? Do you think these initiatives will help the company appeal to younger consumers? Why, or why not?

Critical Thinking Questions

1. Campbell's is a large company. How can cloud tools work for smaller organizations? Consider three types of organizations: a college with about 2,000 students, the police department of a city with a population of about 250,000, and a family-owned chain of five car dealerships in the same region.
2. Spagnoletti has shifted resources from back-office systems to marketing initiatives. Commenting on this choice, he says, "If your strategies are clear, and you understand the risks to your back office versus the opportunities, it's very easy to make those shifts and it's noticeable." What risks is Spagnoletti taking?

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Case Two

TUI Deutschland Uses Information Systems to Gain a Competitive Advantage

To succeed, a business needs an edge over its competitors: a competitive advantage. A big part of creating a competitive advantage is using information systems effectively, meaning a business can't simply buy computers and expect good results. As Oscar Berg puts it in his blog The Content Economy, "What [creates] competitive advantage is how we use technologies, how we let them affect our practices and behaviors…. If technologies are carefully selected and applied, they can help to create competitive advantage."

This chapter discusses the five forces that define any competitive situation: rivalry among existing firms in an industry, the threats of new competitors and of substitute products/services, and a firm's relationships with suppliers and customers. Firms use these forces to achieve a sustainable competitive advantage, which is one that others cannot copy immediately to eliminate the edge an innovator can have.

TUI Deutschland is Germany's leading tour operator. Targeted pricing is vital in its market, with the travel company that sets prices to accommodate customers' preferences and habits gaining a competitive advantage. For a large tour operator like TUI, setting optimal prices is not easy. Each season, the employee responsible for a particular tour must set around 100,000 prices for each destination region. The factors that affect the final price of hotel rooms, for example, include facilities, types of rooms, arrival dates, and expected demand.

"In the past, decision-making processes were not clear," explains Matthias Wunderlich, head of Business Intelligence at TUI Deutschland GmbH. "There were too many gaps in the system, since the information needed to make pricing decisions was hidden in different places. The result was a pricing process that was complex, laborious, time-consuming, and occasionally inconsistent."

Wunderlich's team developed a new information system to make this process more effective. Used for the first time for the destination of Tenerife, it organizes historical booking data, making relevant information available to pricing specialists. They define the desired margin for a destination and specify parameters for results. The system calculates combinations and dependencies until the optimum result is achieved. It forecasts which group of customers will drive demand for particular accommodations at each point of the season, from coastal hotels for families during the school holidays to luxury hotels with first-class amenities for premium customers during the low season.

"We have to ensure that a four-star hotel, for example, is always cheaper on a given date than a five-star hotel in the same customer segment," explains Wunderlich. "With the new solution, this is guaranteed. There is no need for a time-consuming manual procedure to ensure it is done correctly."

Because the new pricing process is based on customer data, it reflects the needs and habits of customers. A pricing specialist can set prices that are attractive to customers while still achieving desired margins.

"Traditional pricing methods are no longer appropriate for today's travel and tourism market," says Wunderlich. "In the past it was practically impossible to set prices in a way that was flexible and customer-focused. This has all changed. The pricing specialist in effect becomes an expert in a particular customer group and knows exactly what a certain customer is prepared to pay for a certain travel service. This increases profits, but not at the expense of our customers."

Discussion Questions

1. Of the five competitive forces discussed in this case, which do you think TUI's system affects?
2. Has TUI's new information system making pricing fairer for its customers? Why or why not?

Critical Thinking Questions

1. What online travel sites have you used? Do you think they make good use of their data? Why or why not?
2. Consider a bookstore that gives customers a card to be punched for each book they buy. With ten punches, they get a free paperback of their choice. This low-tech system leverages the force of customer power: By promising customers future benefits, it reduces their motivation to switch suppliers even if another store sells books for less. How could a bookstore use technology to make this loyalty program more effective in retaining customers?

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Questions for Web Case

See the Web site for this book to read about the Altitude Online case for this chapter. The following questions cover this Web case.

Altitude Online: Outgrowing Systems

Discussion Questions

1. Why do you think it's a problem for Altitude Online to use different information systems in its branch locations?
2. What information do you think Jon should collect from the branch offices to plan the new centralized information system?

Critical Thinking Questions

1. With Jon's education and experience, he could design and implement a new information system for Altitude Online himself. What would be the benefits and drawbacks of doing the job himself compared to contracting with an information systems contractor?
2. While Jon is visiting the branch offices, how might he prepare them for the inevitable upheaval caused by the upcoming overhaul to the information system?

Altitude Online: Addressing the Needs of the Organization

Discussion Questions

1. What are the advantages of Altitude Online adopting a new ERP system compared to simply connecting existing corporate systems?
2. Why isn't an out-of-the-box ERP system enough for Altitude Online? What additional needs does the company have? Is this the case for businesses in other industries as well?

Critical Thinking Questions

1. Why do you think Jon is taking weeks to directly communicate with stakeholders about the new system?
2. Why do you think Jon and the system administrators decided to outsource the software for this system to an ERP company rather than developing it from scratch themselves?

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Technology

CHAPTERS

2 Hardware and Software

Principles	Learning Objectives
• Computer hardware must be carefully selected to meet the evolving needs of the organization and its supporting information systems.	• Identify and discuss the role of the essential hardware components of a computer system. • Identify the characteristics of and discuss the usage of various classes of single-user and multiuser computer systems.
• The computer hardware industry and users are implementing green computing designs and products as well as modern data centers.	• Define the term green computing and identify the primary goals of this program. • Identify several benefits of green computing initiatives that have been broadly adopted. • Identify some of the challenges and tradeoffs that must be considered in implementing a data center.
• Systems and application software are critical in helping individuals and organizations achieve their goals.	• Identify and briefly describe the functions of the two basic kinds of software. • Outline the role of the operating system and identify the features of several popular operating systems.
• Organizations use off-the-shelf application software for common business needs and proprietary application software to meet unique business needs and provide a competitive advantage.	• Discuss how application software can support personal, workgroup, and enterprise business objectives. • Identify three basic approaches to developing application software and discuss the pros and cons of each.
• Organizations should choose a programming language whose functional characteristics are appropriate for the task at hand, considering the skills and experience of the programming staff.	• Outline the overall evolution and importance of programming languages and clearly differentiate among the generations of programming languages.
• The software industry continues to undergo constant change; users need to be aware of recent trends and issues to be effective in their business and personal life.	• Identify several key software issues and trends that have an impact on organizations and individuals.

Information Systems in the Global Economy
FUJITSU, JAPAN

Supercomputers Are Not Just for Research Anymore

Kyodo/Landov

For decades, only governments and large research institutions used supercomputers, the most powerful computers with the fastest processing speed and highest performance. With the most extensive and rapid computational capabilities, supercomputers supported research in quantum mechanics, molecular modeling, climate, and other scientific fields. Even today, most supercomputers are deployed for scientific research. Fujitsu, for example, is a Japan-based IT and communications multinational corporation and one of the leading manufacturers of supercomputers. In 2013, Fujitsu announced the launch of two supercomputer projects: the ACA Correlator for a Chile-based radio telescope; and Raijin, a supercomputer named after the Japanese god of thunder that will run complex weather and climate modeling. Raijin has the ability to perform the same number of calculations in one hour that it would take 7 billion people, armed with calculators, to perform in 20 years. This same year, other government-sponsored research institutions placed orders for supercomputers.

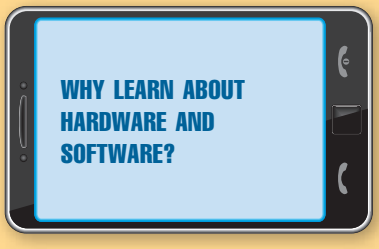
However, among Fujitsu's 2013 announcements came the notice that Canon, the long-time camera maker and today the leading multinational supplier of laser printers, copying machines, and paper management systems, would be purchasing a Fujitsu supercomputer. The event was unusual enough that several IT analysts picked up the story. What would Canon be doing with a supercomputer?

It turns out that Canon will use the supercomputer as part of its initiative to develop "prototypeless design." A prototype is a physical model of a new product that takes a great deal of time and money to build. Yet building a prototype is necessary so that companies can check whether a product can function in the ways the designers intended without glitches. In the high-tech world, these prototypes have become smaller and increasingly more sophisticated—making the process of building one even more of a challenge. By using Fujitsu's supercomputer to replace physical prototypes with virtual prototyping and analytical simulations, Canon will gain a competitive advantage—a faster, better, cheaper method of developing new products. Canon chose not just any supercomputer, but an updated version of Fujitsu's K computer, which until very recently was the fastest supercomputer in the world and still has relatively low power consumption. Selecting the K computer helps Canon meet its commitment to environment-friendly production.

Canon is not the first corporation to purchase a supercomputer. In fact, in 2004 IBM sold a supercomputer to pharmaceutical company Bristol-Myers Squibb; even though at a billion dollars per K computer, not a lot of corporations could afford them. In 2012, however, sales for supercomputers rocketed by 30 percent as prices dropped as low as half a billion per machine. Companies including PayPal and Procter & Gamble also bought their own supercomputers. Fujitsu's K computer will allow Canon to cuts its development costs, and as prices continue to decline, other companies will no doubt find ways to use supercomputers to gain a strategic advantage.

As you read this chapter, consider the following:

- What major competitive advantage does Canon gain from its purchase of the supercomputer?
- Is the way we use hardware, such as supercomputers, changing? If so, how?
- What impact does the decreasing cost of hardware over time have on its use in the corporate world?



Organizations invest in computer hardware and software to improve worker productivity, increase revenue, reduce costs, and provide better customer service. Those that don't may be stuck with outdated hardware and software that is unreliable and cannot take advantage of the latest advances. As a result, obsolete hardware and software can place an organization at a competitive disadvantage. Managers, no matter what their career field and educational background, are expected to know enough about their business needs to be able to ask tough questions of those recommending the hardware and software to meet those needs. This is especially true in small organizations that might not have information systems specialists. Cooperation and sharing of information between business managers and IT managers is needed to make wise IT investments that yield real business results. Managers in marketing, sales, and human resources often help IS specialists assess opportunities to apply hardware and software and evaluate the various options and features. Managers in finance and accounting especially must also keep an eye on the bottom line, guarding against overspending, yet be willing to invest in computer hardware and software when and where business conditions warrant it.

Today's use of technology must be practical and yield real business benefits, as demonstrated in the opening vignette by the use of supercomputers at Canon, Bristol-Myers Squibb, PayPal, and Procter & Gamble. Employing information technology and providing additional processing capabilities can increase employee productivity, expand business opportunities, and allow for more flexibility. This chapter discusses the hardware and software components of a computer-based information system (CBIS). Recall that hardware refers to the physical components of a computer that perform the input, processing, storage, and output activities of the computer. Software consists of the computer programs that govern the operation of the computer. When making hardware and software decisions, the overriding consideration of a business should be how the hardware and software can support the objectives of the information system and the goals of the organization.

COMPUTER SYSTEMS: INTEGRATING THE POWER OF TECHNOLOGY

People involved in selecting their organization's computer hardware must clearly understand current and future business requirements so that they can make informed acquisition decisions. Consider the following examples of applying business knowledge to reach sound decisions on acquiring hardware:

- The city of Bunbury in western Australia decided to upgrade its servers, storage systems, network, and associated software from multiple suppliers to hardware from a single vendor. The goal was to reduce future hardware replacement costs, cut power consumption, and lessen the effort required to manage the multiple devices used to sustain the city's information systems.[1]
- Jason De Vos does video editing for projects such as live streaming Lollaplooza, ACL Fest, and JazzFest music festivals. His work must be of the highest quality and yet still be completed on an extremely tight schedule, often as short as a few hours. Based on these requirements,

Jason uses powerful workstations that are dependable and can complete the vast amount of processing required for video editing in the least amount of time.[2]

As these examples demonstrate, choosing the right computer hardware requires understanding its relationship to the information systems and the current and future needs of the organization.

HARDWARE COMPONENTS

central processing unit (CPU): The part of the computer that consists of three associated elements: the arithmetic/logic unit, the control unit, and the register areas.

arithmetic/logic unit (ALU): The part of the CPU that performs mathematical calculations and makes logical comparisons.

Computer system hardware components include devices that perform the functions of input, processing, data storage, and output. See Figure 2.1.

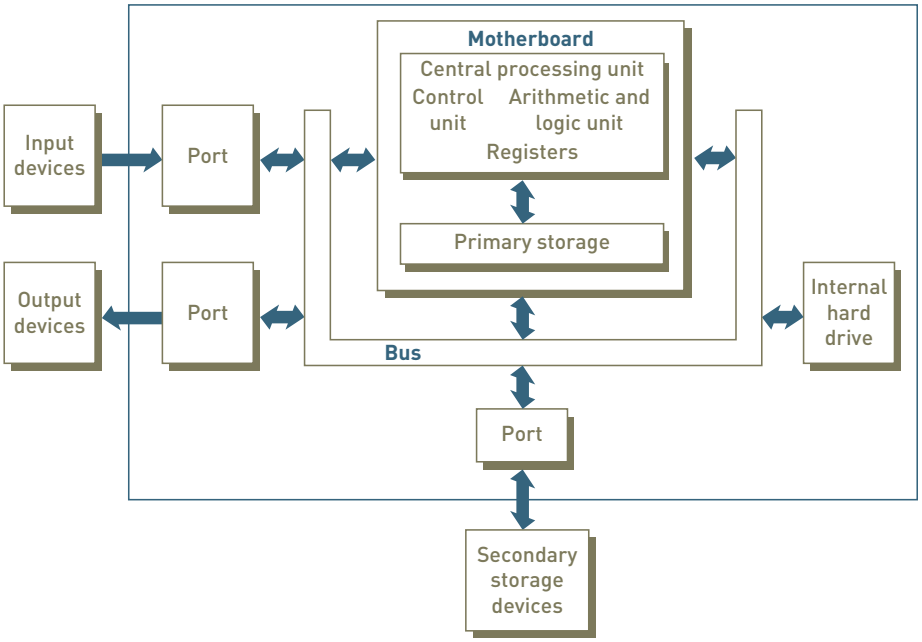


FIGURE **2.1**

Hardware components

These components include the input devices, output devices, ports, bus, primary and secondary storage devices, and the central processing unit (CPU). The control unit, the arithmetic/logic unit (ALU), and the register storage areas constitute the CPU.

control unit: The part of the CPU that sequentially accesses program instructions, decodes them, and coordinates the flow of data in and out of the ALU, the registers, the primary storage, and even secondary storage and various output devices.

register: High-speed storage area used to temporarily hold small units of program instructions and data immediately before, during, and after execution by the CPU.

bus: A bus is a set of physical connections (such as cables and printed circuits) that can be shared by multiple hardware components so they can communicate with one another.

primary storage (main memory; memory): Holds program instructions and data, is closely associated with the CPU.

The ability to process (organize and manipulate) data is a critical aspect of a computer system, in which processing is accomplished by an interplay between one or more of the central processing units and primary storage. Each **central processing unit (CPU)** consists of three primary elements: the arithmetic/logic unit, the control unit, and storage registers. The **arithmetic/logic unit (ALU)** performs mathematical calculations and makes logical comparisons. The **control unit** sequentially accesses program instructions, decodes them, and coordinates the flow of data in and out of the ALU, primary storage, and even secondary storage and various output devices. **Registers** are high-speed storage areas used to temporarily hold small units of program instructions and data immediately before, during, and after execution by the CPU. A **bus** is a set of physical connections (such as cables and printed circuits) that can be shared by multiple hardware components so they can communicate with one another. **Primary storage**, also called **main memory** or **memory**, holds program instructions and data, is closely associated with the CPU.

Now that you have learned about the basic hardware components and the way they function, you are ready to examine processing power, speed, and capacity. These three attributes determine the capabilities of a hardware device.

PROCESSING AND MEMORY DEVICES: POWER, SPEED, AND CAPACITY

The components responsible for processing—the CPU and memory—are housed together in the same box or cabinet, called the *system unit*. All other computer system devices, such as the monitor and keyboard, are linked either directly or indirectly into the system unit housing. As discussed previously, achieving IS objectives and organizational goals should be the primary consideration in selecting processing and memory devices. In this section, we investigate the characteristics of these important devices.

Processing Characteristics and Functions

Because efficient processing and timely output are important, organizations use a variety of measures to gauge processing speed. These measures include the time it takes to complete a machine cycle, clock speed, and others.

Clock Speed

clock speed: A series of electronic pulses produced at a predetermined rate that affects machine cycle time.

gigahertz (GHz): Billions of cycles per second, a measure of clock speed.

Each CPU produces a series of electronic pulses at a predetermined rate, called the **clock speed**, which affects machine cycle time. The control unit executes an instruction in accordance with the electronic cycle, or pulses of the CPU "clock." Each instruction takes at least the same amount of time as the interval between pulses. The shorter the interval between pulses, the faster each instruction can be executed. The clock speed for personal computers is measured in the range of multiple **gigahertz (GHz)**, or billions of cycles per second.

Memory Characteristics and Functions

Located physically close to the CPU (to decrease access time), memory provides the CPU with a working storage area for program instructions and data. The chief feature of memory is that it rapidly provides the data and instructions to the CPU.

Storage Capacity

byte (B): Eight bits that together represent a single character of data.

Like the CPU, memory devices contain thousands of circuits imprinted on a silicon chip. Each circuit is either conducting electrical current (on) or not (off). Data is stored in memory as a combination of on or off circuit states. Usually 8 bits are used to represent a character, such as the letter A. Eight bits together form a **byte (B)**. In most cases, storage capacity is measured in bytes, with 1 byte equivalent to one character of data. The contents of the Library of Congress, with more than 126 million items and 530 miles of bookshelves, would require about 20 petabytes of digital storage. To store a yottabyte on terabyte-size hard drives would require ten billion city block size data-centers that would cover an area the size of the states of Delaware and Rhode Island. Table 2.1 lists units for measuring computer storage capacity.

Types of Memory

random access memory (RAM): A form of memory in which instructions or data can be temporarily stored.

Several forms of memory are available. Instructions or data can be temporarily stored in **random access memory (RAM)**. RAM is temporary and volatile—RAM chips lose their contents if the current is turned off or disrupted (as in a power surge, brownout, or electrical noise generated by lightning or nearby machines). RAM chips are mounted directly on the computer's main circuit

TABLE 2.1 Computer storage units

Name	Abbreviation	Number of Bytes
Byte	B	1
Kilobyte	KB	1,000
Megabyte	MB	$1,000^2$
Gigabyte	GB	$1,000^3$
Terabyte	TB	$1,000^4$
Petabyte	PB	$1,000^5$
Exabyte	EB	$1,000^6$
Zettabyte	ZB	$1,000^7$
Yottabyte	YB	$1,000^8$

board or in chips mounted on peripheral cards that plug into the computer's main circuit board. These RAM chips consist of millions of switches that are sensitive to changes in electric current.

read-only memory (ROM): A nonvolatile form of memory.

Read-only memory (ROM), another type of memory, is nonvolatile. In ROM, the combination of circuit states is fixed, and therefore its contents are not lost if the power is removed. ROM provides permanent storage for data and instructions that do not change, such as programs and data from the computer manufacturer, including the instructions that tell the computer how to start up when power is turned on.

Multiprocessing

multiprocessing: The simultaneous execution of two or more instructions at the same time.

There are a number of forms of **multiprocessing**, which involves the simultaneous execution of two or more instructions.

Multicore Microprocessors

multicore microprocessor: A microprocessor that combines two or more independent processors into a single computer so that they share the workload and improve processing capacity.

A **multicore microprocessor** combines two or more independent processors into a single computer so that they share the workload and boost processing capacity. A dual-core processor is like a four-lane highway—it can handle up to twice as many cars as its two-lane predecessor without making each car drive twice as fast. In addition, a dual-core processor enables people to perform multiple tasks simultaneously such as playing a game and burning a CD. AMD and Intel are battling for leadership in the multicore processor marketplace with both companies offering quad-core, six-core, and eight-core CPU chips that can be used to build powerful personal computers. Apple has redesigned its Mac Pro computer based on one 12-core Intel Xeon E5 CPU chip.[3]

When selecting a CPU, organizations must balance the benefits of processing speed with energy requirements, size, and cost. CPUs with faster clock speeds and shorter machine cycle times require more energy to dissipate the heat generated by the CPU and are bulkier and more expensive than slower ones.

Chip designers and manufacturers are exploring various means to avoid heat problems in their new designs. ARM is a computer chip design company whose energy-efficient chip architecture is broadly used in smartphones and tablet computers. Intel expects to begin producing computer processor chips based on a new 3D technology that will cut chip power consumption in half,

making the chips ideal for use in the rapidly growing smartphone and tablet computer market.

Parallel Computing

parallel computing: The simultaneous execution of the same task on multiple processors to obtain results faster.

Another form of multiprocessing, called **parallel processing**, speeds processing by linking several processors to operate at the same time, or in parallel. The most frequent uses for parallel computing include modeling, simulation, and analyzing large amounts of data. For example, parallel computing is used in medicine to develop new imaging systems that can complete ultrasound scans in less time with greater accuracy, enabling doctors to provide better, more timely diagnosis to patients. Instead of building physical models of new products, engineers can create virtual models and use parallel computing to test how the products work and then change design elements and materials as needed. The Blue Waters supercomputer is one of the most powerful computers in the world and can perform 1 quadrillion computations per second. Its peak speed is over 3 million times faster than the typical laptop computer. The computer is an example of a **massively parallel processing system** that employs over 26,000 processors working together to support scientific and engineering research projects from predicting the behavior of complex biological systems to the simulation of the evolution of the cosmos.[4]

massively parallel processing system: A form of multiprocessing that speeds processing by linking hundreds or thousands of processors to operate at the same time, or in parallel, with each processor having its own bus, memory, disks, copy of the operating system, and applications.

Grid Computing

grid computing: The use of a collection of computers, often owned by multiple individuals or organizations, to work in a coordinated manner to solve a common problem.

Grid computing is the use of a collection of computers, often owned by many people or organizations, to work in a coordinated manner to solve a common problem. Grid computing is one low-cost approach to parallel processing. The grid can include dozens, hundreds, or even thousands of computers that run collectively to solve extremely large parallel processing problems. Key to the success of grid computing is a central server that acts as the grid leader and traffic monitor. This controlling server divides the computing task into subtasks and assigns the work to computers on the grid that have (at least temporarily) surplus processing power. The central server also monitors the processing, and if a member of the grid fails to complete a subtask, the server will restart or reassign the task. When all the subtasks are completed, the controlling server combines the results and advances to the next task until the whole job is completed.

The World Community Grid is an ongoing project dedicated to building the world's largest public computing grid to tackle projects that benefit humanity. The effort is funded and operated by IBM and includes over 450 organizations and nearly 70,000 registered users. Participants download and install a small program on their computer so that during the computer's idle time, it can request data from the World Community Grid's server, perform computations on this data, and send the results back to the server. Projects running on the World Community Grid include analyzing various aspects of AIDS, cancer, clean water, malaria, and rice crop yields, and identifying compounds that are promising to solar power developers.[5,6]

SECONDARY STORAGE AND INPUT AND OUTPUT DEVICES

As you have seen, memory is an important factor in determining overall computer system power. However, memory provides only a small amount of storage area for the data and instructions the CPU requires for processing. Computer systems also need to store larger amounts of data, instructions, and information more permanently than main memory allows. Secondary storage, also called *permanent storage,* serves this purpose.

Compared with memory, secondary storage offers the advantages of nonvolatility, greater capacity, and greater economy. Most forms of secondary storage are considerably less expensive than memory. As Table 2.2 shows,

TABLE 2.2 Cost comparison for various forms of storage

Data Storage Type	Cost per GB			
	2006	2009	2011	2013
1 TB desktop external hard drive	DNA	$0.12	$0.09	$0.10
25 GB rewritable Blu-ray disc	DNA	$0.44	$0.11	$0.30
500 GB portable hard drive	DNA	$0.23	$0.15	$0.12
72 GB DAT 72 data cartridge	$0.77	$0.21	$0.24	$0.26
50 4.7 GB DVD+R discs	$5.32	$0.09	$0.31	$0.07
8 GB flash drive	$99.99	$2.50	$2.48	$1.25
9.1 GB write-once, read-many optical disc	$10.51	$9.99	$8.12	$7.14
2 GB DDR2 SDRAM computer memory upgrade	$138.46	$25.00	$15.95	$8.00

Source: Office Depot Web site, *www.officedepot.com*, February 5, 2006, December 2009, October 2011, and October 2013; DNA = data not available.

the cost per GB of storage continues to decline over time. Because of the electromechanical processes involved in using secondary storage, however, it is considerably slower than primary storage, or memory. The selection of secondary storage media and devices requires understanding their major characteristics—access method, capacity, and portability.

Access Methods

sequential access: A retrieval method in which data must be accessed in the order in which it is stored.

direct access: A retrieval method in which data can be retrieved without the need to read and discard other data.

Data and information access can be either sequential or direct. **Sequential access** means that data must be accessed in the order in which it is stored. For example, inventory data stored sequentially may be stored by part number, such as 100, 101, and 102. If you want to retrieve information on part number 125, you need to read and discard all the data relating to parts 001 through 124.

Direct access means that data can be retrieved directly, without having to pass by other data in sequence. With direct access, it is possible to go directly to and access the needed data—such as part number 125—without reading through parts 001 through 124. For this reason, direct access is usually faster than sequential access. The devices used to sequentially access secondary storage data are called **sequential access storage devices (SASDs)**; those used for direct access are called **direct access storage devices (DASDs)**.

sequential access storage device (SASD): A device used to sequentially access secondary storage data.

direct access storage device (DASD): A device used for direct access of secondary storage data.

Secondary Storage Devices

The most common forms of secondary storage devices are magnetic, optical, and solid state. Some of these media (magnetic tape) allow only sequential access, while others (magnetic and optical discs) provide direct and sequential access.

Magnetic Tapes

magnetic tape: A type of sequential secondary storage medium, now used primarily for storing backups of critical organizational data in the event of a disaster.

One common secondary storage medium is **magnetic tape**. Magnetic tape is a Mylar film coated with iron oxide, and portions of the tape are magnetized to represent bits. Magnetic tape is a sequential access storage medium. Although access is slower, magnetic tape is usually less expensive than disk storage. Magnetic tape is often used to back up disk drives and to store data off-site for recovery in case of disaster. Technology is improving to provide tape storage devices with greater capacities and faster transfer speeds. Large, bulky tape drives have been replaced with much smaller tape cartridge devices measuring a few millimeters in diameter that take up much less floor space and allow hundreds of tape cartridges to be stored in a small area. Over 380 petabytes of magnetic tape storage supports the Blue Waters supercomputer mentioned previously.[7] See Figure 2.2.

Courtesy of Deutsches Klimarechenzentrum GmbH

FIGURE **2.2**

Robotic tape backup system

The National Center for Atmospheric Research uses a robotic tape backup system to back up the supercomputer that solves the world's most computationally intensive climate modeling problems.

Magnetic Disks

hard disk drive (HDD): A direct access storage device used to store and retrieve data from rapidly rotating disks coated with magnetic material.

magnetic disk: A direct access storage device, with bits represented by magnetized areas.

A **hard disk drive (HDD)** is a direct access storage device used to store and retrieve data from rapidly rotating disks coated with magnetic material. See Figure 2.3. As with magnetic tape, **magnetic disks** represent bits using small magnetized areas. Magnetic disks are direct access storage devices that enable fast data retrieval and are used by companies that need to respond quickly to customer requests. For example, if a manager needs information on the credit history of a customer or the seat availability on a particular flight, the information can be obtained in seconds if the data is stored on a direct access storage device.

FIGURE **2.3**

Hard disk drive

A hard disk drive provides direct access to stored data. The read/write head can move directly to the location of a desired piece of data, dramatically reducing access times compared to magnetic tape.

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As with other computer system components, the access methods, storage capacities, and portability required of secondary storage media are determined by the information system's objectives. An objective of a credit card company's information system might be to rapidly retrieve stored customer data to approve customer purchases. In this case, a fast access method is critical. In other cases, such as equipping the Coca-Cola field sales force with pocket-sized personal computers, portability and storage capacity might be major considerations in selecting and using secondary storage media and devices.

IBM recently built a huge data repository consisting of 200,000 conventional HDDs working together to provide a storage capacity of 120 petabytes—large enough to hold 60 copies of the 150 billion pages needed to back up the Web. An unnamed client is using the storage device with a supercomputer to perform detailed simulations of real-world events such as weather forecasts, seismic processing for the petroleum industry, and molecular studies of genomes or proteins.[8]

RAID

Companies' data storage needs are expanding rapidly. Today's storage configurations routinely entail many hundreds of gigabytes. However, putting an organization's data online involves a serious business risk—the loss of critical data can put a corporation out of business. The concern is that the most critical mechanical components inside a HDD storage device—the disk drives, fans, and read/write heads—can fail. Thus organizations now require that their data storage devices be fault tolerant, that is, they can continue with little or no loss of performance if one or more key components fail.

redundant array of independent/inexpensive disks (RAID): A method of storing data that generates extra bits of data from existing data enabling the system to create a "reconstruction map" so that if a hard drive fails, the system can rebuild lost data.

A **redundant array of independent/inexpensive disks (RAID)** is a method of storing data that generates extra bits of data from existing data, enabling the system to create a "reconstruction map" so that if a hard drive fails, it can rebuild lost data. With this approach, data can be split and stored on different physical disk drives using a technique called *striping* to evenly distribute the data. RAID technology has been applied to storage systems to improve system performance and reliability.

disk mirroring: A process of storing data that provides an exact copy that protects users fully in the event of data loss.

RAID can be implemented in several ways. RAID 1 subsystems duplicate data on the hard drives. This process, called **disk mirroring**, provides an exact copy that protects users fully in the event of data loss. However, to keep complete duplicates of current backups, organizations need to double their storage capacity. Other RAID methods are less expensive because they duplicate only part of the data, allowing storage managers to minimize the amount of extra disk space they must purchase to protect data.

Patients of the Gila Regional Medical Center in Silver City, New Mexico, come to the radiology department for x-rays, ultrasounds, CAT scans, and MRIs. These scans comprised some 600 gigabytes of data stored on 80 double-sided DVDs. The medical center upgraded from DVDs to RAID storage devices to provide the radiologists with fast access to the complete set of all medical images. RAID also provided additional back-up capabilities to reduce the risk of any lost images.[9]

Virtual Tape

virtual tape: A storage device for less frequently needed data so that it appears to be stored entirely on tape cartridges, although some parts of it might actually be located on faster hard disks.

Virtual tape is a storage technology for less frequently needed data so that it appears to be stored entirely on tape cartridges, although some parts might actually be located on faster hard disks. The software associated with a virtual tape system is sometimes called a *virtual tape server*. Virtual tape can be used with a sophisticated storage-management system that moves data to slower but less costly forms of storage media as people use the data less often. Virtual tape technology can decrease data access time, lower the total cost of ownership, and reduce the amount of floor space consumed by tape operations.

Storage Area Networks

storage area network (SAN): A high-speed, special-purpose network that integrates different types of data storage devices (e.g. hard disk drives, magnetic tape, solid state secondary storage devices) into a single storage system and connects that to computing resources across an entire organization.

A **storage area network (SAN)** is a high-speed, special-purpose network that integrates different types of data storage devices (e.g., hard disk drives, magnetic tape, solid state secondary storage devices) into a single storage system and connects that to computing resources across an entire organization. See Figure 2.4. SANs can provide important capabilities such as disk mirroring, data backup and restore, data archiving, data migration from one storage device to another, and the sharing of data among computing devices connected to the network.

Using a SAN, an organization can centralize the people, policies, procedures, and practices for managing storage, and a data storage manager can apply these data practices consistently across an enterprise. This centralization eliminates inconsistent treatment of data by different system administrators and users, providing efficient and cost-effective data storage practices.

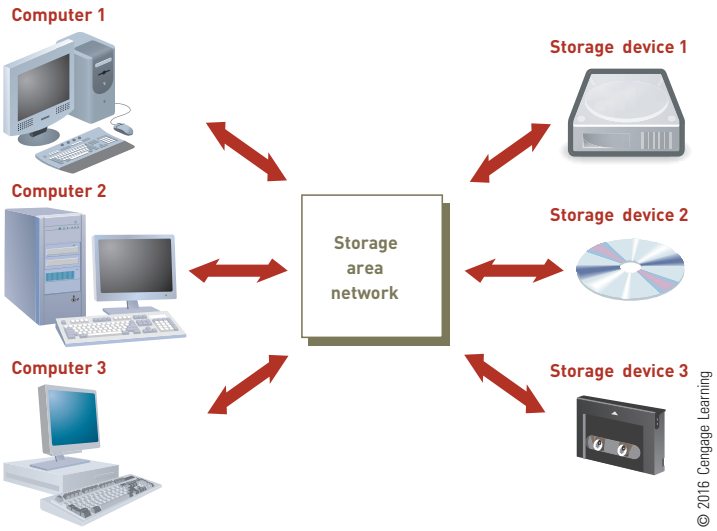

FIGURE **2.4**

Storage area network

A SAN provides high-speed connections among data-storage devices and computers over a network.

Revlon is a global manufacturer and seller of beauty products in over 100 countries on six continents. The firm implemented a SAN to meet its data storage needs in a simple, standard manner. The SAN has helped Revlon reduce the time to deliver projects and decreased hardware investment costs by over $70 million compared to other storage solutions.[10]

Optical Discs

compact disc read-only memory (CD-ROM): A common form of optical disc on which data cannot be modified once it has been recorded.

A common optical disc is the **compact disc read-only memory (CD-ROM)** with a storage capacity of 740 MB of data. After data is recorded on a CD-ROM, it cannot be modified—the disc is "read-only." A CD burner, the informal name for a CD recorder, is a device that can record data to a compact disc. *CD-recordable (CD-R)* and *CD-rewritable (CD-RW)* are the two most common types of drives that can write CDs, either once (in the case of CD-R) or repeatedly (in the case of CD-RW). CD-rewritable (CD-RW) technology allows PC users to back up data on CDs.

digital video disc (DVD): A storage medium used to store software, video games, and movies.

A **digital video disc (DVD)** is a five-inch diameter CD-ROM look-alike with the ability to store about 135 minutes of digital video or several gigabytes of data. Software programs, video games, and movies are common uses for this storage medium.

DVDs have replaced recordable and rewritable CD discs (CD-R and CD-RW) as the preferred format for sharing movies and photos. Whereas a CD can hold about 740 MB of data, a single-sided DVD can hold 4.7 GB, with double-sided DVDs having a capacity of 9.4 GB. Recordings can be made on record-once discs (DVD-R and DVD+R) or on rewritable discs (DVD-RW, DVD+RW, and DVD-RAM). Not all types of rewritable DVDs are compatible with other types.

The Blu-ray high-definition video disc format based on blue-laser technology stores at least three times as much data as a DVD now holds. The primary use for this new format is in home entertainment equipment to store high-definition video, though this format can also store computer data.

The Holographic Versatile Disc (HVD) is an advanced optical disc technology still in the development stage that will store more data than even the Blu-ray optical disc system. HVD is the same size and shape as a regular DVD but can hold 1 terabyte (or more) of information.

Solid State Secondary Storage Devices

Solid state storage devices (SSDs) store data in memory chips rather than magnetic or optical media. These memory chips require less power and provide faster data access than magnetic data-storage devices. In addition, SSDs have few moving parts, so they are less fragile than hard disk drives.

All these factors make the SSD a preferred choice for portable computers. Two current disadvantages of SSD are their high cost per GB of data storage (roughly a 5 : 1 disadvantage compared to hard disks) and lower capacity compared to current hard drives. SSD is a rapidly developing technology, and future improvements will lower their cost and increase their capacity.

A universal serial bus (USB) flash drive is one example of a commonly used SSD. See Figure 2.5. USB flash drives are external to the computer and are removable and rewritable. Most weigh less than an ounce and can provide a wide range of storage capacity. Samsung announced solid state storage drives available with capacities from 120 GB to 1,000 GB.[11]

FIGURE **2.5**

Flash drive

Flash drives are solid state storage devices.

Storage as a Service

storage as a service: Storage as a service is a data storage model where a data storage service provider rents space to individuals and organizations.

Storage as a service is a data storage model in which a data storage service provider rents space to people and organizations. Users access their rented data storage via the Internet. Such a service enables the users to store and back up their data without requiring a major investment to create and maintain their own data storage infrastructure. Businesses can also choose pay-per-use services, where they rent space on massive storage devices housed either at a service provider (such as Hewlett-Packard or IBM) or on the customer's premises, paying only for the amount of storage they use. This approach is sensible for organizations with wildly fluctuating storage needs, such as those involved in the testing of new drugs or in developing software.

Individuals and organizations must be able to access data, documents, databases, presentations, and spreadsheets from anywhere with any sort of Internet-enabled device such as a smartphone, tablet computer, or laptop. In response to this need, numerous cloud-based storage services have emerged, including Amazon's Elastic Compute Cloud, Apple iCloud, Dropbox, Google Drive, Microsoft SkyDrive, and Mozy. These services provide data storage at a rate of $2 or less per gigabyte a year. However, some storage services will not work with the operating systems on some computing devices, so consumers should make sure that their smartphone, tablet, or other device is compatible before subscribing.[12] Amazon's Simple Storage Service allows uploading, storage, and downloading of practically any file or object up to 5 gigabytes (GB). The subscriber data is stored on redundant servers across multiple data centers. Subscribers can choose to label their data private or make it publicly accessible. Users can also elect to encrypt data prior to storage.

A Mozy customer who had his laptop stolen was able to provide police with photos of the thief because Mozy continued to back up data after the laptop was stolen, including the thief's photos and documents. The customer accessed the photos from his online storage site, and police captured the thief and returned the laptop.[13]

The overall trend in secondary storage is toward use of direct access methods, higher capacity, and increased portability. The needs of businesses

and individual users should be considered when selecting a specific type of storage. In general, the ability to store large amounts of data and information and access it quickly can increase organizational effectiveness and efficiency.

Input Devices

Data entry and input devices come in many forms. They range from special-purpose devices that capture specific types of data to more general-purpose input devices. Some of the special-purpose data entry and input devices are discussed later in this chapter. First, we focus on devices used to enter and input general types of data, including text, audio, images, and video for personal computers.

Common Personal Computer Input Devices

A keyboard and a computer mouse are the most common devices used for entry and input of data such as characters, text, and basic commands. Some companies manufacture keyboards that are more comfortable, more easily adjusted, and faster to use than standard keyboards. These ergonomic keyboards, such as the split keyboard, are designed to avoid wrist and hand injuries caused by hours of typing. Other keyboards include touchpads that let you enter sketches on the touchpad while still using keys to enter text. Other innovations are wireless mice and keyboards, which keep a physical desktop free from clutter. See Figure 2.6.

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FIGURE **2.6**

Drawing pad and integrated keyboard

A drawing pad and integrated keyboard can replace a traditional keyboard and mouse for input.

You use a computer mouse to point to and click symbols, icons, menus, and commands on the screen. The computer takes a number of actions in response, such as entering data into the computer system.

Speech-Recognition Technology

speech-recognition technology: Input devices that recognize human speech.

Using **speech-recognition technology**, the computer can interpret human speech as an alternative means of providing data or instructions. The most basic systems are designed to support a limited conversation on a fixed topic. For example, your insurance provider may employ a speech-recognition system to support calls to its billing department. The scope of the conversation is very limited and the caller is guided to make one of a few possible and very distinct responses. For example, a typical prompt is "Do you wish to inquire about your monthly bill or make a payment?" More advanced systems can recognize continuous speech and convert it to text as in closed-caption live TV broadcasts, sometimes with amusing results when key words are not properly converted to text.

Maxwell Winward, one of the top law firms in the United Kingdom, employs speech-recognition technology to convert its attorneys' dictation directly into text, thus eliminating workflow bottlenecks and freeing up support personnel to undertake a broader range of work.[14]

Motion-Sensing Input Devices

The major video game makers Nintendo, Microsoft, and PlayStation have come out with game controllers based on motion-sensing input devices. These manufacturers hope that their motion-sensing input devices will broaden their user base beyond the typical gamer and increase their market share. However, such input devices may also prove useful in the operation of business information systems.

Digital Cameras

digital camera: An input device used with a PC to record and store images and video in digital form.

Digital cameras record and store images or video in digital form, so when you take pictures, the images are electronically stored in the camera. You can download the images to a computer either directly or transfer them by using a flash memory card, and then edit and print the images, send them to another location, or paste them into another application. For example, you can download a photo of your project team captured by a digital camera and then post it on a Web site or paste it into a project status report. Digital cameras have eclipsed film cameras used by professional photographers for photo quality and features such as zoom, flash, exposure controls, special effects, and even video-capture capabilities. With the right software, you can add sound and handwriting to the photo. Many computers, smartphones, and even cell phones come equipped with a digital camera to enable their users to place video calls and take pictures and videos.

Canon, Casio, Nikon, Olympus, Panasonic, Pentax, Sony, and other camera manufacturers offer full-featured, high-resolution digital camera models at prices ranging from $150 to $3500. Some manufacturers offer pocket-sized camcorders for less than $100.

Scanning Devices

Scanning devices capture image and character data. A page scanner is like a copy machine. You either insert a page into the scanner or place it face down on the glass plate of the scanner and then scan it. With a handheld scanner, you manually move or roll the scanning device over the image you want to scan. Both page and handheld scanners can convert monochrome or color pictures, forms, text, and other images into machine-readable digits. Considering that U.S. enterprises generate an estimated 1 billion pieces of paper daily, many companies are looking to scanning devices to help them manage their documents and reduce the high cost of using and processing paper.

The NeatReceipt filing system is a compact, portable scanner and associated software that enable the user to scan business cards and convert them into digital contacts. NeatReceipt can also scan receipts to convert them into records of vendors and amounts that can be used for tax preparation.[15]

Optical Data Readers

You can also use a special scanning device called an *optical data reader* to scan documents. The two categories of optical data readers are optical mark recognition (OMR) and optical character recognition (OCR). You use OMR readers for grading tests and other purposes such as scanning forms. With this technology, you use pencils to fill in bubbles or check boxes on OMR paper, which is also called a "mark sense form." OMR systems are used in standardized tests, including the SAT and GMAT tests, and to record votes in elections. In contrast, most OCR readers use reflected light to recognize and scan various machine-generated characters. With special software, OCR readers can also convert handwritten or typed documents into digital data. After data is entered, it can be shared, modified, and distributed over computer networks to hundreds or thousands of people.

Traditionally, you had to use a special OCR scanner device to create an image of the characters to be converted and then use expensive OCR software

to convert that image into text. It is now possible to complete this process using the camera in an Android smartphone or tablet computer. Once the image is stored on the camera or tablet, you use the Google Drive app for Android to copy the image to Google Drive where Google's software and servers can do the OCR conversion for you at no cost.

Magnetic Ink Character Recognition (MICR) Devices

In the 1950s, the banking industry became swamped with paper checks, loan applications, bank statements, and so on. The result was the development of magnetic ink character recognition (MICR), a system for reading banking data quickly. With MICR, data is placed on the bottom of a check or other form using a special magnetic ink. Using a special character set, data printed with this ink is readable by people and computers. See Figure 2.7.

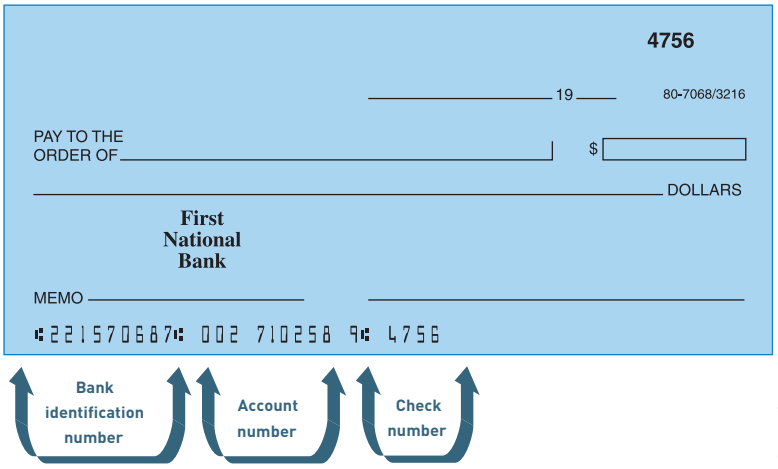


FIGURE **2.7**

MICR device

Magnetic ink character recognition technology codes data on the bottom of a check or other form using special magnetic ink, which is readable by people and computers. For an example, look at the bottom of a bank check.

Magnetic Stripe Cards

magnetic stripe card: A type of card that stores a limited amount of data by modifying the magnetism of tiny iron-based particles contained in a band on the card.

A **magnetic stripe card** stores a limited amount of data by modifying the magnetism of tiny iron-based particles contained in a band on the card. The magnetic stripe is read by physically swiping the card at a terminal. For this reason, such cards are called contact cards.

Magnetic stripe technology is in wide use in the U.S. credit card industry. The data encoded on the magnetic stripe on the back of the card is read by swiping the card past a magnetic reading head. To protect the consumer, businesses in the United States have invested in extensive computer networks for verifying and processing this data. Software at the point-of-sale (POS) terminal automatically dials a stored telephone number to call an acquirer, an organization that collects credit-authentication requests from merchants, and provides the merchants with a payment guarantee. When the acquirer company receives the credit-card authentication request, it checks the transaction for validity by reading the card number, expiration date, and credit card limit recorded on the magnetic stripe. If everything checks out, the authorization is granted. Unfortunately, the magnetic stripe is not really a secure place to store sensitive consumer information. The data on the stripe can be read, written, deleted, or changed with easily obtainable hardware and software.

Smart Cards

smart card: Credit card embedded with computer chip containing key consumer and account data; cardholders must either enter their pin (chip-and-PIN) or sign (chip-and-sign) for each transaction to be approved.

To better protect the consumer and to avoid setting up and operating expensive computer networks, most European countries use smart card technology. **Smart cards** are embedded with computer chips containing key consumer and account data. Cardholders must either enter their pin (chip-and-PIN) or

sign (chip-and-sign) for each transaction to be approved. The smart cards require different terminals from those used for magnetic stripe cards. All the information needed for authorization is contained in the chip or is captured at the point-of-sale. With smart cards, merchants do not need to send data over networks to obtain authorization.[16]

Although credit card fraud is a problem in the U.S., credit card issuers cannot force merchants to invest in the new terminals required for smart cards. As a result, deployment of this technology is lagging in the United States. A few dozen U.S. credit card issuers employ this technology including select cards from American Express, Bank of America, Chase, Citibank, and US Bank; however, only a few U.S. merchants are capable of accepting these cards.[17]

Contactless Payment Cards

contactless payment card: A card with an embedded chip that only needs to be held close to a terminal to transfer its data; no PIN number needs to be entered.

Contactless payment cards contain an embedded chip and antenna that enables the consumer to simply hold the card close to a terminal to transfer the data necessary to make a payment. Typically, no signature or PIN entry is required for purchases less than $25, making transactions speedier than payments made by conventional credit or debit card or even cash. Contactless payment cards are ideal in situations where the consumer must make a fast payment or risk holding up others in line such as when boarding a form of mass transportation. It is estimated that over 32 million people use contactless payment cards in Britain.[18] Some observers are concerned that it is relatively easy to scan details from contactless cards using kits available for less than $75.[19] American Express ExpressPay, ExonMobile SpeedPass, MasterCard PayPass, and Visa PayWave are contactless payment cards used in the United States.

Point-of-Sale Devices

point-of-sale (POS) device: A terminal used to enter data into the computer system.

Point-of-sale (POS) devices are terminals used to capture data. They are frequently used in retail operations to enter sales information into the computer system. The POS device then computes the total charges, including tax. POS devices use various types of input and output devices, such as keyboards, bar-code readers, scanning devices, printers, and screens. Much of the money that businesses spend on computer technology involves POS devices. Figure 2.8 shows a handheld POS terminal device.

Restaurants, bars, and retail shops are switching from traditional cash registers and costly credit card terminals to simpler devices that plug into smartphones and tablet computers. For example, a device called the Square Stand includes a built-in card reader that connects to an iPad and a hub device that connects to accessories including a cash drawer, receipt printer, and scanner. With this device, a small retailer can have a cash register that keeps track of inventory and provides instant sales analysis for the cost of an iPad and $450 for the Square Stand, printer, and cash drawer. This is a much less expensive and less bulky solution than a standard cash register system. PayPal and Groupon also offer similar devices.[20]

Bar-Code Scanners

A bar-code scanner employs a laser scanner to read a bar-coded label and pass the data to a computer. This form of input is used widely in store checkouts and warehouse inventory control. Bar codes are also used in hospitals, where a nurse scans a patient's wristband and then a bar code on the medication about to be administered to prevent medication errors.

Several companies have created applications that convert your cell phone camera into a barcode reader. You can scan the code that you find on print ads, packaging, or labels to launch Web sites and buy items with a few clicks.

FIGURE **2.8**

Handheld POS terminal device

Using a wireless, handheld POS device, restaurant staff can take orders and payments on the floor.

Radio Frequency Identification

Radio frequency identification (RFID): A technology that employs a microchip with an antenna to broadcast its unique identifier and location to receivers.

Radio frequency identification (RFID) is a technology that employs a microchip with an antenna to broadcast its unique identifier and location to receivers. The purpose of an RFID system is to transmit data by a mobile device, called a tag (see Figure 2.9), which is read by an RFID reader and processed according to the needs of a computer program. One popular application of RFID is to place microchips on retail items and install in-store readers that track the inventory on the shelves to determine when shelves should be restocked. The RFID tag chip includes a special form of EPROM memory that holds data about the item to which the tag is attached. A radio frequency signal can update this memory as the status of the item changes. The data transmitted by the tag might provide identification, location information, or details about the product tagged, such as date of manufacture, retail price, color, or date of purchase.

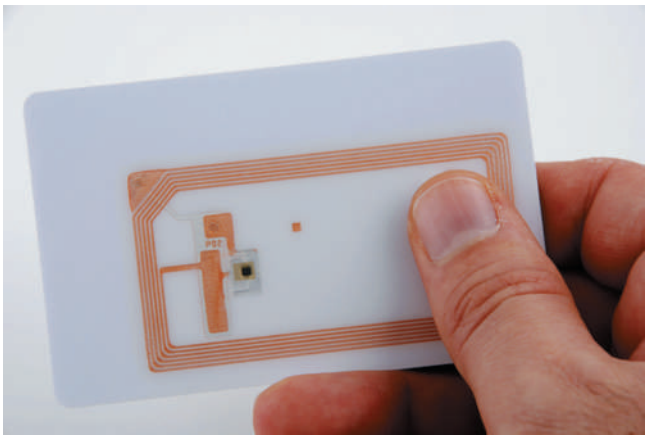


FIGURE **2.9**

RFID tag

An RFID tag is small compared to current bar-code labels used to identify items.

Lone Pine Construction has hundreds of pieces of equipment, tools, and a fleet of construction vehicles. To keep track of these assets, the firm assigned a manager for several months to identify all assets, load pertinent data about each asset into a database, and place RFID tags on key assets. Now a manager can visit the various job sites and quickly count the assets to ensure that none are missing. These measures have saved thousands of dollars and the firm has decided to increase the number of assets covered by this system.[21]

Pen Input Devices

By touching the screen with a pen input device, you can activate a command or cause the computer to perform a task, enter handwritten notes, and draw objects and figures. See Figure 2.10. Pen input requires special software and hardware. Handwriting recognition software, for example, converts onscreen handwriting into text. Pen input is especially attractive if you are uncomfortable using a keyboard. The success of pen input depends on how accurately and at what cost handwriting can be read and translated into digital form.

FIGURE **2.10**

Using a pen input device

Using a pen input device directly on a digital pad, graphic designers can precisely edit photos and drawings.

Touch-Sensitive Screens

Advances in screen technology allow display screens to function as input as well as output devices. By touching certain parts of a touch-sensitive screen, you can start a program or trigger other types of action. Touch-sensitive screens can eliminate the need for a keyboard, which conserves space and increases portability. Touch screens are frequently used at gas stations to allow customers to select grades of gas and request a receipt; on photocopy machines for selecting options; at fast-food restaurants for entering customer choices; at information centers for finding facts about local eating and drinking establishments; and at amusement parks to provide directions to patrons.

The Thales Group is a French multinational company and a major manufacturer of aircraft cockpits. Its head of cockpit innovation, Denis Bonnet, is a strong advocate of the use of touch screen controls for pilots to replace the current use of buttons, trackballs, and keypads for performing flying tasks. The goals are to reduce complexity by reducing the number of buttons and control panels, make the pilot interaction more intuitive, and enable the pilot to remain focused on flying.[22]

Output Devices

Computer systems provide output to decision makers at all levels of an organization so they can solve a business problem or capitalize on a competitive opportunity. In addition, output from one computer system can provide input into another computer system. The desired form of this output might be visual, audio, or even digital. Whatever the output's content or form, output devices are designed to provide the right information to the right person in the right format at the right time.

Display Monitors

pixel: A dot of color on a photo image or a point of light on a display screen.

The display monitor is a device used to display the output from the computer. Because early monitors used a cathode-ray tube (CRT) to display images, they were sometimes called *CRTs*. The cathode-ray tubes generate one or more electron beams. As the beams strike a phosphorescent compound (phosphor) coated on the inside of the screen, a dot on the screen called a pixel lights up. A **pixel** is a dot of color on a photo image or a point of light on a display screen. It appears in one of two modes: on or off. The electron beam sweeps across the screen so that as the phosphor starts to fade, it is struck and lights up again.

The display screen is a device used to show the output from the computer. Today a variety of flat-panel display screens are far lighter and thinner than the traditional cathode ray tubes associated with early computers. Table 2.3 compares types of flat-panel display screens.

TABLE 2.3 Various types of flat-panel displays

Type	Description	Noteworthy Feature
Liquid crystal display (LCD)	Uses several layers of charged liquid crystals placed between clear plates that are lit from behind by a fluorescent light to create light and images.	The viewing angle tends to be worse than that of plasma displays.
Light-emitting diode (LED)	An LCD display that uses light-emitting diodes (LEDs) as backlight on the screen rather than a fluorescent lamp.	Provides better contrast and lower energy consumption than LCDs.
Organic light-emitting diode (OLED)	Functions by exciting organic compounds with electric current to produce bright, sharp images.	Does not employ a backlight, which enables improved contrast and lower power consumption than LCD and LED displays.
Plasma	Uses electricity to excite gas atoms to light up appropriate phosphors on the screen to emit light and color.	Performs well in dark conditions and not as well in well-lit rooms.

With today's wide selection of display screens, price and overall quality can vary tremendously. The quality of a screen image is largely determined by the number of horizontal and vertical pixels used to create it. The images shown on your display device are composed of a million or more pixels. Resolution is the total number of pixels contained in the display; the more pixels, the clearer and sharper the image. A common resolution is 2,040 horizontal pixels × 1536 vertical pixels. The size of the display monitor also affects the quality of the viewing. The same pixel resolution on a small screen is sharper than on a larger screen, where the same number of pixels is spread out over a larger area.

Because most users leave their computers on for hours at a time, power usage is an important factor when deciding which type monitor to purchase. Although the power usage varies from model to model, LCD monitors generally consume between 35 and 50 percent less power than plasma screens. OLED monitors use even less power than LCD monitors.

Printers and Plotters

Hard copy is paper output from a device called a printer. Printers with different speeds, features, and capabilities are available. Some can be set up to accommodate paper forms such as blank check forms, invoice forms, and so forth. Newer printers allow businesses to create customized printed output for each customer from standard paper and data input using full color.

The speed of the printer is typically measured by the number of pages printed per minute (ppm). Like a display screen, the quality, or resolution,

of a printer's output depends on the number of dots printed per inch (dpi). A 600-dpi printer prints more clearly than a 300-dpi printer. A recurring cost of using a printer is the inkjet or laser cartridge that must be replaced periodically—every few thousand pages for laser printers and every 500 to 1000 pages for inkjet printers. Figure 2.11 shows an inkjet printer.

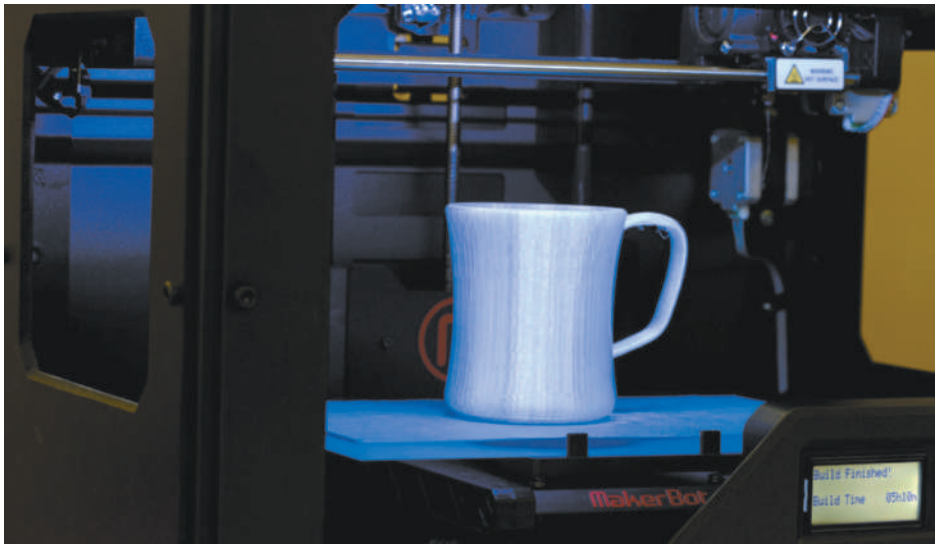
© iStockphoto.com/Demo

FIGURE **2.11**

Multifunction inkjet printer

The Hewlett-Packard all-in-one 6310 inkjet printer provides printing, scanning, and copying functions.

3D printers have created a major breakthrough in how many items will be "manufactured." See Figure 2.12. 3D printing technology takes a three-dimensional model of an object stored on your computer and sends it to a 3D printer to create the object using strands of a plastic filament or synthetic powder. The filament comes in spools of various colors and is fed through a heated extruder that moves in several directions to place layers on top of each other until the object is created. 3D printers come with a wide range of capabilities as far as how fast they can build objects and how large of an object they can build. 3D systems sells the highly rated Cubify CubeX and Cubify Cube printers.[23]



RICH SUGG/MCT/Landov

FIGURE **2.12**

3D printer

3D print technology is making it possible to print objects ranging from everyday objects to houses.

INFORMATION SYSTEMS @ WORK

Printing Livers at Organovo

In San Diego, California, a device the size of an espresso machine shoots a milky paste into six petri dishes filled with opaque goo. With miraculous speed, three little hexagons form in each dish which soon grow into honeycombs the size of fingernails. The honeycombs are tissue, nearly identical to human liver tissue. The device is a 3D printer and the company that is planning on using the device to turn human cells into human organs for transplants is Organovo.

Organovo was established in 2007, but its founders began their initial work at universities. In 2003, Dr. Thomas Boland first patented his technique for the ink-jet printing of viable cells. Between 2004 and 2005, the National Science Foundation (NSF) granted a team led by Professor Gabor Forgacs $5 million, which the team used to develop and patent the first bioprinting platform. In 2008, Organovo raised $3 million in start-up funds—enough to set up its laboratory in San Diego. Finally, in 2010, Organovo developed its first fully cellular blood vessel, proving that human tissues and eventually human organs can be created using only human cells through 3D printing technology.

Unlike other manufacturing devices, 3D printers have a unique ability to customize a product by tweaking the blueprint that is fed into the printer. As a result, this expensive hardware is making in-roads into industries where customization is critical. Nokia, for example, is offering its 3D printer owners a blueprint they can tweak to design their own mobile phone cases. Bespoke Innovations creates specialized coverings that surround an existing prosthetic leg and mimic the shape of the original leg, based on 3D scanning of the remaining leg. To create human tissues and organs, scientists must build highly customized artificial scaffolds to seed the cells temporarily until they are strong enough to stand alone.

Though popular science magazines rave about the potential of this technology for transplants in the future, Organovo already has a much bigger market opportunity in pharmaceutics. Companies spend $1.2 billion and 12 years, on average, to develop and test a new drug. Companies must conduct tests first on cells, then on animals, and finally on humans. Organovo tissues can be used in testing and may generate much more reliable predictions. In fact, in 2012 Organovo partnered with Pfizer and United Therapeutics, two major pharmaceutical companies to do research into 3D printing of tissues and body parts. Today, Organovo can create liver tissues, but it is working on creating kidney and heart cells as well.

Discussion Questions

1. Why is the use of 3D printers critical to the manufacturing of human organs?
2. What other potential uses does 3D printing technology have in health care and other industries?

Critical Thinking Questions

1. What competitive advantage did technology provide Organovo?
2. Organovo is now a private corporation, but much of the research for the patents it holds was funded by the U.S. government through NSF and the National Institutes of Health. Is it right that Organovo and its investors should be the sole financial beneficiaries of this research? Why or why not?

SOURCES: Organovo Web site, *www.organovo.com/company/history*, accessed August 25, 2012; "Nokia backs 3D printing for mobile phone cases," *BBC*, January 18, 2013, *www.bbc.co.uk/news/technology-21084430*, accessed August 25, 2013; Bespoke Innovations Web site, *www.bespokeinnovations.com/content/what-fairing*, accessed August 25, 2013; Leckart, Steven, "How 3D Printing Body Parts Will Revolutionize Medicine," *Popular Science*, August 6, 2013, *www.popsci.com/science/article/2013-07/how-3D-printing-body-parts-will-revolutionize-medicine*, accessed August 25, 2013; Stoffel, Brian, "How Big Is Organovo's Market Opportunity?" *The Motley Fool*, August 23, 2013, *www.fool.com/investing/general/2013/08/23/how-big-is-organovos-market-opportunity.aspx*, accessed August 21, 2013.

3D printing is commonly used by aerospace firms, auto manufacturers, and other design-intensive companies. It is especially valuable during the conceptual stage of engineering design when the exact dimensions and material strength of the prototype are not critical. Some architectural design firms are using 3D printers to create full color models of their projects to show clients. eBay has announced a new iPhone app called eBay Exact that allows users to browse and buy customizable print-on-demand merchandise (mainly jewelry and accessories). The items are priced in the $9 to $350 range and can be configured and ordered using the mobile app. eBay's 3D printing partners will then manufacture and ship the products directly to consumers within two weeks.[24] Biomedical engineers are exploring a process called bioprinting that uses 3D printers to build human parts and organs from actual human cells.[25]

Plotters are a type of hard-copy output device used for general design work. Businesses typically use these devices to generate paper or acetate blueprints, schematics, and drawings of buildings or new products onto paper or transparencies. Standard plot widths are 24 inches and 36 inches, and the length can be whatever meets the need—from a few inches to several feet.

E-Books

The digital media equivalent of a conventional printed book is called an e-book (short for electronic book). The Project Gutenberg Online Book Catalog lists over 36,000 free e-books and a total of over 100,000 e-books available. E-books can be downloaded from Project Gutenberg (*www.gutenberg.org*) or many other sites onto personal computers or dedicated hardware devices known as e-book readers. The devices cost anywhere from around $100 to $450, and downloads of the bestselling books and new releases cost around $10. The e-book reader has the capacity to store thousands of books. The most current Amazon.com Kindle, Kobo Aura, and Barnes & Noble Nook are popular e-readers with e-paper displays that look like printed pages or with LCD screens that are bright and shiny but can be difficult to read in bright sunlight.[26] E-books weigh less than three-quarters of a pound, are around one-half inch thick, and come with a display screen ranging from 5 to 8 inches. Thus, these readers are as compact as most paperbacks and can be easily held in one hand. Recent e-book readers display content in 16 million colors and high resolution. See Figure 2.13. On many e-readers, the size of the text can be magnified for readers with poor vision.

Amazon.com, Inc.

FIGURE **2.13**

Kindle e-book reader

Kindle uses an e-paper display that looks similar to the printed page.

COMPUTER SYSTEM TYPES

Computer systems can range from desktop or portable computers to massive supercomputers that require housing in large rooms. Let's examine the types of computer systems in greater detail. Table 2.4 shows general ranges of capabilities for various types of computer systems.

TABLE 2.4 Types of computer systems

Single-user computer systems can be divided into two groups: portable computers and nonportable computers.

	Single-User Computers			
Portable Computers				
Factor	**Handheld**	**Laptop**	**Notebook/Ultrabook**	**Tablet**
Cost	$150–$3,000	$300–$1,200	$300–$800	$350–$700
Weight (pounds)	<0.5	<7	<3	<2
Screen size (inches)	2–4	<17	<13	<13
Typical use	Data collection, organize personal data	Improve worker productivity	Sufficient processing power to run nearly every business application	Capture data at the point of contact, read email, surf the Internet, read e-books, view photos, play games, listen to music and watch video files
Nonportable Computers				
Factor	**Thin Client**	**Desktop**	**Nettop**	**Workstation**
Cost	$200–$500	$500–$2,500	$150–$350	$1,500–$9,500
Weight (pounds)	<3	20–30	<5	<20–35
Typical use	Enter data and access applications via the Internet	Improve worker productivity	Replace desktop with small, low-cost, low-energy computer	Perform engineering, CAD, and software development

Multiple-user computer systems include servers, mainframes, and supercomputers

Multiple-User Computers			
Factor	**Server**	**Mainframe**	**Supercomputer**
Cost	>$500	>$75,000	>$250,000
Weight (pounds)	>25	>100	>100
Typical use	Execute network and Internet applications	Execute computing tasks for large organizations and provide massive data storage	Run scientific applications; perform intensive number crunching

Portable Computers

portable computer: A computer small enough to carry easily.

handheld computer: A compact-sized computing device that is small enough to hold comfortably in one hand, and typically includes a display screen with stylus and/or touch screen input along with a compact keyboard or numeric keypad.

Many computer manufacturers offer a variety of **portable computers**, those that are small enough to carry easily. Portable computers include handheld computers, laptop computers, ultrabooks, and tablet computers.

A **handheld computer** is a compact computing device that is small enough to hold comfortably in one hand, and typically includes a display screen with stylus or touch screen input along with a compact keyboard or numeric keypad. Most can communicate with desktop computers over wireless networks. Some even add a built-in GPS receiver with software that can integrate location data into applications run on the device. For example, if you click an entry in an electronic address book, the device displays a map and directions from your current location. Such a computer can also be mounted in your car and serve as a navigation system. One of the shortcomings of handheld computers is that they require a lot of power relative to their size.

Handheld computers frequently serve as point-of-sale devices that can capture credit card data. Rugged versions of handheld computers are designed to meet demanding military standards for drops, vibration, humidity,

dust, immersion in water, altitude, and temperature extremes. This version of a handheld computer can be as expensive as $3,000.

Laptop Computers

laptop computer: A personal computer designed for use by mobile users, being small and light enough to sit comfortably on a user's lap.

A **laptop computer** is a personal computer designed for use by mobile users, being small and light enough to sit comfortably on a user's lap. Laptop computers use a variety of flat panel technologies to produce lightweight and thin display screens with good resolution. In terms of computing power, laptop computers can match most desktop computers as they come with powerful CPUs as well as large-capacity primary memory and disk storage. This type of computer is highly popular among students and mobile workers who carry their laptops on trips and to meetings and classes. Many personal computer users now prefer a laptop computer over a desktop because of its portability, lower energy usage, and smaller space requirements.

Ultrabook Computers

Numerous portable computers are smaller than the typical laptop and have various names including notebook and the even smaller ultrabook. The newest notebook computers come with a natural user interface including both voice control integration and touch screens; high-quality display screens; always on, always connected capabilities; all day battery life; and processing power sufficient to run most business applications and games.

Tablet Computers

tablet computer: A portable, lightweight computer with no keyboard that allows you to roam the office, home, or factory floor carrying the device like a clipboard.

Tablet computers are portable, lightweight personal computers that can come with or without a keyboard and allow you to roam the office, home, or factory floor carrying the device like a clipboard. You can enter text with a writing stylus directly on the screen thanks to built-in handwriting recognition software. Other input methods include an onscreen keyboard and speech recognition. Tablet PCs that support input only via a writing stylus are called *slate computers*. The *convertible tablet PC* comes with a swivel screen and can be used as a traditional notebook or as a pen-based tablet PC. Most new tablets come with a front-facing camera for videoconferencing and a second camera for snapshot photos and video.

Tablet computers are especially popular with students and gamers. They are also frequently used in the healthcare, retail, insurance, and manufacturing industries because of their versatility.

The Apple iPad is a tablet computer capable of running the same software that runs on the older Apple iPhone and iPod Touch devices, giving it a library of over a million applications. It also runs software developed specifically for the iPad. The device has a 9.7-inch screen and an onscreen keypad, weighs 1.5 pounds, and supports Internet access over wireless networks.

A number of computer companies are offering tablet computers to compete with Apple's iPad, including the Playbook from BlackBerry, the TouchPad from Hewlett Packard, the Kindle Fire from Amazon, the Streak by Dell, the Tablet S and Tablet P from Sony, the Thrive by Toshiba, the Galaxy Tab and Galaxy Note from Samsung (see Figure 2.14), the Xoom from Motorola, and the low-cost (less than $75) Aakash and Ubislate from the India-based company Quad.

Nonportable Single-User Computers

Nonportable single-user computers include thin client computers, desktop computers, nettop computers, and workstations.

thin client: A low-cost, centrally managed computer with essential but limited capabilities and no extra drives (such as CD or DVD drives) or expansion slots.

A **thin client** is a low-cost, centrally managed computer with no internal or external attached drives for data storage. These computers have limited capabilities and perform only essential applications, so they remain "thin" in terms of the client applications they include. As stripped-down computers, they do not

FIGURE **2.14**

Tablet computer

The Samsung Galaxy Note 10.1 Android tablet has a large touch screen and a quad-core processor.

have the storage capacity or computing power of typical desktop computers, nor do they need it for the role they play. With no hard disk, they never pick up viruses or suffer a hard disk crash. Unlike personal computers, thin clients download data and software from a network when needed, making support, distribution, and updating of software applications much easier and less expensive. Thin clients work well in a cloud-computing environment to enable users to access the computing and data resources available within the cloud.

Jewelry Television is viewed by over 65 million people in the United States and millions more visit its Web site (*www.jtv.com*). As a result of this exposure, the company has become one of the world's largest jewelry retailers. Its 300 call center representatives handle more than 6 million calls per year using thin client computers to access information to respond to customer queries and to place orders.[27]

desktop computer: A relatively small, inexpensive, single-user computer that is highly versatile.

Desktop computers are single-user computer systems that are highly versatile. Named for their size, desktop computers can provide sufficient computing power, memory, and storage for most business computing tasks. The Apple iMac is a family of Macintosh desktop computers first introduced in 1998, in which all the components (including the CPU, the disk drives, and so on) fit behind the display screen. The Mac Pro is a small and cylindrical shaped computer based on the Intel Xeon E5 chipset with up to 12 cores of processing power and two powerful GPU chips. See Figure 2.15.

nettop computer: An inexpensive desktop computer designed to be smaller, lighter, and consume much less power than a traditional desktop computer.

A **nettop computer** is an inexpensive (less than $600) desktop computer designed to be smaller and lighter and to consume much less power than a

CHRISTOPH DERNBACH/DPA/LANDOV

FIGURE **2.15**

Mac Pro desktop computer

Mac Pro desktop towers are small and cylindrical.

traditional desktop computer. A nettop is designed to perform basic processing tasks such as exchanging email, Internet surfing, and accessing Web-based applications. This computer can also be used for home theater activities such as watching video, viewing pictures, listening to music, and playing games. Unlike netbook computers, nettop computers are not designed to be portable, and they come with or without an attached screen. (Nettops with attached screens are called all-in-ones.) A nettop without an attached screen can be connected to an existing monitor or even a TV screen. It also may include an optical drive (CD/DVD).

workstation: A more powerful personal computer used for mathematical computing, computer-assisted design, and other high-end processing, but still small enough to fit on a desktop.

Workstations are more powerful than personal computers but still small enough to fit on a desktop. They are used to support engineering and technical users who perform heavy mathematical computing, computer-assisted design (CAD), video editing, and other applications requiring a high-end processor. Such users need very powerful CPUs, large amounts of main memory, and extremely high-resolution graphic displays. Workstations are typically more expensive than the average desktop computer. Some computer manufacturers are now providing laptop versions of their powerful desktop workstations.

Multiple-User Computer Systems

Multiple-user computers are designed to support workgroups from a small department of two or three workers to large organizations with tens of thousands of employees and millions of customers. Multiple-user systems include servers, mainframe computers, and supercomputers.

server: A computer used by many users to perform a specific task, such as running network or Internet applications.

A **server** is a computer employed by many users to perform a specific task, such as running network or Internet applications. While almost any computer can run server operating system and server applications, a server computer usually has special features that make it more suitable for operating in a multiuser environment. These features include greater memory and storage

capacities, faster and more efficient communications abilities, and reliable back-up capabilities. A Web server handles Internet traffic and communications. An enterprise server stores and provides access to programs that meet the needs of an entire organization. A file server stores and coordinates program and data files. Server systems consist of multiuser computers, including supercomputers, mainframes, and other servers. Often an organization will house a large number of servers in the same room where access to the machines can be controlled and authorized support personnel can more easily manage and maintain the servers. Such a facility is called a *server farm*. Apple, Google, Microsoft, the U.S. government, and many other organizations have built billion dollar server farms in small rural communities where both land and electricity are cheap.[28]

blade server: A server that houses many individual computer motherboards that include one or more processors, computer memory, computer storage, and computer network connections.

A **blade server** houses many computer motherboards that include one or more processors, computer memory, computer storage, and computer network connections. These all share a common power supply and air-cooling source within a single chassis. By placing many blades into a single chassis, and then mounting multiple chassis in a single rack, the blade server is more powerful but less expensive than traditional systems based on mainframes or server farms of individual computers. In addition, the blade server approach requires much less physical space than traditional server farms.

mainframe computer: A large, powerful computer often shared by hundreds of concurrent users connected to the machine via terminals.

A **mainframe computer** is a large, powerful computer shared by dozens or even hundreds of concurrent users connected to the machine over a network. The mainframe computer must reside in a data center with special heating, ventilating, and air-conditioning (HVAC) equipment to control temperature, humidity, and dust levels. In addition, most mainframes are kept in a secure data center with limited access to the room. The construction and maintenance of a controlled-access room with HVAC can add hundreds of thousands of dollars to the cost of owning and operating a mainframe computer.

Mainframe computers have been the workhorses of corporate computing for nearly 50 years. They can support hundreds of users simultaneously and can handle all of the core functions of a corporation. Mainframe computers provide the data processing power and data storage capacity to enable banks and brokerage firms to deliver new mobile services, credit card companies to detect identity theft, and government agencies to better serve citizens. Indeed, 96 of the world's top 100 banks, 23 of the top 25 retailers, and 9 out of 10 of the world's largest insurance companies run IBM mainframe computers. Mainframe computers process 30 billion business transactions per day including credit card transactions, billing for telecommunications firms, stock trades, money transfers, and transactions for ERP systems.[29]

supercomputer: The most powerful computer system with the fastest processing speed.

Supercomputers are the most powerful computers with the fastest processing speed and highest performance. They are special-purpose machines designed for applications that require extensive and rapid computational capabilities. Originally, supercomputers were used primarily by government agencies to perform the high-speed number crunching needed in weather forecasting, earthquake simulations, climate modeling, nuclear research, study of the origin of matter and the universe, and weapons development and testing. They are now used more broadly for commercial purposes in the life sciences and the manufacture of drugs and new materials. For example, Procter & Gamble uses supercomputers in the research and development of many of its leading commercial brands such as Tide and Pampers to help develop detergent with more soap suds and improve the quality of its diapers. PayPal uses a supercomputer to keep track of its customers and payments.[30]

The fastest supercomputer as of June 2013 is the Tianhe-2 built by the National University of Defense Technology located in Hunan Province, China. See Figure 2.16. It was built at an estimated cost of about $3 billion and is expected to be used to control traffic lights, predict earthquakes, develop new drugs, design cars, and create movie special effects.[31]

LONG HONGTAO/Xinhua/Landov

FIGURE **2.16**

World's fastest computer

The supercomputer Tianhe-2 can operate as fast as 33.86 petaflops per second, and is currently ranked as the world's fastest computer.

DATA CENTERS

data center: A climate-and-access-controlled building or a set of buildings that houses the computer hardware that deliver an organization's data and information services.

A **data center** is a climate-and-access-controlled building or a set of buildings that houses the computer hardware that delivers an organization's data and information services. The rapid growth in the demand of additional computing capacity is causing an explosion in the growth of new and existing data centers. Rackspace is a major cloud computing service provider that is adding new servers to its data centers at the rate of over 1,500 per month.[32] Apple, Facebook, AT&T, Rackspace, and IT services company Wipro are among firms that have spent hundreds of millions in a single year on new data centers.

A driving force behind the increased spending on new data centers is that organizations are consolidating their data centers from many locations to a few locations. The goal of consolidation is to lower ongoing operating costs—less spending on utilities, property taxes, and labor. General Motors recently consolidated from 23 data center locations to just two. This has reduced both its operating costs and energy usage.[33] Overall, research group Gartner estimates that spending on data centers will reach $143 billion in 2013.[34]

Businesses and technology vendors are working to develop data centers that run more efficiently and require less energy for processing and cooling. For example, Microsoft is investing nearly $1 billion in a modular data center campus in Boydton, Virginia. This state-of-the-art data center employs prefabricated, container-like data center modules called IT-PACS, each with the capacity to hold thousands of servers. Individual modules sit on slabs completely exposed to the elements and provide weather-tight protection for the servers, data storage devices, and other equipment inside. The servers inside the module are cooled efficiently by water and fan-driven systems that require much less energy than air conditioning units. This data center design approach enables Microsoft to deploy additional computing capacity quicker and at a lower initial cost and a lower ongoing operating cost. [35] Google, Dell, Hewlett-Packard, and others have adopted similar modular data center approaches.[36] See Figure 2.17.

In a further attempt to lower ongoing operating costs, organizations are locating their data centers in areas with milder climates and lower energy rates and land costs. For organizations in the United States, this translates to rural locations in the south and the northwest. Apple's $1-billion data center,

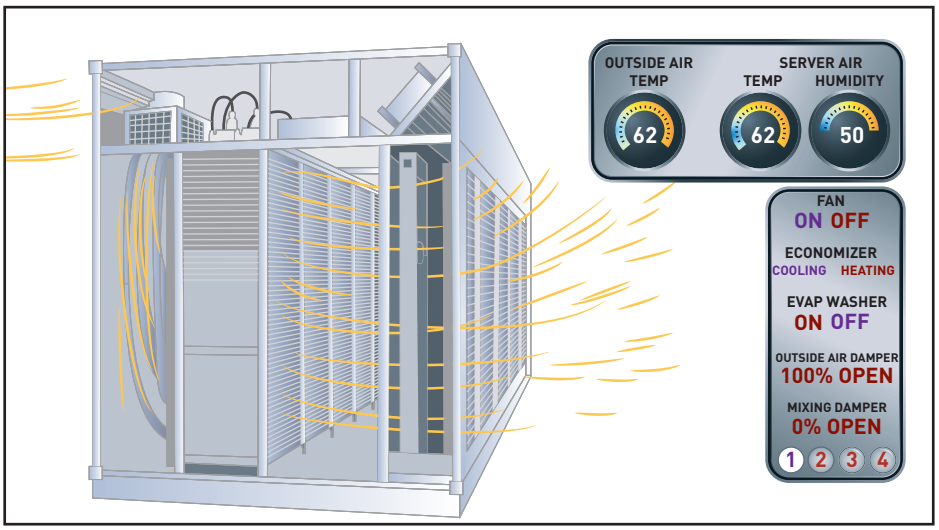


FIGURE **2.17**

Modular data center

Each module in a modular data center has a server that is cooled efficiently by water and by fans that require much less energy than air conditioning units.

Google's $600-million data center, and Facebook's $450-million data center are all located in rural North Carolina.[37]

The ability to absorb the impact of a disaster (e.g., hurricane, earthquake, terrorism attack, or war) and quickly restore services is a critical concern when it comes to the planning for new data centers. As a result, data centers of large information systems service organizations are often distributed among multiple locations in different areas of the country or even different countries to ensure continuous operations in the event of a disaster. If a data center is affected by a disaster, it is possible to redirect that center's work load to one or more of the distributed data centers not affected. IBM is an extreme example of distributed data centers. Since 2009, IBM has opened nine data centers in Brazil, Mexico, Costa Rica, Chile, Colombia, Peru, and Uruguay to ensure around-the-clock services to its Latin American customers. Globally, IBM has more than 400 widely distributed data centers to meet the needs of its customers.[38] In addition to the distribution strategy, most data centers have implemented some form of back-up generator or uninterruptible power supply in the event that the local power provider fails.

GREEN COMPUTING

Electronic devices such as computer hardware and cell phones contain hundreds or even thousands of components. The components, in turn, are composed of many different materials, including some that are known to be potentially harmful to humans and the environment, such as beryllium, cadmium, lead, mercury, brominated flame retardants (BFRs), selenium, and polyvinyl chloride.[39] Electronics manufacturing employees and suppliers at all steps along the supply chain and manufacturing process are at risk of unhealthy exposure to these raw materials. Users of these products can also be exposed to these materials when using poorly designed or improperly manufactured devices. Care must also be taken when recycling or destroying these devices to avoid contaminating the environment.

green computing: A program concerned with the efficient and environmentally responsible design, manufacture, operation, and disposal of IS-related products.

Green computing is concerned with the efficient and environmentally responsible design, manufacture, operation, and disposal of IS-related products, including all types of computers, printers, and printer materials such as cartridges and toner. Business organizations recognize that going green is in

their best interests in terms of public relations, safety of employees, and the community at large. They also recognize that green computing presents an opportunity to substantially reduce total costs over the life cycle of their IS equipment. Green computing has three goals: reduce the use of hazardous material, allow companies to lower their power-related costs, and enable the safe disposal or recycling of computers and computer-related equipment.

Electronic Product Environmental Assessment Tool (EPEAT): A system that enables purchasers to evaluate, compare, and select electronic products based on a total of 51 environmental criteria.

Electronic Product Environmental Assessment Tool (EPEAT) is a system that enables purchasers to evaluate, compare, and select electronic products based on a total of 51 environmental criteria. Products are ranked in EPEAT according to three tiers of environmental performance: bronze, silver, and gold. See Table 2.5.[40] Individual purchasers as well as corporate purchasers of computers, printers, scanners, and multifunction devices can use the EPEAT Web site (*www.epeat.net*) to screen manufacturers and models based on environmental attributes.[41]

TABLE 2.5 EPEAT product tiers

Tier	Number of Required Criteria That Must Be Met	Number of Optional Criteria That Must Be Met
Bronze	All 23	None
Silver	All 23	At least 50%
Gold	All 23	At least 75%

Computer manufacturers such as Apple, Dell, and Hewlett-Packard have long competed on the basis of price and performance. As the difference among the manufacturers in these two arenas narrows, support for green computing is emerging as a new business strategy for these companies to distinguish themselves from the competition. Apple claims to have the "greenest lineup of notebooks" and is making progress at removing toxic chemicals. Dell's new mantra is to become "the greenest technology company on Earth." Hewlett-Packard highlights its long tradition of environmentalism and is improving its packaging to reduce use of materials. Hewlett-Packard is also urging computer users around the world to shut down their computers at the end of the day to save energy and reduce carbon emissions.

We now turn to the other critical component of effective computer systems—software. Like hardware, software has made great technological leaps in a relatively short time span.

OVERVIEW OF SOFTWARE

computer program: A sequence of instructions for the computer.

Software consists of computer programs that control the workings of computer hardware. **Computer programs** are sequences of instructions for the computer. Documentation describes the program functions to help the user operate the computer system. The program displays some documentation onscreen or online, while other forms appear in external resources, such as printed manuals. Software can be one of two basic types: systems software and application software.

The effective use of software has a profound impact on individuals and organizations. It can make the difference between profits and losses and between financial health and bankruptcy. As Figure 2.18 shows, companies recognize this impact, spending more on software than on computer hardware or other areas of information systems. This is far different from when computers first were available; software was given away and customers paid only for the hardware. Today, spending on software actually exceeds spending on hardware.[42]

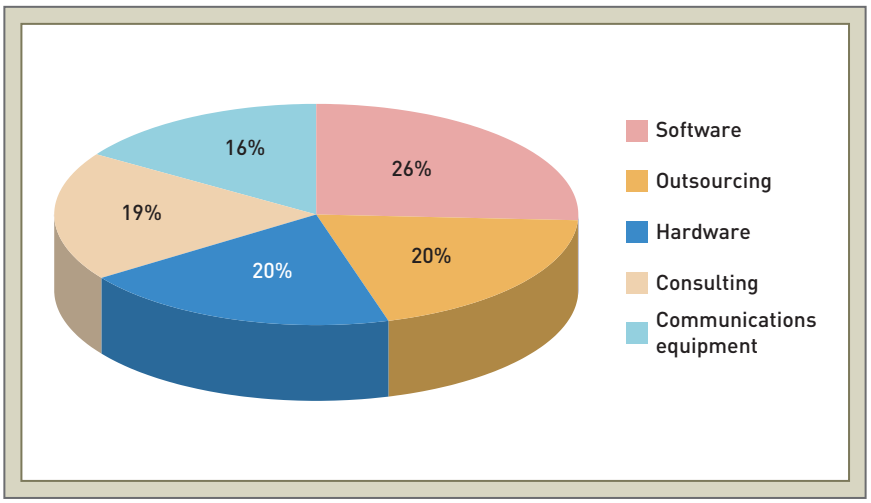


FIGURE **2.18**

Software expenditures exceed spending on hardware

Since the 1950s, businesses have greatly increased their expenditures on software compared with hardware.

Systems software is the set of programs designed to coordinate the activities and functions of the hardware and various programs throughout the computer system. Systems software is designed for a specific CPU design and class of hardware. Application software consists of programs that help users solve particular computing problems. You can find millions of software applications with over 1.6 million apps alone designed to run on Android and iPhone smartphones.[43] In most cases, application software resides on the computer's hard disk before it is brought into the computer's main memory and run. Application software can also be stored on CDs, DVDs, and even flash or key chain storage devices that plug into a USB port. An increasing amount of application software is available on the Web. Sometimes referred to as a *rich Internet application* (*RIA*), a Web-delivered software application combines hardware resources of the Web server and the PC to deliver valuable software services through a Web browser interface. Before an enterprise decides on the best approach for acquiring application software, they should analyze their goals and current and future needs carefully.

Supporting Individual, Group, and Organizational Goals

Every organization relies on the contributions of individuals, groups, and the entire enterprise to achieve business objectives. To help them achieve these objectives, the organization provides them with specific application software and information systems. One useful way of classifying the many potential uses of information systems is to identify the scope of the problems and opportunities addressed by a particular organization, called the sphere of influence. For most companies, the spheres of influence are personal, workgroup, and enterprise. Table 2.6 shows how various kinds of software support these three spheres.

TABLE 2.6 Software supporting individuals, workgroups, and enterprises

Software	Personal	Workgroup	Enterprise
Systems software	Smartphone, tablet computer, personal computer, and workstation operating systems	Network operating systems	Server and mainframe operating systems
Application software	Word processing, spreadsheet, database, and graphics	Electronic mail, group scheduling, shared work, and collaboration	General ledger, order entry, payroll, and human resources

Information systems that operate within the *personal sphere of influence* serve the needs of individual users. These information systems enable users to improve their personal effectiveness, increasing the amount of work that can be done and its quality. Such software is often referred to as *personal productivity software.* For example, Clear is a user-friendly to-do list app for the iPhone and Mac,[44] while Bump lets you swap contacts and other content with nearby mobile devices over a Wi-Fi network.[45]

A *workgroup* is two or more people who work together to achieve a common goal. A workgroup may be a large, formal, permanent organizational entity such as a section or department or a temporary group formed to complete a specific project. An information system that operates in the *workgroup sphere of influence* supports a workgroup in the attainment of a common goal. Users of such applications must be able to communicate, interact, and collaborate to be successful. For example, SignNow is a free app that speeds up the approval process for important documents by letting you print documents, and then sign, scan, format, and send them to the next person on the approval chain.[46] Cooper is a project management application that lets you create a project plan, add people resources to the project, and then have them sign in and update the status of their tasks.[47]

Information systems that operate within the *enterprise sphere of influence* support the firm in its interaction with its environment. The surrounding environment includes customers, suppliers, shareholders, competitors, special-interest groups, the financial community, and government agencies. For example, many enterprises use IBM Cognos software as a centralized Web-based system where employees, partners, and stakeholders can report and analyze corporate financial data.

Installing and Removing Software

Before you can use any type of software, it must be installed on a computer. Installing new software usually involves only a few setup steps. Software for personal computers typically comes on CDs or is downloaded from the Web.

When possible, it is best to remove software using an add/remove software utility that comes with the operating system or that is part of some utility software such as Norton System Works and McAfee QuickClean. This will help ensure that all elements of unwanted software are removed.

SYSTEMS SOFTWARE

Controlling the operations of computer hardware is one of the most critical functions of systems software. Systems software also supports the application programs' problem-solving capabilities. Different types of systems software include operating systems and utility programs.

Operating Systems

An operating system (OS) is a set of computer programs that control the computer hardware and act as an interface with application programs. See Figure 2.19. Operating systems can control one computer or multiple computers, or they can allow multiple users to interact with one computer.

The various combinations of OSs, computers, and users include the following:

- **Single computer with a single user.** This system is commonly used in a personal computer, tablet computer, or a smart phone that supports one user at a time. Examples of OSs for this setup include Microsoft Windows, Mac OS X, and Google Android.
- **Single computer with multiple simultaneous users.** This system is typical of larger server or mainframe computers that can support hundreds or

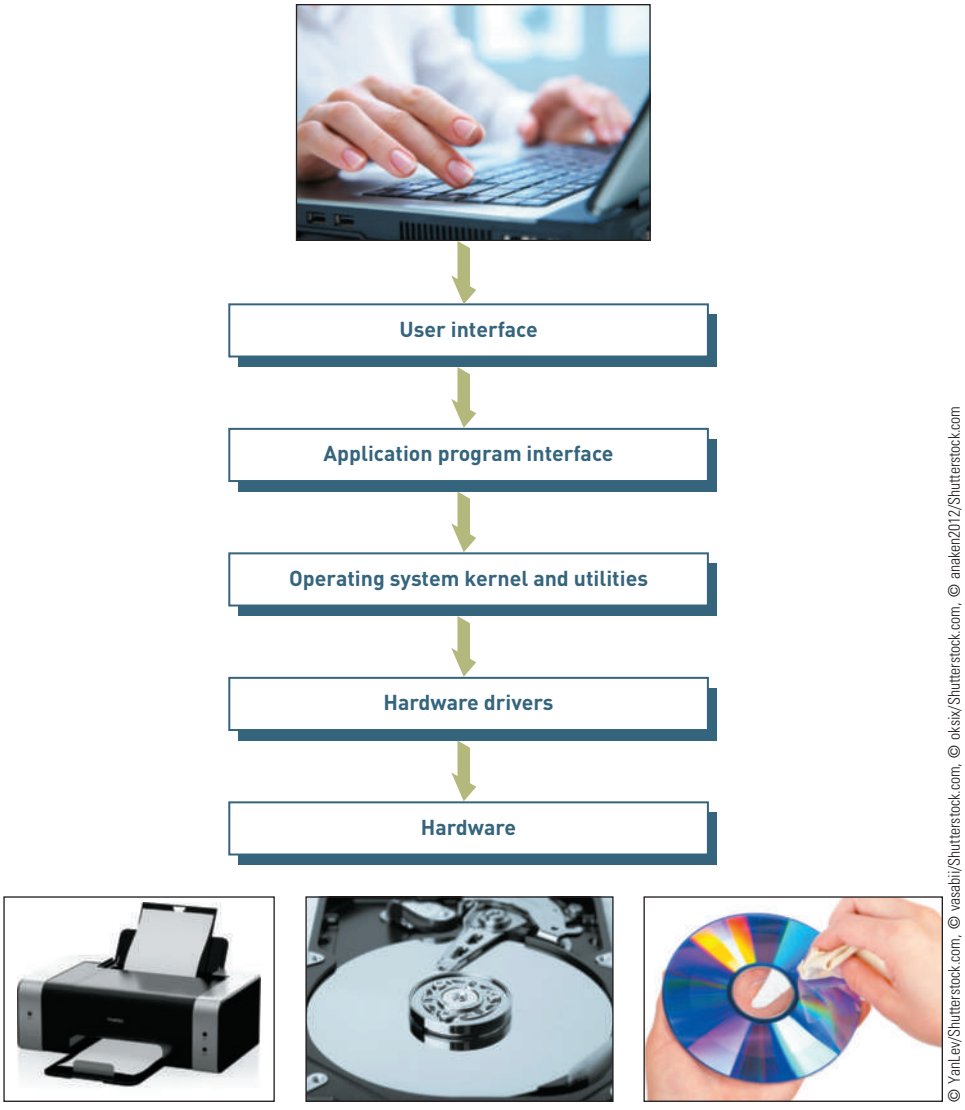


FIGURE **2.19**

Role of operating systems

The role of the operating system is to act as an interface between application software and hardware.

thousands of people, all using the computer at the same time. Examples of OSs that support this kind of system include UNIX, z/OS, and HP UX.

- **Multiple computers with multiple users.** This type of system is typical of a network of computers, such as a home network with several computers attached or a large computer network with hundreds of computers attached supporting many users, sometimes located around the world. Most PC operating systems double as network operating systems. Network server OSs include Red Hat Linux, Windows Server, and Mac OS X Server.
- **Special-purpose computers.** This type of system is typical of a number of computers with specialized functions, such as those that control sophisticated military aircraft, space shuttles, digital cameras, or home appliances. Examples of OSs for these purposes include Windows Embedded, Symbian, and some distributions of Linux.

The OS, which plays a central role in the functioning of the complete computer system, is usually stored on disk. After a computer system is started, or "booted up," portions of the OS are transferred to memory as they are needed. You can also boot a computer from a CD, DVD, or even a thumb drive that plugs into a USB port. A storage device that contains some or all of

the OS is often called a "rescue disk" because you can use it to start the computer if you have problems with the primary hard disk.

The set of programs that make up the OS performs a variety of activities, including the following:

- Performing common computer hardware functions
- Providing a user interface and input/output management
- Providing a degree of hardware independence
- Managing system memory
- Managing processing tasks
- Sometimes providing networking capability
- Controlling access to system resources
- Managing files

Common Hardware Functions

All applications must perform certain hardware-related tasks, such as the following:

- Get input from the keyboard or another input device
- Retrieve data from disks
- Store data on disks
- Display information on a monitor or printer

Each of these tasks requires a detailed set of instructions. The OS converts a basic request into the set of detailed instructions that the hardware requires. In effect, the OS acts as an intermediary between the application and the hardware. The typical OS performs hundreds of such tasks, translating each into one or more instructions for the hardware. The OS notifies the user if input or output devices need attention, if an error has occurred, and if anything abnormal happens in the system.

User Interface and Input/Output Management

user interface: The element of the operating system that allows people to access and command the computer system.

command-based user interface: A user interface that requires you to give text commands to the computer to perform basic activities.

graphical user interface (GUI): An interface that displays pictures (icons) and menus that people use to send commands to the computer system.

One of the most important functions of any OS is providing a **user interface**, which allows people to access and interact with the computer system. The first user interfaces for mainframe and personal computer systems were command based.

A **command-based user interface** requires text commands to be given to the computer to perform basic activities. For example, the command ERASE 00TAXRTN would cause the computer to erase or delete a file called 00TAXRTN. RENAME and COPY are other examples of commands used to rename files and copy files from one location to another.

A **graphical user interface (GUI)** displays pictures (called *icons*) and menus that people use to send commands to the computer system. Many people find that GUIs are easier to use because users intuitively grasp the functions. Today, the most widely used graphical user interface is Microsoft Windows. As the name suggests, Windows is based on the use of a window, or a portion of the display screen dedicated to a specific application. The screen can display several windows at once.

Today's mobile devices and some PCs use a touch user interface also called a *natural user interface* (*NUI*) or multitouch interface by some. Sight interfaces use a camera on the computer to determine where a person is looking on the screen and performs the appropriate command or operation. Some companies are also experimenting with sensors attached to the human brain (brain interfaces) that can detect brain waves and control a computer as a result. Sight and brain interfaces can be very helpful to disabled individuals.

Speech recognition is also available with some operating systems. Microsoft and other operating system manufacturers have developed voice command computer control software. Microsoft employs a special programming language

called Speech Application Program Interface (SAPI) to associate your voice commands with specific actions performed by the computer. OpenEars makes it simple for you to add speech recognition to your iPhone, iPad, or iPod. Siri, the personal assistant which acts as an app on Apple's iOS operating system, uses a natural language user interface to answer questions.

Operating system developers must be extremely careful in making changes to their user interface. The Windows 8 touch interface represented a major change from its traditional mouse driven point-and-click user interface. Initial user reaction has been lukewarm at best with users complaining about the loss of the "Start" button to display a pop-up menu of programs, folders, and icons.

Hardware Independence

application program interface (API): An interface that allows applications to make use of the operating system.

To run, applications request services from the OS through a defined **application program interface (API)**. Programmers can use APIs to create application software without understanding the inner workings of the operating system. It provides a software-to-software interface, not an end user interface.

Memory Management

The OS also controls how memory is accessed and maximizes available memory and storage. Most recent OSs manage memory better than older OSs. The memory-management feature of many OSs allows the computer to execute program instructions effectively and to speed processing. One way to increase the performance of an old computer is to upgrade to a newer OS and increase the amount of memory.

Most OSs support virtual memory, which allocates space on the hard disk to supplement the immediate, functional memory capacity of RAM. Virtual memory works by swapping programs or parts of programs between memory and one or more disk devices—a concept called paging. This procedure reduces CPU idle time and increases the number of jobs that can run in a given time span.

Processing Tasks

Operating systems use the following five basic task management techniques to increase the amount of processing that can be accomplished in a given amount of time.

- **Multiuser**: Allows two or more users to run programs at the same time on the same computer. Some operating systems permit hundreds or even thousands of concurrent users. The ability of the computer to handle an increasing number of concurrent users smoothly is called scalability.
- **Multiprocessing**: Supports running a program on more than one CPU.
- **Multitasking**: Allows more than one program to run concurrently.
- **Multithreading**: Allows different threads of a single program to run concurrently. A thread is a set of instructions within an application that is independent of other threads. For example, in a spreadsheet program, the thread to open the workbook is separate from the thread to sum a column of figures.
- **Real time**: Responds to input instantly. To do this, the operating system task scheduler can stop any task at any point in its execution if it determines another higher priority task needs to run immediately. Such systems are used to control the operation of jet engines, deployment of air bags, the operation of anti-lock braking systems, and other real-time operations.

Not all operating systems employ all these techniques. For example, the general purpose operating systems with which we are most familiar (e.g., Windows, Mac OS, and Linux) cannot support real-time processing.

Networking Capability

Most operating systems include networking capabilities so that computers can join together in a network to send and receive data and share computing resources. Operating systems for larger server computers are designed specifically for computer networking environments.

Access to System Resources and Security

Because computers often handle sensitive data that can be accessed over networks, the OS needs to provide a high level of security against unauthorized access to the users' data and programs. Typically, the OS establishes a logon procedure that requires users to enter an identification code, such as a user name, and a matching password. Operating systems may also control what system resources a user may access. When a user successfully logs on to the system, the OS allows access to only portions of the system for which the user has been cleared. The OS records who is using the system and for how long and reports any attempted breaches of security.

File Management

The OS manages files to ensure that files in secondary storage are available when needed and that they are protected from access by unauthorized users. Many computers support multiple users who store files on centrally located disks or tape drives. The OS keeps track of where each file is stored and who can access them.

Current Operating Systems

Early OSs were very basic. Today, however, more advanced OSs have been developed, incorporating sophisticated features and impressive graphics effects. Table 2.7 classifies a number of current OSs by sphere of influence.

TABLE 2.7 Operating systems serving three spheres of influence

Personal	Workgroup	Enterprise
Microsoft Windows	Microsoft Windows Server	Microsoft Windows Server
Mac OS X, Mac OS X iPhone	Mac OS X Server	
Linux	Linux	Linux
Google Android, Chrome OS		
HP webOS		
	UNIX	UNIX
	IBM i and z/OS	IBM i and z/OS
	HP-UX	HP-UX

Microsoft PC Operating Systems

Since a once-small company called Microsoft developed PC-DOS and MS-DOS to support the IBM personal computer introduced in the 1980s, personal computer OSs have steadily evolved. *PC-DOS* and *MS-DOS* had command-driven interfaces that were difficult to learn and use. Each new version of OS has improved the ease of use, processing capability, reliability, and ability to support new computer hardware devices.

MS-DOS had command-driven interfaces that were difficult to learn and use. MS-DOS gave way to Windows, which opened the PC market to everyday users. Windows evolved through several versions, including Windows 1.01, 2.03, 3.0, and 3.1; Windows 95, 98, and Me; Windows NT, Windows 2000, Windows XP, Windows Vista, Windows 7, and Windows 8.

Windows 7 has strong support for touch displays and netbooks, ushering in a new era of mobile computing devices. Windows 7 is available in configurations designed for 32-bit or 64-bit processors. Users running newer computers are advised to install the 64-bit version, if their computers can support it, to experience faster processor performance. One of the greatest advantages of using a 64-bit version computer is the ability to access physical memory (RAM) above the 4-gigabyte (GB) range, which is not addressable by 32-bit computers. The 4-GB limit can be a severe problem for servers and computers accessing large databases.

Microsoft Windows 8 includes a touch interface and many new features for the consumer market. The Start screen displays colorful application "tiles" instead of icons. Windows 8 is available for a number of platforms, including smartphones, tablet computers, PCs, and servers. Many smartphone and mobile device makers plan to use Windows in their devices. See Figure 2.20.

Microsoft product screenshots used with permission from Microsoft Corporation.

FIGURE **2.20**

Microsoft Windows 8

Windows 8 uses a Start screen rather than a Start menu.

Windows 9 is expected to be released in 2014 and will be capable of running on smartphones, tablets, and desktop computers.[48]

Apple Computer Operating Systems

In July 2001, Mac OS X was released as an entirely new OS for the Mac based on the UNIX operating system. It included a new user interface, which provided a new visual appearance for users—including luminous and semitransparent elements, such as buttons, scroll bars, windows, and fluid animation to enhance the user's experience.

Since its first release, Apple has upgraded OS X several times. OS X 10.9 Mavericks is Apple's latest operating system. See Figure 2.21. It offers the ability to launch the iBooks app and books you've already downloaded to your iPad, iPhone, or iPod Touch will appear in your library. Directions, bookmarks, and recent searches are automatically passed on to all your iOS devices. You can open multiple displays on multiple screens, and use power-saving technology that enables you to browse up to an hour longer without running out of power.

Because Mac OS X runs on Intel processors, Mac users can set up their computer to run both Windows and Mac OS X and select which platform they want to work with when they boot their computer. Such an arrangement is called *dual booting*. While Macs can dual boot into Windows, the opposite is not true. Apple does not allow OS X to be run on any machine other than an Apple. However, Windows PCs can dual boot with Linux and other OSs.

Mac OS Mavericks

FIGURE **2.21**

Mac OS X Mavericks

Mavericks incorporates many features of Apple's mobile devices into its desktop operating system.

Linux

Linux is an OS developed by Linus Torvalds in 1991 as a student in Finland. The OS is distributed under the *GNU General Public License*, and its source code is freely available to everyone. It is, therefore, called an *open-source* operating system.

Individuals and organizations can use the open-source Linux code to create their own distribution (flavor) of Linux. Such a distribution consists of the Linux kernel (core of the operating system) that controls the hardware, manages files, separates processes, and performs other basic functions along with other software. This other software defines the terminal interface and the commands you use, produces the graphical user interface that you see, and provides other useful utility programs. The Linux distributor takes all the code for these programs and combines it into a single operating system that can be installed on a computer. The distributor may also add their own finishing touches such as what the desktop looks like, what color schemes and character sets are displayed, and what browser and other optional software is included with the operating system. Typically, the distribution is "optimized" to perform in a particular environment such as for a desktop computer, server, or TV cable box controller.

Well in excess of 100 distributions of Linux have been created.[49] Many distributions are available as free downloads. Three of the most widely used distributions come from software companies RedHat, SUSE, and Canonical. Although the Linux kernel is free software, both Red Hat and SUSE produce retail versions of the operating system that earned them revenues of hundreds of millions in 2012 by distributing and servicing the software.[50] OpenSUSE is the distribution sponsored by SUSE. See Figure 2.22.

Google

Over the years, Google has extended its reach from providing a popular search engine (Google) to application software (Google Docs), email (Gmail), mobile operating system (Android), Web browser (Chrome), and more recently, PC operating system (Chrome OS). The various releases of the Android operating system have been given tasty names such as Gingerbread, Jelly Bean, and Ice Cream Sandwich. It is estimated that by mid-2013, the number of Android users worldwide exceeded 1 billion.[51]

Chrome OS is a Linux-based operating system for netbooks and nettops, which are notebooks and desktop PCs primarily used to access Web-based information and services such as email, Web browsing, social networks, and

Courtesy of openSUSE.org

FIGURE **2.22**

OpenSUSE operating system

OpenSUSE is a distribution of Linux available as a free download.

Google online applications. The OS is designed to run on inexpensive low-power computers. Chrome OS for personal computers is designed to start fast and provide quick access to applications through the Internet. An open-source version of Chrome OS, named Chromium OS, was made available at the end of 2009. Because it is open-source software, developers can customize the source code to run on different platforms, incorporating unique features.

Workgroup Operating Systems

To keep pace with user demands, the technology of the future must support a world in which network usage, data-storage requirements, and data-processing speeds increase at a dramatic rate. This rapid increase in communications and data-processing capabilities pushes the boundaries of computer science and physics. Powerful and sophisticated OSs are needed to run the servers that meet these business needs for workgroups.

Windows Server

Microsoft designed *Windows Server* to perform a host of tasks that are vital for Web sites and corporate Web applications. For example, Microsoft Windows Server can be used to coordinate the many servers in large data centers. It delivers benefits such as a powerful Web server management system, virtualization tools that allow various operating systems to run on a single server, advanced security features, and robust administrative support. Windows Home Server allows individuals to connect multiple PCs, storage devices, printers, and other devices into a home network. It provides a convenient way to store and manage photos, video, music, and other digital content. It also provides backup and data recovery functions.

UNIX

UNIX is a powerful OS originally developed by AT&T for minicomputers—the predecessors of servers that are larger than PCs and smaller than mainframes. UNIX can be used on many computer system types and platforms including workstations, servers, and mainframe computers. UNIX also makes it much easier to move programs and data among computers or to connect mainframes and workstations to share resources. There are many variants of UNIX, including HP/UX from Hewlett-Packard, AIX from IBM, and Solaris from Oracle. The UNIX platform (computer capable of running the UNIX operating system plus the operating system itself) is considered a high-cost platform compared to Linux and Windows Server.

Oracle, known primarily as a database management software firm, acquired Sun in 2010. Sun products included server hardware, the Solaris

operating system, and the Java programming language. Oracle now offers so-called general-purpose engineered systems that include a combination of Oracle and Sun software running on Sun servers under the Solaris operating system.[52] KASIKORNBANK is a Thai financial institution that provides a variety of financial services. It operates 897 branches and sub-offices across the country and has 10 overseas offices. The bank consolidated its disparate security systems onto Sun servers running under the Solaris operating system.[53]

Red Hat Linux

Red Hat Software offers Red Hat Enterprise Linux Server, an operating system that is very efficient at serving Web pages and can manage a cluster of several servers. Distributions such as SUSE and Red Hat have proven Linux to be a very stable and efficient OS. Red Hat Enterprise Virtualization (RHEV) software provides virtualization capabilities for servers and desktop computers to enable the hardware to run more than one operating system. See Figure 2.23.

www.redhat.com

FIGURE **2.23**

Red Hat Linux

Red Hat Enterprise Virtualization (RHEV) software provides virtualization capabilities for servers and desktop computers.

Mac OS X Server

The *Mac OS X Server* is the first modern server OS from Apple Computer and is based on the UNIX OS. The most recent version is OS X Mavericks Server. It includes support for 64-bit processing, along with several server functions and features that allow the easy management of network and Internet services such as email, Web site hosting, calendar management and sharing, wikis, and podcasting.

HP-UX

The HP-UX is a robust UNIX-based OS from Hewlett-Packard designed to handle a variety of business tasks, including online transaction processing and Web applications. It supports Hewlett-Packard's largest and most powerful computers and those designed to run Intel's Itanium processors.

Kenya Woman Finance Trust serves women only in Africa and is the leading deposit-taking microfinance institution in Kenya. It targets low-income women as an entry and contact point to their families with the objective of alleviating poverty by offering innovative savings and credit products. Initially, KWFT was limited to providing loans, but as it grew, KWFT took actions to become licensed as a Deposit Taking Microfinance (DTM) to offer financial services related to savings. One key step was to make a significant upgrade to its information system infrastructure. KWFT acquired Temenos T24 core banking software and an HP Integrity Superdome 2 server designed to run an organization's mission critical applications. The server runs using the HP-UX operating system and provides KWFT with the processing power and reliability necessary to handle more than 30,000 small transactions each day.[54]

Enterprise Operating Systems

Mainframe computers, often referred to as "Big Iron," provide the computing and storage capacity to meet massive data-processing requirements and offer many users high performance and excellent system availability, strong security, and scalability. In addition, a wide range of application software has been developed to run in the mainframe environment, making it possible to purchase software to address almost any business problem. Examples of mainframe OSs include z/OS from IBM, HP-UX from Hewlett-Packard, and Linux. The *z/OS* is IBM's first 64-bit enterprise OS and is capable of handling very heavy workloads including serving thousands of concurrent users and running an organization's critical applications. (The z stands for zero downtime.) The IBM i operating system provides a highly scalable and virus resistant collection of software that integrates a combination of relational database, security, Web services, networking, and storage management capabilities.

Mobile Operating Systems

Smartphones now employ full-fledged personal computer operating systems such as the Google Android, Apple iOS, and Microsoft Windows Phone that determine the functionality of your phone and the applications that you can run. These operating systems have software development kits that allow developers to design thousands of apps providing a myriad of mobile services.

Table 2.8 lists the top four mobile operating systems for smartphones and tablets based on worldwide market share as of the second quarter 2013.

TABLE 2.8 Comparison of smartphone operating systems 2Q 2013 shipments

Smartphone Operating System	Worldwide Market Share of Sales during 2Q 2013	Estimated Total Number of Applications Mid-2013	Estimated Rate of Increase in Number of New Applications
Google Android	79.3%	>1,000,000	800/day
Apple iOS	13.2%	900,000	600/day
Microsoft Windows Phone	3.7%	145,000	130/day
Blackberry Limited, Blackberry	2.9%	120,000	NA

Sources: Etherington, Darrell, "Android Nears 80% Market Share In Global Smartphone Shipments, As iOS And BlackBerry Share Slides, Per IDC," Tech Crunch, August 7, 2013, *http://techcrunch.com/2013/08/07/android-nears-80-market-share-in-global-smartphone-shipments-as-ios-and-blackberry-share-slides-per-idc*; Cunningham, Andrew, "One Developer Makes Over 47,000 of BlackBerry 10's 120,000 Apps," Ars Technica, August 21, 2013, *http://arstechnica.com/gadgets/2013/08/one-developer-makes-over-47000-of-blackberry-10s-120000-apps*; Rowinski, Dan, ReadWrite, January 08, 2013, Google Play Will Beat Apple App Store To 1,000,000 Apps, *http://readwrite.com/2013/01/08/google-play-to-hit-1-million-apps-before-apple-app-store#awesm=~okUaRI5V5A0WOR*.

Table 2.9 lists the top four tablet operating systems based on sales in the first quarter of 2013.

TABLE 2.9 Worldwide market share of tablet computer operating systems 1Q 2013 shipments

Tablet Computer Operating System	Worldwide Market Share
Android	56.5%
iOS	39.6%
Windows	3.3%
Others	0.3%

Source: Kovach, Steve, "Android Now Ahead Of Apple's iOS In Tablet Market Share," *www.businessinsider.com/android-ahead-of-ios-tablet-market-share-2013-5#ixzz2kfajQMiW*, accessed May 1, 2013.

Embedded Operating Systems

An embedded system is a computer system (including some sort of processor) that is implanted in and dedicated to the control of another device. Embedded systems control many devices in common use today including TV cable boxes, cell phones, digital watches, digital cameras, MP3 players, calculators, microwave ovens, washing machines, and traffic lights. The typical auto contains many embedded systems to control anti-lock brakes, air bag deployment, fuel injection, active suspension devices, transmission control, and cruise control. A GPS device uses an embedded system to help people find their way around town or more remote areas. See Figure 2.24.

FIGURE **2.24**

GPS devices use embedded operating systems

A GPS device uses an embedded system to acquire information from satellites, display your current location on a map, and direct you to your destination.

Some embedded systems include specialized operating systems. For example, Hewlett-Packard purchased Palm, an early smartphone manufacturer, and its respected Palm webOS operating system used to run its Pre and Pixi smartphones in 2010. The smartphones were a market failure and in early 2013, LG bought all the assets associated with webOS from HP. It plans to use the software in its smart TVs to enable users to watch streaming movies and TV and YouTube videos, connect to social networks, play games, get news and download apps.[55]

Some of the more popular OSs for embedded systems are described in the following sections.

Windows Embedded

Windows Embedded is a family of Microsoft OSs included with or embedded into small computer devices. Windows Embedded Compact includes several versions that provide computing power for TV set top boxes, automated industrial machines, media players, medical devices, digital cameras, PDAs, GPS receivers, ATMs, gaming devices, and business devices such as cash registers. Microsoft Windows Embedded Automotive helps manufacturers provide drivers with everything they need to stay in touch with others, be entertained, and be informed. Drivers can also monitor vehicle performance, screen for maintenance issues, and allow remote tracking of the car's location. Speech recognition, touch interface, and hands-free technologies enable drivers to stay focused on the road and in control of their surroundings. The Ford Sync system uses an in-dashboard display and wireless networking technologies to link automotive systems with cell phones and portable media players. See Figure 2.25.

Daniel Acker/Bloomberg/Getty Images

FIGURE **2.25**

Microsoft Auto and Ford Sync

The Ford Sync system, developed on the Microsoft Auto operating system, allows drivers to wirelessly connect cell phones and media devices to automotive systems.

Proprietary Linux-Based Systems

Because embedded systems are usually designed for a specific purpose in a specific device, they are usually proprietary or custom-created and owned by the manufacturer. Nintendo Wii, for example, uses a custom-designed OS based on the Linux kernel. Linux is a popular choice for embedded systems because it is free and highly configurable. It has been used in many embedded systems, including e-book readers, ATM machines, cell phones, networking devices, and media players.

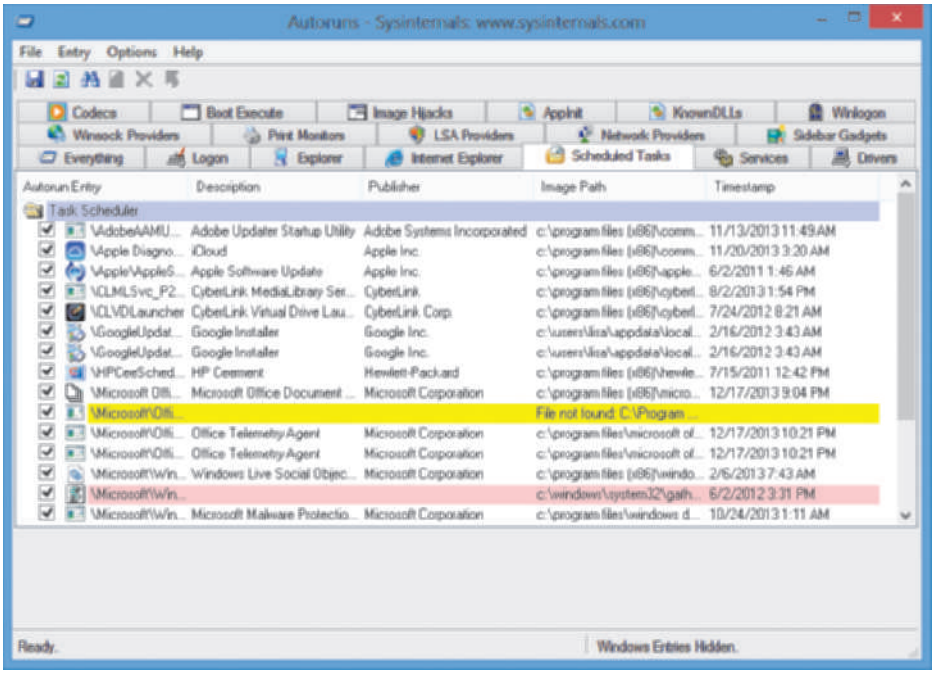
UTILITY PROGRAMS

utility program: Program that helps to perform maintenance or correct problems with a computer system.

Utility programs help to perform a variety of tasks. For example, some utility programs merge and sort sets of data, keep track of computer jobs being run, compress files of data before they are stored or transmitted over a network (thus saving space and time), and perform other important tasks.

Just as your car engine runs best if you have regular tune-ups, computers also need regular maintenance to ensure optimal performance. Over time your computer's performance can start to diminish as system errors occur, files clutter your hard drive, and security vulnerabilities materialize. The Sysinternals Suite is a popular personal computer utility for maintaining the performance of your Windows system by repairing errors in the registry and

on your hard drive, protecting your system and privacy, and optimizing sluggish system processes.[56] The Sysinternals window shown in Figure 2.26 summarizes the tasks the troubleshooting utility can perform on a PC. The Sysinternals Suite includes utilities for files, disks, networking, security, and system information.



Microsoft product screenshots used with permission from Microsoft Corporation

FIGURE **2.26**

Sysinternals Suite

The Sysinternals Suite is a collection of utilities for troubleshooting and maintaining a Windows system.

Although many PC utility programs come installed on computers, you can also purchase utility programs separately. Table 2.10 provides examples of some common types of utilities.

TABLE 2.10 Examples of utility programs

Personal	Workgroup	Enterprise
Software to compress data so that it takes less hard disk space	Software that maintains an archive of changes made to a shared document	Software to archive contents of a database by copying data from disk to tape
Software that assists in determining which files to delete to free up disk space	Software that monitors group activity to determine levels of participation	Software that monitors network traffic and server loads
Antivirus and antispyware software for PCs	Software that reports unsuccessful user logon attempts	Software that reports the status of a particular computer job

Middleware

middleware: Software that allows various systems to communicate and exchange data.

Middleware is software that allows various systems to communicate and exchange data. Middleware is often developed to address situations where a company acquires different types of information systems through mergers, acquisitions, or expansion and wants the systems to share data and interact. Middleware can also serve as an interface between the Internet and private corporate systems. For example, middleware can be used to transfer a request

for information from a corporate customer on the corporate Web site to a traditional database on a mainframe computer and return the results to the customer on the Internet.

service-oriented architecture (SOA): A modular method of developing software and systems that allows users to interact with systems and systems to interact with each other.

The use of middleware to connect disparate systems has evolved into an approach for developing software and systems called SOA. A **service-oriented architecture (SOA)** uses modular application services to allow users to interact with systems and systems to interact with each other. Systems developed with SOA are flexible and ideal for businesses that need a system to expand and evolve over time. SOA modules can be reused for a variety of purposes, which reduces development time. Because SOA modules are designed using programming standards so they can interact with other modules, rigid custom-designed middleware software is not needed to connect systems.

APPLICATION SOFTWARE

Application software applies the power of a computer to give individuals, workgroups, and the entire enterprise the ability to solve problems and perform specific tasks. Application programs interact with systems software, and the systems software directs the computer hardware to perform the necessary tasks.

The availability of many software options enables users to select the software that best meets the needs of the individual, workgroup, or enterprise. For example, a large, multinational organization such as Procter & Gamble chose the SAP Enterprise Resource Planning software with its vast array of options, features, and functionality to meet its complex global accounting needs. Meanwhile, the tiny neighborhood Just Right Bakery found that Intuit's Quicken worked well to meet its simple accounting needs.

Take care when adopting new applications because software is sometimes initially released with inherent problems. For example, the Web-based application introduced by the federal government to enable people to apply for the new healthcare options made available by the Affordable Care Act was poorly designed and was unable to handle the large number of initial applicants, causing many users to abandon the site in frustration.

Most of the computerized business jobs and activities discussed in this book involve application software. We begin by investigating the types and functions of application software.

Types and Functions of Application Software

proprietary software: One-of-a-kind software designed for a specific application and owned by the company, organization, or person that uses it.

off-the-shelf software: Software mass-produced by software vendors to address needs that are common across businesses, organizations, or individuals.

The key to unlocking the potential of any computer system is application software. A company can either develop a one-of-a-kind program for a specific application (called **proprietary software**) or purchase and use an existing software program (sometimes called **off-the-shelf software**). It is also possible to modify some off-the-shelf programs, giving a blend of off-the-shelf and customized approaches. The relative advantages and disadvantages of proprietary software and off-the-shelf software are summarized in Table 2.11.

Many companies use off-the-shelf software to support business processes. Key questions for selecting off-the-shelf software include the following. First, will the software run on the OS and hardware you have selected? Second, does the software meet the essential business requirements that have been defined? Third, is the software manufacturer financially solvent and reliable? Finally, does the total cost of purchasing, installing, and maintaining the software compare favorably to the expected business benefits?

The Rhode Island Division of Taxation chose an off-the-shelf Integrated Tax System to provide a wide range of processing and administration functionality for the 56 taxes and fees currently administered by the state. The software is flexible enough that it can be modified to handle new tax programs that may be ratified in the future. The system enables the Division of

TABLE 2.11 Comparison of proprietary and off-the-shelf software

Proprietary Software		Off-the-Shelf Software	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
You can get exactly what you need in terms of features, reports, and so on.	It can take a long time and significant resources to develop required features.	The initial cost is lower because the software firm can spread the development costs over many customers.	An organization might have to pay for features that are not required and never used.
Being involved in the development offers control over the results.	In-house system development staff may be hard pressed to provide the required level of ongoing support and maintenance because of pressure to move on to other new projects.	The software is likely to meet the basic business needs—you can analyze existing features and the performance of the package before purchasing.	The software might lack important features, thus requiring future modification or customization. This lack can be very expensive because users must adopt future releases of the software as well.
You can modify features that you might need to counteract an initiative by competitors or to meet new supplier or customer demands.	The features and performance of software that has yet to be developed presents more potential risk.	The package is likely to be of high quality because many customer firms have tested the software and helped identify its bugs.	The software might not match current work processes and data standards.

Taxation to operate more effectively and efficiently, generates additional revenue for the state, and creates useful new online tools for tax practitioners, taxpayers, and other stakeholders.[57]

Workers in many organizations operate in a cloud computing environment in which software, data storage, and other services are provided by the Internet ("the cloud"); the services are run on another organization's computer hardware and both software and data are easily accessed. Examples of public cloud service providers, which make their services available to the general public, include Amazon Elastic Compute Cloud (EC2), IBM's Blue Cloud, Sun Cloud, Google AppEngine, and Windows Azure Services Platform. Public cloud users can realize a considerable cost savings because the very high initial hardware, application, and bandwidth costs are paid for by the service provider and passed along to users as a relatively small monthly fee or per-use fee. Furthermore, the amount of services used can be easily scaled up or down depending on user demand for services.

Software as a Service (SaaS): A service that allows businesses to subscribe to Web-delivered application software.

Software as a Service (SaaS) allows organizations to subscribe to Web-delivered application software. In most cases, the company pays a monthly service charge or a per-use fee. Many business activities are supported by SaaS. SaaS vendors include Oracle, SAP, Net Suite, Salesforce, and Google. General Electric Aviation uses the SaaS software Salesforce to communicate with commercial customers and manage sales opportunities. Initially it used Salesforce to provide everyone with access to customer data, but eventually it enabled a level of collaboration among sales and marketing people that changed the day-to-day business.[58]

Cloud computing and SaaS, however, involve some risks. For example, sensitive information could be compromised in a number of ways, including unauthorized access by employees or computer hackers; the host might not be able to keep its computers and network up and running as consistently as necessary; or a disaster could disable the host's data center, temporarily putting an organization out of business. It can also be difficult to integrate the SaaS approach with existing software.

Personal Application Software

Hundreds of computer applications can help individuals at school, home, and work. The features of personal application software are summarized in Table 2.12. In addition to these general-purpose programs, thousands of other personal computer applications perform specialized tasks: to help you do your taxes, get in shape, lose weight, get medical advice, write wills and other legal documents, make repairs to your computer, fix your car, write music, and edit your pictures and videos. This type of software, often called *user software* or *personal productivity software,* includes the general-purpose tools and programs that support individual needs.

TABLE 2.12 Examples of personal application software

Type of Software	Explanation	Example
Word processing	Create, edit, and print text documents	Microsoft Word Google Docs Apple Pages OpenOffice Writer
Spreadsheet	Provide a wide range of built-in functions for statistical, financial, logical, database, graphics, and date and time calculations	Microsoft Excel IBM Lotus 1-2-3 Google Spreadsheet Apple Numbers OpenOffice Calc
Database	Store, manipulate, and retrieve data	Microsoft Access IBM Lotus Approach Borland dBASE Google Base OpenOffice Base
Graphics	Develop graphs, illustrations, and drawings	Adobe Illustrator Adobe FreeHand Microsoft PowerPoint OpenOffice Impress
Project management	Plan, schedule, allocate, and control people and resources (money, time, and technology) needed to complete a project according to schedule	Microsoft Project Symantec On Target Scitor Project Scheduler Symantec Time Line
Financial management	Provide income and expense tracking and reporting to monitor and plan budgets (some programs have investment portfolio management features)	Intuit Quicken
Desktop publishing (DTP)	Use with personal computers and high-resolution printers to create high-quality printed output, including text and graphics; various styles of pages can be laid out; art and text files from other programs can also be integrated into published pages	QuarkXpress Microsoft Publisher Adobe InDesign Corel Ventura Publisher Apple Pages

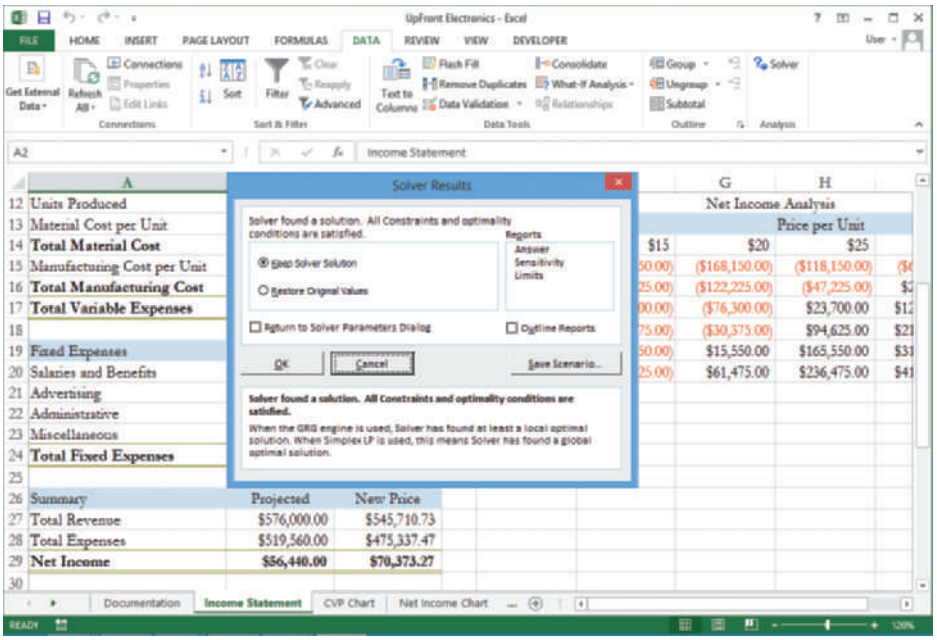
Word Processing

If you write reports, letters, or term papers, word-processing applications can be indispensable. The majority of personal computers in use today have word-processing applications installed. Such applications can be used to create, edit, and print documents. Most come with a vast array of features, including those for checking spelling, creating tables, inserting formulas, creating graphics, and much more. This book (and most like it) was entered into a word-processing application using a personal computer.

A team of people can use a word-processing program to collaborate on a project. The authors and editors who developed this book, for example, used the Track Changes and Review features of Microsoft Word to track and make changes to chapter files. With these features, you can add comments or make revisions to a document that a coworker can review and either accept or reject.

Spreadsheet Analysis

People use spreadsheets to prepare budgets, forecast profits, analyze insurance programs, summarize income tax data, and analyze investments. Whenever numbers and calculations are involved, spreadsheets should be considered. Features of spreadsheets include graphics, limited database capabilities, statistical analysis, built-in business functions, and much more. See Figure 2.27. The business functions include calculation of depreciation, present value, internal rate of return, and the monthly payment on a loan, to name a few. Optimization is another powerful feature of many spreadsheet programs. *Optimization* allows the spreadsheet to maximize or minimize a quantity subject to certain constraints. For example, a small furniture manufacturer that produces chairs and tables might want to maximize its profits. The constraints could be a limited supply of lumber, a limited number of workers that can assemble the chairs and tables, or a limited amount of various hardware fasteners that might be required. Using an optimization feature, such as Solver in Microsoft Excel, the spreadsheet can determine what number of chairs and tables to produce with labor and material constraints to maximize profits.



Microsoft product screenshot used with permission from Microsoft Corporation.

FIGURE **2.27**

Spreadsheet program

Consider spreadsheet programs, such as Microsoft Excel, when calculations are required.

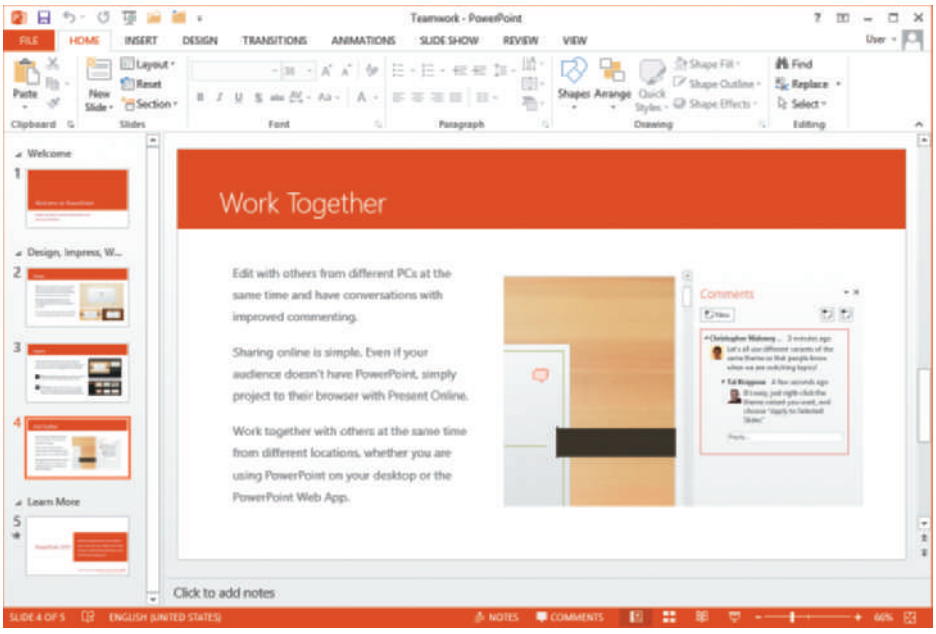
Database Applications

Database applications are ideal for storing, manipulating, and retrieving data. These applications are particularly useful when you need to manipulate a large amount of data and produce reports and documents. Database manipulations include merging, editing, and sorting data. The uses of a database application are varied. You can keep track of a CD collection, the items in your apartment, tax records, and expenses. A student club can use a database to store names, addresses, phone numbers, and dues paid. In business, a database application

can help process sales orders, control inventory, order new supplies, send letters to customers, and pay employees. Database management systems can be used to track orders, products, and customers; analyze weather data to make forecasts for the next several days; and summarize medical research results. A database can also be a front end to another application. For example, you can use a database application to enter and store income tax information, and then export the stored results to other applications, such as a spreadsheet or tax-preparation application.

Graphics Programs

With today's graphics programs, it is easy to develop attractive graphs, illustrations, and drawings. Graphics programs can be used to develop advertising brochures, announcements, and full-color presentations. If you are asked to make a presentation at school or work, you can use a graphics program to develop and display slides while you are making your talk. A graphics program can be used to help you make a presentation, a drawing, or an illustration. See Figure 2.28. Most presentation graphics programs come with many pieces of *clip art*, such as drawings and photos of people meeting, medical equipment, telecommunications equipment, entertainment, and much more.



Microsoft product screenshot used with permission from Microsoft Corporation.

FIGURE **2.28**

Presentation graphics program

Presentation graphics programs, such as Microsoft PowerPoint, can help you make a presentation at school or work.

Personal Information Managers

Personal information managers (*PIMs*) help individuals, groups, and organizations store useful information, such as a list of tasks to complete or a list of names and addresses. They usually provide an appointment calendar and a place to take notes. In addition, information in a PIM can be linked. For example, you can link an appointment with a sales manager that appears in the calendar with information on the sales manager in the address book. When you click the appointment in the calendar, information on the sales manager from the address book is automatically opened and displayed on the computer screen. Microsoft Outlook is an example of a PIM software package.

Web portals support PIM by allowing users to access calendars, to-do lists, email, social networks, contacts, and other information all from one page.

Some PIMs allow you to schedule and coordinate group meetings. If a computer or handheld device is connected to a network, you can upload the PIM data and coordinate it with the calendar and schedule of others using the same PIM software on the network. You can also use some PIMs to coordinate emails to invite others to meetings. As users receive their invitations, they click a link or button to be automatically added to the guest list.

Software Suites and Integrated Software Packages

software suite: A collection of programs packaged together in a bundle.

A **software suite** is a collection of programs packaged together in a bundle. Software suites can include a word processor, spreadsheet, database management system, graphics program, communications tool, organizer, and more. Some suites support the development of Web pages, note taking, and speech recognition, whereby applications in the suite can accept voice commands and record dictation. Software suites offer many advantages. The software programs have been designed to work similarly so that after you learn the basics for one application, the other applications are easy to learn and use. Buying software in a bundled suite is cost-effective; the programs usually sell for a fraction of what they would cost individually.

Microsoft Office, Corel WordPerfect Office, Lotus SmartSuite, and Apache OpenOffice are examples of popular general-purpose software suites for personal computer users. Each of these software suites includes a spreadsheet program, word processor, database program, and graphics presentation software. All can exchange documents, data, and diagrams. See Table 2.13. In other words, you can create a spreadsheet and then cut and paste that spreadsheet into a document created using the word-processing application. Forrester Research reports that 80 percent of enterprise customers use some version of Microsoft Office. The latest version is Office 2013.

TABLE 2.13 Major components of leading software suites

Personal Productivity Function	Microsoft Office	IBM Lotus Symphony	Corel WordPerfect Office	Apache OpenOffice	Apple iWork	Google Apps
Word Processing	Word	Documents	WordPerfect	Writer	Pages	Docs
Spreadsheet	Excel	Spreadsheets	Quattro Pro	Calc	Numbers	Spreadsheet
Presentation Graphics	PowerPoint	Presentations	Presentations	Impress and Draw	Keynote	Presentation
Database	Access			Base		Base

Some companies offer Web-based productivity software suites that require the installation of no hardware on your device—only a Web browser. Google, Zoho, and Thinkfree offer free online word processors, spreadsheets, presentations, and other software that require no installation on the PC.

After observing this trend, Microsoft responded with an online version of some of its popular Office applications. Microsoft Office 365 offers basic software suite features over the Internet using cloud computing. Microsoft Word, Outlook, Excel, Exchange for messaging, SharePoint for collaboration, and Lync for conferencing can be accessed. These cloud-based applications cost on the order of $10 per user per month depending on the features used. The online versions of Word, Excel, PowerPoint, and OneNote are tightly integrated with Microsoft's desktop Office suite for easy sharing of documents among computers and collaborators.

FHI 360 is a nonprofit global health and development organization working on family planning, reproductive health, and HIV/AIDS.[59] FHI 360 selected

Microsoft Office 365 for its productivity software solution because the service supports a number of applications that are hosted locally by the nonprofit, while other documents and resources are stored off-site by Microsoft. This model enables FHI 360 to store sensitive patient data subject to the Health Insurance Portability and Accountability Act of 1996 (HIPAA) compliance on its own hardware rather than in the cloud. Office 365 also enables FHI 360 to do email, instant messaging, Web conferencing, document sharing and collaboration. In addition, Office 365's videoconferencing and instant messaging capabilities will save FHI 360 approximately $20,000 annually.[60]

Most software spending goes to application software, as shown in Figure 2.29.[61]

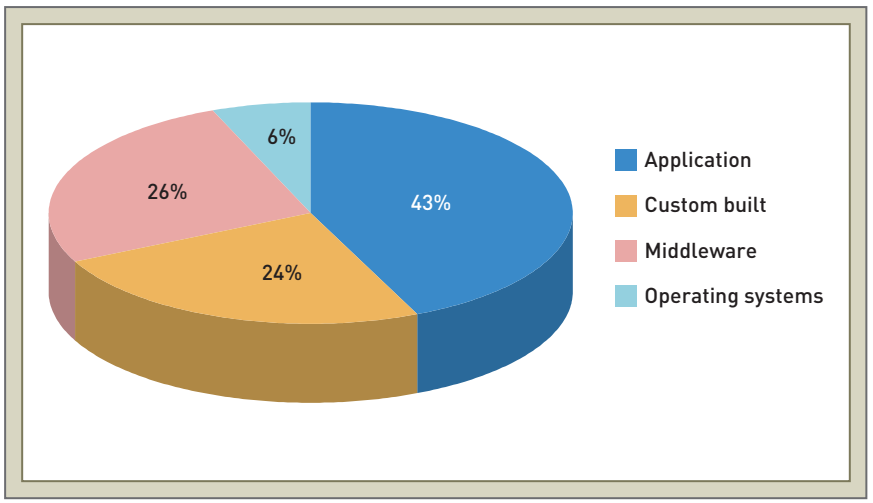


FIGURE **2.29**

Spending by type of software

Of all software types, businesses spend the most on application software.

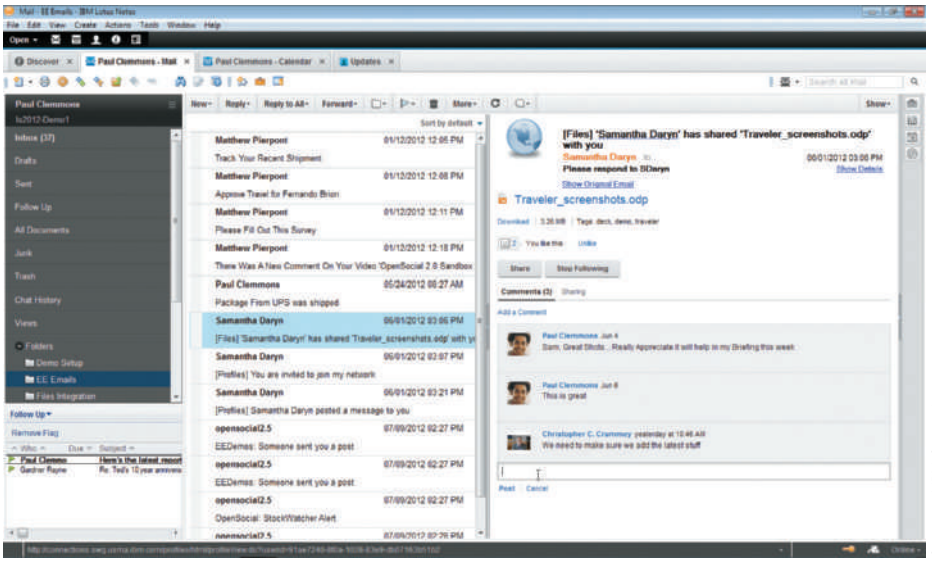
Workgroup Application Software

Workgroup application software is designed to support teamwork, whether people are in the same location or dispersed around the world. This support can be accomplished with software known as *groupware* that helps groups of people work together effectively. Microsoft Exchange Server, for example, has groupware and email features. Also called *collaborative software*, this approach allows a team of managers to work on the same production problem, letting them share their ideas and work via connected computer systems.

Examples of workgroup software include group scheduling software, electronic mail, and other software that enables people to share ideas. Lotus Notes and Domino are examples of workgroup software from IBM. Web-based software is ideal for group use. Because documents are stored on a Web server, anyone with an Internet connection can access them easily. Google provides options in its online applications that allow users to share documents, spreadsheets, presentations, calendars, and notes with other specified users or everyone on the Web. This sharing makes it convenient for several people to contribute to a document without concern for software compatibility or storage. Google also provides a tool for creating Web-based forms and surveys. When invited parties fill out the form, the data is stored in a Google spreadsheet. See Figure 2.30.

Enterprise Application Software

Software that benefits an entire organization—enterprise application software—can also be developed specifically for the business or purchased off the shelf. Some software vendors, such as SAP, specialize in developing software for enterprises. Many organizations are moving to integrated enterprise software that supports supply chain management (movement of raw materials from



Courtesy of IBM Corporation

FIGURE **2.30**

IBM Lotus Notes Social Edition

IBM Lotus Notes Social Edition is workgroup software.

suppliers through shipment of finished goods to customers). Following are some applications that can be addressed with enterprise software.

Accounts payable	Invoicing
Accounts receivable	Manufacturing control
Airline industry operations	Order entry
Automatic teller systems	Payroll
Cash-flow analysis	Receiving
Check processing	Restaurant management
Credit and charge card administration	Retail operations
Distribution control	Sales ordering
Fixed asset accounting	Savings and time deposits
General ledger	Shipping
Human resource management	Stock and bond management
Inventory control	Tax planning and preparation

Organizations can no longer respond to market changes using nonintegrated information systems based on overnight processing of yesterday's business transactions, conflicting data models, and obsolete technology. Wal-Mart and many other companies have sophisticated information systems to speed processing and coordinate communications between stores and their main offices. Many corporations are turning to enterprise resource planning (ERP) software, a set of integrated programs that manage a company's vital business operations for an entire multisite, global organization. Thus, an ERP system must be able to support many legal entities, languages, and currencies. Although the scope can vary from vendor to vendor, most ERP systems provide integrated software to support manufacturing and finance. In addition to these core business processes, some ERP systems might support business functions such as human resources, sales, and distribution. The primary benefits of implementing ERP software include eliminating inefficient systems, easing adoption of improved work processes, improving access to data for operational decision making, standardizing technology vendors and equipment, and enabling supply chain management. In contrast, small businesses usually do not need complex enterprise application software. They rely on software such as Intuit QuickBooks and Microsoft Office Small Business Accounting for accounting and record keeping.

ETHICAL & SOCIETAL ISSUES

Digital Software Systems May Improve Nuclear Power Plant Safety

The safety of nuclear power plants has always been an important consideration in their design. In the wake of the Fukushima plant failure after a record tsunami in March 2011, safety has an even higher priority. Using software to control power plants offers the potential of increased safety compared to earlier methods.

Duke Energy's Oconee nuclear power plant on the eastern shore of Lake Keowee near Seneca, South Carolina, was commissioned in 1973. As it entered the twenty-first century, its older analog control systems were showing their age. The plant suffered minor control failures during the 1990s, though no people were injured and no radiation leaked out as a result. Digital controls were added to some parts of the system in the late 1990s and early 2000s to deal with the most acute problems, but it was clear that Oconee's entire control structure needed to be replaced.

The purpose of a reactor protection system (RPS) is to protect the integrity of the plant's nuclear fuel by monitoring inputs from the reactor core. To accomplish this monitoring, application software must check sensors located throughout the reactor. If any safe operating values are exceeded, the software takes action, such as injecting cooling water or shutting the reactor down by inserting control rods.

After reviewing RPS applications, Duke Energy chose the Teleperm XS (TXS) system from Areva of France because TXS is designed to modernize existing analog instrumentation and control systems, and because its design includes features to ensure reliability. TXS is licensed in 11 countries and was already in use in other nuclear reactors outside the United States, thus assuring Duke that Oconee would not be a test site. TXS encompasses three functional systems:

- **Protection**: Monitoring safety parameters, enabling automatic protection and safeguard actions when an initiating event occurs
- **Surveillance**: Monitoring the core, rod control, and reactor coolant system and performing actions to protect reactor thresholds from being breached
- **Priority and actuator control system**: Managing the control and monitoring of operational and safety system actuators

Reactor Unit 1 of the Oconee facility became the first U.S. nuclear power plant to convert to fully digital control in 2011, Unit 3 in 2012, and Unit 2 in 2013. The conversions took place during the respective reactors' scheduled refueling shutdowns.

The nuclear power industry has recognized the importance of this instrumentation and control system upgrade. In 2012, the Nuclear Energy Institute awarded Duke Energy its "Best of the Best" Top Industry Practice award. Speaking at the award ceremony, Preston Gillespie, vice president at the Oconee site, said, "When I look back over the decision of leaders that I worked for ten years ago, who had the vision of what it would take to install a safety-related digital system, I stand very much in respect of what those leaders did. They knew it would be hard; they knew the cost would be great; they knew they had to find the right partner; they knew they had to get it through the licensing process. All of this, they knew, would result in reliable and safe operation of the plant. Because of that vision, the trail is now blazed for the rest of the industry to take advantage of the fruits of their labor."

If the conversion improves safety and reliability over time, other nuclear power plants will likely follow Oconee's lead as soon as they can afford it,

said David Lochbaum, director of the Nuclear Safety Project for the Union of Concerned Scientists: "There are a lot of eyes on that. If it goes well, you'll probably see many people in the queue making it happen. If it doesn't go well, they are going to wait for Duke Energy to iron out the kinks."

Discussion Questions

1. What functions does Duke's new reactor protection system (RPS) software perform?
2. Duke Energy selected off-the-shelf software for Oconee rather than writing custom software (or having a software development firm write it for them). Discuss the pros and cons of these two approaches in this situation. Do you think Duke Energy made the correct choice? Why or why not?

Critical Thinking Questions

1. What advantages does transforming from analog to digital systems convey? What advantages is the digital upgrade of the RPS expected to afford to Duke?
2. Computers are increasingly used to control systems that affect human lives. Besides nuclear power plants, examples include passenger aircraft, elevators, and medical equipment. Should the programmers who write software for those systems be licensed, be certified, or be required to pass standardized official examinations?

SOURCES: Areva Web site, *www.areva.com*, accessed May 31, 2012; Collins, J., "S.C. Nuke Plant First in U.S. to Go Digital," Herald-Sun (Durham, N.C.), *www.heraldsun.com/view/full_story/13488870/article-S-C–nuke-plant-first-in-U-S–to-go-digital*, May 29, 2011; Staff, "Oconee Nuclear Station Projects Honored with Three Awards by the Nuclear Energy Institute," Duke Energy, *www.duke-energy.com/news/releases/2012052301.asp*, May 23, 2012; Hashemian, H., "USA's First Fully Digital Station," Nuclear Engineering International, *www.neimagazine.com/story.asp?storyCode=2058654*, January 21, 2011; Staff, "Duke Energy Employees Win Top Nuclear Industry Award for Improving Safety With Digital Milestone," Nuclear Energy Institute, *www.nei.org/newsandevents/newsreleases/duke-energy-employees-win-top-nuclear-industry-award-for-improving-safety-with-digital-milestone*, May 23, 2012.

According to a survey, cost is the greatest concern for selecting enterprise software. Other factors include the difficulty to install and manage enterprise software and the ability to integrate enterprise software with other software applications. Increasingly, enterprise application software is being found on smartphones and mobile devices. In one survey, over 80 percent of respondents believe that having enterprise application software that can be used on smartphones and mobile devices was an important factor in selecting enterprise software.

Application Software for Information, Decision Support, and Specialized Purposes

Specialized application software for information, decision support, and competitive advantage is available in every industry. For example, many schools and colleges use Blackboard or other learning management software to organize class materials and grades. Genetic researchers, as another example, are using software to visualize and analyze the human genome. Music executives use decision support software to help pick the next hit song.

Playa lakes appear only after spring rainstorms cause freshwater to collect in the round depressions of the otherwise flat landscape of parts of West Texas, Oklahoma, New Mexico, Nebraska, Colorado, and Kansas. Playas are an important habitat for migratory birds and waterfowl. The Playa DSS is used by natural resource professionals, land managers, and developers to enable them to make better decisions regarding how their collective actions may impact the playas and their associated wildlife.[62]

But how are all these systems actually developed and built? The answer is through the use of programming languages, discussed next.

Programming Languages

Both OSs and application software are written in coding schemes called *programming languages*. The primary function of a programming language is to provide instructions to the computer system so that it can perform a processing activity. IS professionals work with **programming languages**, which are sets of keywords, symbols, and rules for constructing statements that people can use to communicate instructions to a computer. Programming involves translating what a user wants to accomplish into instructions that the computer can understand and execute. The desire to use the power of information processing efficiently in problem solving has pushed the development of literally thousands of programming languages, but only a few dozen are commonly used today. A brief summary of the various programming language generations is provided in Table 2.14.

programming languages: Sets of keywords, symbols, and rules for constructing statements that people can use to communicate instructions to a computer.

TABLE 2.14 Evolution of programming languages

Generation	Language	Approximate Development Date	Sample Statement or Action
First	Machine language	1940s	00010101
Second	Assembly language	1950s	MVC
Third	High-level language	1960s	READ SALES
Fourth	Query and database languages	1970s	PRINT EMPLOYEE NUMBER IF GROSS PAY>1000

Although many programming languages are used to write new business applications, more lines of code are written in COBOL in existing business applications than any other programming language. Today, programmers often use visual and object-oriented languages. In the future, they will likely be using artificial intelligence languages to a greater extent. In general, these languages are easier for nonprogrammers to use compared with older generation languages.

SOFTWARE ISSUES AND TRENDS

Because software is such an important part of today's computer systems, issues such as software bugs, licensing, and global software support have received increased attention.

Software Bugs

A software bug is a defect in a computer program that keeps it from performing as its users expect it to perform. Some software bugs are obvious and cause the program to terminate unexpectedly. Other bugs are subtler and allow errors to creep into your work.

Knight Capital Americas LLC experienced a significant software error in the operation of its automated routing system for equity orders. Over a 45-minute period, the system erroneously routed some 4 million executions in 154 stocks for more than 397 million shares. By the time that Knight stopped sending the orders, the firm had built a net long position in 80 stocks of approximately $3.5 billion and a net short position in 74 stocks of approximately $3.15 billion. By the time everything was sorted out, Knight lost more $460 million from these unwanted positions.[63] Following this disastrous trading error, the firm agreed in December 2012 to be acquired by Getco LLC to form KCG Holdings.[64]

The following list summarizes tips for reducing the impact of software bugs.

- Register all software so that you receive bug alerts, fixes, and patches.
- Check the manual or read-me files for solutions to known problems.
- Access the support area of the manufacturer's Web site for patches.
- Install the latest software updates.
- Before reporting a bug, make sure that you can recreate the circumstances under which it occurs.
- After you can recreate the bug, call the manufacturer's tech support line.
- Consider waiting before buying the latest release of software to give the vendor a chance to discover and remove bugs. Many schools and businesses don't purchase software until the first major revision with patches is released.

Copyrights and Licenses

Most companies aggressively guard and protect the source code of their software from competitors and other predators as well as lawsuits. As a result, most software products are protected by law using copyright or licensing provisions. Those provisions can vary, however. In some cases, you are given unlimited use of software on one or two computers. This stipulation is typical with many applications developed for personal computers. In other cases, you pay for your usage—if you use the software more, you pay more. This approach is becoming popular with software placed on networks or larger computers. Most of these protections prevent you from copying software and giving it to others. Some software now requires that you register or activate it before it can be fully used. This requirement is another way software companies prevent illegal distribution of their products.

Software Upgrades

Software companies revise their programs periodically. Software upgrades vary widely in the benefits that they provide, and what some people call a benefit others might call a drawback. Deciding whether to upgrade to a new version of software can be a challenge for corporations and people with a large investment in software. Should the newest version be purchased when it is released? Some users do not always get the most current software upgrades or versions, unless it includes significant improvements or capabilities. Developing an upgrading strategy is important for many businesses. American Express, for example, has standardized its software upgrade process around the world to make installing updated software faster and more efficient. The standardized process also helps the company make sure that updated software is more stable with fewer errors and problems.

Global Software Support

Large, global companies have little trouble persuading vendors to sell them software licenses for even the most far-flung outposts of their company. But can those same vendors provide adequate support for their software customers in all locations? Supporting local operations is one of the biggest challenges IS teams face when putting together standardized, company-wide

systems. In slower technology growth markets, such as Eastern Europe and Latin America, there may be no official vendor presence at all. Instead, large vendors such as Sybase, IBM, and Hewlett-Packard typically contract out support for their software to local providers.

One approach that has been gaining acceptance in North America is to outsource global support to one or more third-party distributors. The user company can still negotiate its license with the software vendor directly, but it then hands the global support contract to a third-party supplier. The supplier acts as a middleman between software vendor and user, often providing distribution, support, and invoicing.

In today's computer systems, software is an increasingly critical component. Whatever approach people and organizations take to acquire software, everyone must be aware of the current trends in the industry. Informed users are wise consumers.

SUMMARY

Principle:

Computer hardware must be carefully selected to meet the evolving needs of the organization and its supporting information systems.

Hardware refers to the physical components of a computer that perform the input, processing, storage, and output activities of the computer. Processing is performed by an interplay between the central processing unit (CPU) and memory. Primary storage, or memory, provides working storage for program instructions and data to be processed and provides them to the CPU. Together, a CPU and memory process data and execute instructions.

Processing that uses several processing units is called multiprocessing. A multicore processor combines two or more independent processors into a single computer so that they can share the workload and boost processing capacity. Parallel processing involves linking several processors to work together to solve complex problems. Grid computing is the use of a collection of computers, often owned by multiple individuals or organizations, to work in a coordinated manner to solve a common problem. Grid computing is one low-cost approach to parallel processing.

Computer systems can store large amounts of data and instructions in secondary storage, which is less volatile and has greater capacity than memory. Storage media can be either sequential access or direct access. Common forms of secondary storage include magnetic tape, magnetic disk, optical disc storage, and solid state storage devices. Redundant array of independent/inexpensive disks (RAID) is a method of storing data that allows the system to more easily recover data in the event of a hardware failure. A storage area network (SAN) uses computer servers, distributed storage devices, and networks to provide fast and efficient storage. Solid state storage devices store data in memory chips rather than magnetic or optical media. Storage as a service is a data storage model in which a data storage provider rents space to people and organizations.

Input and output devices allow users to provide data and instructions to the computer for processing and allow subsequent storage and output. These devices are part of a user interface through which humans interact with computer systems. Input and output devices vary widely, but they share common characteristics of speed and functionality.

The keyboard and computer mouse are the most common devices used for entry of data. Speech recognition technology enables a computer to interpret human speech as an alternative means of providing data and instructions. Digital cameras record and store images or video in digital form. A magnetic stripe card stores a limited amount of data and can be read by physically swiping the card at a terminal. The chip-and-PIN card employs a computer chip that communicates with a card reader using radio frequencies; it does

not need to be swiped at a terminal. Radio-frequency identification (RFID) technology employs a microchip, called a tag, to transmit data that is read by an RFID reader. The data transmitted could include facts such as item identification number, location information, or other details about the item tagged.

Output devices provide information in different forms, from hard copy to sound to digital format. Display screens are standard output devices; display quality is determined by size, number of colors that can be displayed, and resolution. Other output devices include printers, plotters, and e-books.

Portable single-user computers include handheld computers, laptops, ultrabook computers, and tablet computers. Nonportable single-user computers include thin clients, desktop computers, nettop computers, and workstations. Multiple-user computer systems include servers, mainframe computers, and supercomputers.

Principle:

The computer hardware industry and users are implementing green computing designs and products as well as modern data centers.

Green computing is concerned with the efficient and environmentally responsible design, manufacture, operation, and disposal of IS-related products.

Business organizations recognize that going green is in their best interests in terms of public relations, safety of employees, and the community at large. They also recognize that green computing presents an opportunity to substantially reduce total costs over the life cycle of their IS equipment.

Green computing has three goals: reduce the use of hazardous material, enable companies to lower their power-related costs, and enable the safe disposal or recycling of IS products.

The rapid growth in data centers is stimulated by the increased demand for additional computing and data storage capacity plus the consolidation from many to a few data centers. Organizations are trying a number of strategies to lower the ongoing cost of data center operations.

Principle:

Systems and application software are critical in helping individuals and organizations achieve their goals.

Software consists of programs that control the workings of the computer hardware. The two main categories of software are systems software and application software. Systems software is a collection of programs that interacts between hardware and application software.

An operating system (OS) is a set of computer programs that controls the computer hardware to support users' computing needs. An OS converts an instruction from an application into a set of instructions needed by the hardware. This intermediary role allows hardware independence. An OS also manages memory, which involves controlling storage access and use by converting logical requests into physical locations and by placing data in the best storage space, perhaps virtual memory.

An OS manages tasks to allocate computer resources through multitasking and time-sharing. With multitasking, users can run more than one application at a time.

The ability of a computer to handle an increasing number of concurrent users smoothly is called scalability, a feature critical for systems expected to handle a large number of users.

An OS also provides a user interface, which allows users to access and command the computer. A command-based user interface requires text commands to send instructions; a graphical user interface (GUI), such as Windows, uses icons and menus.

Software applications use the OS by requesting services through a defined application program interface (API). Programmers can use APIs to create application software without having to understand the inner workings of the OS. APIs also provide a degree of hardware independence so that the

underlying hardware can change without necessarily requiring a rewrite of the software applications.

Over the years, many popular OSs have been developed, including Microsoft Windows, the Mac OS X, and Linux. There are several options for OSs in the enterprise as well, depending on the type of server. UNIX is a powerful OS that can be used on many computer system types and platforms, from workstations to mainframe systems. Linux is the kernel of an OS whose source code is freely available to everyone. Google Android, Apple iOS, and Microsoft Windows Phone are popular operating systems used to support mobile communications and consumer appliances. When an OS is stored in solid-state memory embedded in a device, it is referred to as an embedded operating system, or an embedded system for short.

Principle:

Organizations use off-the-shelf application software for common business needs and proprietary application software to meet unique business needs and provide a competitive advantage.

Application software can be proprietary or off the shelf and enables people to solve problems and perform specific tasks.

Application software applies the power of the computer to solve problems and perform specific tasks. One useful way of classifying the many potential uses of information systems is to identify the scope of problems and opportunities addressed by a particular organization or its sphere of influence. For most companies, the spheres of influence are personal, workgroup, and enterprise.

User software, or personal productivity software, includes general-purpose programs that enable users to improve their personal effectiveness, increasing the quality and amount of work that can be done. Software that helps groups work together is often called workgroup application software and includes group scheduling software, electronic mail, and other software that enables people to share ideas. Enterprise software that benefits the entire organization can also be developed or purchased. Many organizations are turning to enterprise resource planning software, a set of integrated programs that manage a company's vital business operations for an entire multisite, global organization.

Three approaches to acquiring application software are to build proprietary application software, buy existing programs off the shelf, or use a combination of customized and off-the-shelf application software. Building proprietary software (in-house or on contract) has the following advantages: The organization gets software that more closely matches its needs; by being involved with the development, the organization has further control over the results; and the organization has more flexibility in making changes. The disadvantages include the following: It is likely to take longer and cost more to develop, the in-house staff will be hard pressed to provide ongoing support and maintenance, and there is a greater risk that the software features will not work as expected or that other performance problems will occur.

Purchasing off-the-shelf software has many advantages. The initial cost is lower, there is a lower risk that the software will fail to work as expected, and the software is likely to be of higher quality than proprietary software. Some disadvantages are that the organization might pay for features it does not need, the software might lack important features requiring expensive customization, and the system might require process reengineering.

Some organizations have taken a third approach—customizing software packages. This approach usually involves a mixture of the preceding advantages and disadvantages and must be carefully managed.

SaaS and recent Web development technologies have led to a new paradigm in computing called cloud computing. Cloud computing refers to the use of computing resources, including software and data storage, on the Internet (the cloud), not on local computers. Rather than installing, storing, and running

software on your own computer, with cloud computing, you access software stored on and delivered from a Web server.

Although hundreds of computer applications can help people at school, home, and work, the primary applications are word processing, spreadsheet analysis, database, graphics, and online services. A software suite, such as Microsoft Office, IBM Lotus Symphony, Corel Word Perfect Office, Apache OpenOffice, Apple iWork, and Google Apps, offers a collection of powerful programs.

Principle:

Organizations should choose a programming language whose functional characteristics are appropriate for the task at hand, considering the skills and experience of the programming staff.

All software programs are written in coding schemes called programming languages, which provide instructions to a computer to perform some processing activity. The several classes of programming languages include machine, assembly, high-level, query and database, and natural and intelligent languages.

Programming languages have changed since their initial development in the early 1950s. In the first generation, computers were programmed in machine language, and the second generation of languages used assembly languages. The third generation consists of many high-level programming languages that use English-like statements and commands. Fourth-generation languages include database and query languages such as SQL.

Users frequently use fourth generation and higher-level programming languages to develop their own simple programs.

Principle:

The software industry continues to undergo constant change; users need to be aware of recent trends and issues to be effective in their business and personal life.

Software bugs, software licensing and copyrighting, software upgrades, and global software support are all important software issues and trends.

A software bug is a defect in a computer program that keeps it from performing in the manner intended. Software bugs are common, even in key pieces of business software.

Software upgrades are an important source of increased revenue for software manufacturers and can provide useful new functionality and improved quality for software users.

Global software support is an important consideration for large, global companies putting together standardized, company-wide systems. A common solution is outsourcing global support to one or more third-party software distributors.

KEY TERMS

application program interface (API)
arithmetic/logic unit (ALU)
blade server
bus
byte (B)
central processing unit (CPU)
clock speed
command-based user interface
compact disc read-only memory (CD-ROM)
computer program
contactless payment card
control unit
data center
desktop computer
digital camera
digital video disc (DVD)
direct access
direct access storage device (DASD)
disk mirroring
Electronic Product Environmental Assessment Tool (EPEAT)
gigahertz (GHz)

graphical user interface (GUI)
green computing
grid computing
handheld computer
hard disk drive (HDD)
laptop computer
magnetic disk
magnetic stripe card
magnetic tape
mainframe computer
massively parallel processing system
middleware
multicore microprocessor
multiprocessing
nettop computer
off-the-shelf software
parallel computing
pixel
point-of-sale (POS) device
portable computer
primary storage (main memory; memory)
programming language
proprietary software
radio frequency identification (RFID)
random access memory (RAM)
read-only memory (ROM)
redundant array of independent/inexpensive disks (RAID)
register
sequential access
sequential access storage device (SASD)
server
service-oriented architecture (SOA)
smart card
Software as a Service (SaaS)
software suite
speech-recognition technology
storage area network (SAN)
storage as a service
supercomputer
tablet computer
thin client
user interface
utility program
virtual tape
workstation

CHAPTER 2: SELF-ASSESSMENT TEST

Computer hardware must be carefully selected to meet the evolving needs of the organization and its supporting information systems.

1. The overriding consideration for a business in making hardware decisions should be how the hardware supports the _____ of the information system and goals of the organization.
2. An advantage of ARM processors over traditional complex instruction set processors is that _____.
   a. they do not require large heat sinks and fans to remove excess heat
   b. they weigh less
   c. they are more energy efficient
   d. all of the above
3. Solid state storage devices require less power and provide faster data access than magnetic data-storage devices. True or False?

The computer hardware industry and users are implementing green computing designs and products as well as modern data centers.

4. Green computing is about saving the environment; there are no real business benefits associated with this program. True or False?
5. The disposal and reclamation operations for IS equipment must be careful to avoid unsafe exposure to _____.

Systems and application software are critical in helping individuals and organizations achieve their goals.

6. Which of the following is an example of a command-driven operating system?
   a. XP
   b. Mavericks
   c. MS DOS
   d. Windows 7
7. It will be years before computers are smart enough to use a speech or motion user interface. True or False?

Organizations use off-the-shelf application software for common business needs and proprietary application software to meet unique business needs and provide a competitive advantage.

8. Software that enables users to improve their personal effectiveness, increasing the amount of work they can do and its quality, is called _____.
   a. personal productivity software
   b. operating system software
   c. utility software
   d. graphics software

9. Optimization can be found in which type of application software?
   a. spreadsheets
   b. word-processing programs
   c. personal information management programs
   d. presentation graphics programs
10. _____ software is one-of-a-kind software designed for a specific application and owned by the company, organization, or person that uses it.

Organizations should choose a programming language whose functional characteristics are appropriate for the task at hand, considering the skills and experience of the programming staff.

11. End users will never be able to master the complexities of programming and create their own applications. True or False?

The software industry continues to undergo constant change; users need to be aware of recent trends and issues to be effective in their business and personal life.

12. Outsourcing global support to one or more third-party software distributors is a common solution to global software support. True or False?

CHAPTER 2: SELF-ASSESSMENT TEST ANSWERS

1. objectives
2. c
3. True
4. False
5. hazardous materials
6. c
7. False
8. a
9. a
10. Proprietary
11. False
12. True

REVIEW QUESTIONS

1. What are the three goals of green computing?
2. Identify two basic characteristics of RAM and ROM.
3. What is RFID technology? Give a practical example of the use of RFID technology.
4. What is a blade server? What are two advantages associated with the use of blade servers?
5. Describe the role of the control unit and the arithmetic and logic unit.
6. What is solid state storage technology? What advantages does it offer?
7. Identify and briefly describe the various classes of portable single-user computers.
8. What is the EPEAT? How is it used?
9. Give three examples of smartphone operating systems.
10. What is Software as a Service (SaaS)? What advantages does it provide for meeting an organization's software needs?
11. What is an application programming interface?
12. Identify and briefly describe five basic task management techniques employed in operating systems.
13. What role does a Linux distributor play?
14. What is the greatest advantage of using a 64-bit computer?
15. What is an embedded system? Give three examples of such a system.
16. What is cloud computing? What are the pros and cons of cloud computing?
17. Describe the term workgroup application software and give three examples.
18. What is middleware?

DISCUSSION QUESTIONS

1. Discuss the role of the business manager in helping to determine the computer hardware to be used by the organization.
2. Briefly discuss the advantages and disadvantages of frequent software upgrades from the perspective of the user of that software. How about from the perspective of the software manufacturer?
3. What would be the advantages for a university computer lab to install thin clients rather than standard desktop personal computers? Can you identify any disadvantages?
4. What is 3D printing? Identify three objects that you think would be practical to create using 3D printing.
5. Which would you rather have—a tablet computer or a smartphone? Why?
6. You are going to buy a personal computer. What operating system features are important to you? What operating system would you select, and why?
7. What are some of the advantages and disadvantages of employing Software as a Service (SaaS)? What precautions might you take to minimize the risk of using one?

8. You have been asked to develop a user interface for someone with limited sight—someone without the ability to recognize shapes on a computer screen. Describe the user interface you would recommend.
9. Identify the three spheres of influence and briefly discuss the software needs of each.
10. Identify the two fundamental sources for obtaining application software. Discuss the advantages and disadvantages of each source.
11. In what ways is an operating system for a mainframe computer different from the operating system for a laptop computer? In what ways are they similar?
12. Describe three personal productivity software packages you are likely to use the most. What personal productivity software packages would you select for your use?
13. Briefly explain the difference between parallel computing, grid computing, and cloud computing.

PROBLEM-SOLVING EXERCISES

1. Do research to find the total worldwide sales in units for smartphones, tablet computers, laptop computers, and desktop computers for the last five or six years. Use graphing software to draw a chart showing these sales figures. Write a paragraph summarizing your findings.
2. "Spreadsheets, even after careful development, contain errors in 1% or more of all formula cells," according to Ray Panko, a professor of IT management at the University of Hawaii and an authority on bad spreadsheet practices. This means that large spreadsheets could contain dozens of undetected errors.[65] Outline several measures that could be taken to ensure the accuracy of a large spreadsheet that is used to make key business decisions.
3. Imagine that you are going to buy a smartphone to improve your communication capabilities and organizational abilities. What tasks do you need it to perform? What features would you look for in this device? Visit a phone store or a consumer electronics store and identify the specific device and manufacturer that comes closest to meeting your needs at a cost under $155. Enter the smartphone specifications into an Excel spreadsheet that you cut and paste into the document defining your needs. Email the document to your instructor.
4. Develop a six-slide presentation that compares the advantages and disadvantages of proprietary software versus off-the shelf software.

TEAM ACTIVITIES

1. With one or two of your classmates, visit a data center or server farm. As you tour the facility, draw a simple diagram showing the locations of various pieces of hardware equipment. Label each piece of equipment. Discuss the need for power backup, surge protection, and HVAC. Be sure to obtain permission from the appropriate company resources prior to your visit.
2. With one or two of your classmates, visit a retail store that employs Radio Frequency Identification chips to track inventory. Interview an employee involved in inventory control, and document the advantages and disadvantages they see in this technology.
3. Form a group of three or four classmates. Find articles from business periodicals, search the Internet, and interview people on the topic of modifying off-the-shelf software packages. Identify the three greatest pros and cons of this strategy. Compile your results for an in-class presentation or a written report.

WEB EXERCISES

1. Countries and manufacturers are competing to develop the fastest supercomputer. Do research on the Web to identify the current three fastest supercomputers and how they are being used. Write a brief report summarizing your findings.
2. Do research on the Web to learn more about why Apple decided to cease registering its products in EPEAT and then later reversed that decision. Write a one-page report summarizing your findings.
3. Use the Web to find multiple reviews and reports on four different personal productivity software suites from various vendors. Create a table in a word-processing document to show what applications are provided by the competing suites. For each suite, write a paragraph summarizing its strengths and weaknesses. Write a final paragraph stating which suite you would choose and why.

CAREER EXERCISES

1. Examine the possibility of a career in computer hardware sales. Which area of sales do you believe holds the brightest prospects for young college graduates—mainframe computers, supercomputers, or high-volume storage devices? Why? What would be some of the advantages and disadvantages of a career in computer hardware sales?
2. Identify three specific smartphone applications that would greatly help you in your current or next job. (The applications may already exist or you may identify ones you wish did exist). Describe specific features of each application and how you would use them.
3. Your employer earns $50 million in annual sales and employs 500 workers. It plans to acquire 100 new portable computers. The chief financial officer has asked you to lead a project team assigned to define users' computer hardware needs and recommend the most cost-effective solution for meeting those needs. Who else (role, department) and how many people would you select to be a member of the team? How would you go about defining users' needs? Do you think that only one kind of portable computer will meet everyone's needs? Should you define multiple portable computers based on the needs of various classes of end user? What business justification can you define to justify this expenditure of roughly $100,000?

CASE STUDIES

Case One

Kaiser Permanente Implements Electronic Health Record (EHR) System

Kaiser Permanente is an integrated healthcare organization founded in 1945. The company operates one of the nation's largest not-for-profit health plans, with over 9 million health plan subscribers. Kaiser Permanente also includes Kaiser Foundation Hospitals (encompassing 37 hospitals) and The Permanente Medical Groups, with 611 medical offices. The company employs nearly 176,000 people, including 17,157 physicians. Its 2012 operating revenue was almost $51 billion.

HealthConnect is the name of Kaiser's comprehensive health information system. Over the past decade, HealthConnect has been a leader in the implementation of electronic health records (EHR), computer-readable records of health-related information on individuals. In 2003, Kaiser had announced its intention to work with Epic Systems Corporation over a three-year period to build an integrated set of systems to support EHRs, computerized physician order entry, scheduling and billing, and clinical decision support at an estimated cost of $1.8 billion. This decision came after Kaiser had already made several unsuccessful attempts at clinical automation projects. The project eventually ballooned into a seven-year, $4.2 billion effort as the scope of the project was expanded time and again. Training and productivity losses made up more than 50 percent of the cost of the project as Kaiser had to cut physicians' hours at clinics during training and was forced to hire physicians temporarily to handle the workload.

However, in 2010, Kaiser announced that it had fully implemented EHR applications at all of its hospitals and clinics. Finally, it could begin reaping the benefits from its efforts.

The HealthConnect system connects Kaiser plan subscribers to their healthcare providers and to their personal healthcare information. The system uses EHRs to coordinate patient care among physician's offices, hospitals, testing labs, and pharmacies. The EHR is designed to ensure that patients and their healthcare providers all have access to current, accurate, and complete patient data. The system and its data are now accessible via smartphone as well as personal computer. During 2012, there were over 88 million subscriber sign-ons to the system.

Physicians and nurses in hospitals, clinics, and private offices document treatment in the EHR system. After a physician enters a diagnosis into the system, he or she may receive a system message indicating that there is a "best practice order set" available for treating the condition. When they enter a medication order, physicians receive alerts about potential allergic reactions or adverse drug reactions based on other medications a patient is already taking. Physicians also receive automatic notifications about how lab test results should affect medication orders.

HealthConnect also provides capabilities to support bar coding for the safe administration of medicine. Under this system of administering medication, the nurse first scans the patient's barcoded identification wristband. The nurse next scans a bar code on the medication container that identifies the specific medicine and dosage. The system verifies that this medicine and dosage has been ordered for this patient. If there is not a match, the nurse receives an audible warning signal.

Kaiser has found that use of a comprehensive EHR improves health plan subscribers' satisfaction with the healthcare delivery system. In addition, HealthConnect empowers healthcare plan subscribers to take more responsibility for managing their own health care. Kaiser subscribers can access HealthConnect via a Web portal at kp.org. Here they are able to view most of their personal health records online, including their lab results, medication history, and treatment summaries. Patients can enter their own readings from blood pressure and glucose meters.

They can also securely email their healthcare providers, which cuts down on the amount of time patients spend on hold waiting to speak to a doctor and on the number of office visits (the number of outpatient visits has dropped an average of 8 percent in the one and one-half years following EHR implementation at each hospital). Each month patients send over 1 million emails to their doctors and healthcare teams through this component of the system. Over 29 million lab test results were viewed online in 2011. In addition, approximately 827,000 prescriptions are being refilled online monthly, and 230,000 appointments are scheduled monthly.

HealthConnect enables physicians to benchmark their performance against colleagues on a number of fronts—efficiency, quality, safety, and service. Hospitals can also benchmark each other on measures such as adverse events and complications. "Best in class" practices can be identified, and physicians and hospitals can borrow these best practices from one another to further improve the overall quality of care.

As the EHR system is further enhanced, Kaiser will likely find new ways to reap benefits from its system to improve efficiency and the quality of healthcare.

Kaiser began working on implementing an EHR system in 2003 and finally completed the implementation in 2010. Along the way, the company tried several different approaches, ran into numerous problems, and spent millions of dollars. It is just now beginning to reap the benefits from this effort. It likely will take time, further system enhancements, and additional expenditures for many other organizations to see similar benefits.

Discussion Questions

1. What troubles did Kaiser run into when it first tried to implement the EHR system? Is Kaiser's experience typical of leading-edge companies? If so, how?
2. Researchers associated with Kaiser Permanente have used the patient record database to make numerous worthwhile discoveries in the areas of preventing whooping cough, determining the correlation between HPV vaccination and sexual activity in young girls, improving methods of cancer detection, avoiding blood clots in women using birth control pills, and lowering cholesterol. Do you think that access to this valuable data should be granted to researchers not associated with Kaiser Permanente? Should researchers be charged a fee to access this data to help offset the ongoing cost of upgrading the system?

Critical Thinking Questions

1. What strategic advantage does Kaiser gain from its EHR system?
2. What do you think are the greatest benefits of the HealthConnect system for Kaiser Permanente subscribers? Can you identify any potential risks or ethical issues associated with the use of this system for Kaiser healthcare plan subscribers? How would you answer these questions from the perspective of a physician or nurse?

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Case Two

Sending Computers into the Cloud

Since the modern electronic computer was invented in the 1940s, the trend has been toward reducing the size of the computer while increasing its capability. The logical end of this trend is to remove the physical computer altogether. While that isn't likely to happen in business, companies have found ways to make their central computers disappear.

Central computers still exist, of course, but if you look around business offices, follow the cables from a desktop or wireless router through walls and down halls, you may not find a central computer. What you'll find instead in more and more organizations are signals going "into the cloud." That saying refers to cloud computing, which provides computing services and database access over the Internet that are accessible from anywhere in the world rather than from a specific computer in a specific location.

Deutsche Bank (DB), the German financial services firm, made a decision to send its computers into the cloud. As Alistair McLaurin of its Global Technology Engineering group put it, the bank "wanted to create something radically different," to "challenge assumptions around what centrally provided IT services could be and how much they must cost." DB created a system in which computing is done by virtual machines (VMs): software-managed "slices" of real computers that behave in every respect like a full computer but that share the hardware of one real computer with many other VMs. A virtual machine is an extension of the familiar concept of running more than one program at a time. In a VM, you run more than one operating system at a time, with each completely isolated from the others. The result is substantial savings in hardware cost and everything that goes with it, such as space and electricity. By putting the computers that host their virtual machines in the cloud, DB freed themselves from the constraints of being at a particular physical location. DB can thus optimize the use of these virtual computers across the entire company.

Another advantage of the virtual approach is that someone who needs a new computer doesn't have to purchase one. Instead, they can use a virtual computer inside a real computer that the company already has; such a VM is easier to set up than a new system. In fact, "a user who is a permanent employee, who wants a new Virtual Machine for their own use only, can do it by visiting one Web site, selecting an operating system [Windows, Solaris, or Linux] and clicking three buttons. The new VM will be ready and available for them within an hour."

The Open Data Center Alliance recently chose DB as the grand prize winner of its Conquering the Cloud Challenge. The specific basis for the award was the way DB's cloud-based

system manages user identities. When a user requests a virtual machine, the system already knows who has to approve the request (if anyone), where its cost should be billed, and who should be allowed to administer the machine. The cloud-based system means users don't have to worry about how virtual machines are created, making it more practical to use them. Because a virtual machine is less expensive than a new desktop computer, DB management wanted to encourage employees to use the virtual machines. Removing barriers to their adoption was important, which is why they designed the cloud-based system to manage user identities.

Currently, programmers and other system developers use DB's cloud system for application development and testing. If a developer is working with a computer that runs Solaris and wants to test an application under Windows 7 or Windows Vista, he or she can do so using a virtual machine quickly and efficiently. The cloud system will be used next for DB production applications, except for those that need 100 percent uptime (such as the one that operates a network of ATMs). After that? Who knows?

Discussion Questions

1. What was innovative about the manner in which the Deutsche Bank manages identities?
2. What other types of companies could use this innovation to cut IT costs?

Critical Thinking Questions

1. Would cloud computing be useful to your school? To a specific small business you can think of?
2. How does the location independence of cloud computing help Deutsche Bank or any other organization?

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Questions for Web Case

See the Web site for this book to read about the Altitude Online case for this chapter. Following are questions concerning this Web case.

Altitude Online: Choosing Hardware Discussion Questions

1. How might Altitude Online determine what new hardware devices it requires to support the service that its employees use?
2. How will Altitude Online determine the computing power and storage requirements of the new system?

Critical Thinking Questions

1. What should Altitude Online do with its old computer hardware as it is replaced with new hardware?
2. Why do you think Altitude Online decided to phase in new desktop computers but replace mobile devices all at once?

Altitude Online: Choosing Software Discussion Questions

1. Why do you think Altitude Online uses two PC platforms—Windows and Mac—rather than standardizing on one? What are the benefits and drawbacks of their decision?
2. Why do you think a business is required to keep copies of all of its software licenses?

Critical Thinking Questions

1. How much freedom should a company like Altitude Online allow for its employees to choose their own personal application software? Why might a company prefer to standardize around specific software packages?
2. What benefits might be provided to an advertising media company like Altitude Online by upgrading to the latest media development and production software? How might upgrading provide the company with a competitive advantage?

NOTES

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3 Database Systems and Applications

Principles	Learning Objectives
• Data management and modeling are key aspects of organizing data and information.	• Define general data management concepts and terms, highlighting the advantages of the database approach to data management. • Describe logical and physical database design considerations and the relational database model.
• A well-designed and well-managed database is an extremely valuable tool in supporting decision making.	• Identify the common functions performed by all database management systems, and identify popular database management systems.
• The number and types of database applications will continue to evolve and yield real business benefits.	• Identify and briefly discuss business intelligence, data mining, and other database applications.

Information Systems in the Global Economy
VELUX, DENMARK

Implementing the Next Generation of Business Intelligence


Adam Mork

The VELUX Group is one of the largest international building materials manufacturers in the world. Headquartered in Denmark, the VELUX group employs about 10,000 people who work in manufacturing plants in 11 countries and sales offices in just under 40 countries spread across Europe, the Americas, Asia, and Australia. It is so successful that in many countries, in fact, a flat roof window is simply called a velux.

Not surprising, then, is the VELUX Group's early adoption of information systems technology to support business intelligence. Business intelligence (BI) involves gathering and analyzing data in a timely manner to support the development of effective business strategies, tactics, and operations. In 2000, the VELUX Group turned to the IT department to initiate the introduction of a BI system. The IT group successfully generated financial reports, but few people used the system.

The VELUX Group's experience was not atypical. At that time, BI system development was often left to IT departments that did not supply the type of reports that managers, the users of the system, needed. By 2005, VELUX top executives became involved in shaping the BI system, deciding what data and analyses the BI system should provide. The number of users increased to 800 company-wide. Yet, many lower level managers were still not relying on the BI reports.

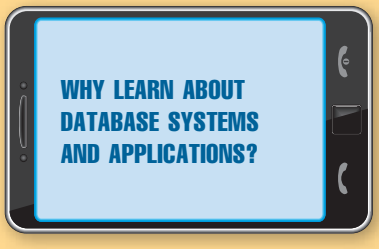
As a result, in 2011, the VELUX Group conducted a thorough investigation to find out why more managers were not using the reports. It created a team to explore the needs of its end-users prior to developing and adopting new SAP BI technology. It discovered that many potential users did not understand the existing data and those that did often had little use for standard reports, but rather needed customized analyses. As a result, some business units and subsidiaries had invested in their own systems, incurring additional costs. The company realized that it would have to develop a user-friendly interface to enable these users to use one centralized, cheaper, faster system. The system had to access a rapidly growing bank of internal and external data in a timely manner.

In 2013, the VELUX Group launched its new SAP BI system. The pool of BI users is now expanding from 800 users to 4,000. The SAP team is also working with users to make sure they have the analytical skills that they need to make use of the new tools at their disposal. Rather than simply generating budgets and financial targets, the new systems uses simulation models to allow managers to plan the number of units and prices to be manufactured at a granular level.

The VELUX Group's endeavors represent the next generation of BI development, in which companies are learning how to tailor their systems to the needs of a wider body of users operating at lower levels of the decision-making process. The hope is to extend the advantages of BI while reducing the costs.

As you read this chapter, consider the following:

- Why is it important for all business units to be involved in the development and adoption of data management, data modeling, and business information systems?
- How can businesses use the information in their databases to be more effective?



A huge amount of data is captured for processing by computers every day. Where does all this data go, and how is it used? How can it help you on the job? In this chapter, you will learn about database systems and applications that can help you make the most effective use of information. If you become a marketing manager, you can access a vast store of data on existing and potential customers from surveys, their Web habits, and their past purchases. This information can help you sell products and services. If you become a corporate lawyer, you will have access to past cases and legal opinions from sophisticated legal databases. This information can help you win cases and protect your organization legally. If you become a human resource (HR) manager, you will be able to use databases and applications to analyze the impact of raises, employee insurance benefits, and retirement contributions on long-term costs to your company. Regardless of your field of study in school, using database systems and applications will likely be a critical part of your job. As you read this chapter, you will see how you can use databases and applications to extract and analyze valuable information to help you succeed. This chapter starts by introducing basic concepts of database management systems.

A database is a well-designed, organized, and carefully managed collection of data. Like other components of an information system, a database should help an organization achieve its goals. A database can contribute to organizational success by providing managers and decision makers with timely, accurate, and relevant information built on data. Databases also help companies analyze information to reduce costs, increase profits, add new customers, track past business activities, and open new market opportunities.

database management system (DBMS): A group of programs that manipulate the database and provide an interface between the database and the user of the database and other application programs.

A **database management system (DBMS)** consists of a group of programs that manipulate the database and provide an interface between the database and its users and other application programs. Usually purchased from a database company, a DBMS provides a single point of management and control over data resources, which can be critical to maintaining the integrity and security of the data. Oracle's DBMS, for example, now includes a firewall to help secure the databases of its customers.[1] A database, a DBMS, and the application programs that use the data make up a database environment.

Databases and database management systems are becoming even more important to organizations as they deal with rapidly increasing amounts of information. Indeed, although many organizations today have dozens of databases, without good data management, it is nearly impossible for anyone to find the right and related information for accurate and business-critical decision making.[2]

DATA MANAGEMENT

Without data and the ability to process it, an organization cannot successfully complete most business activities. It cannot pay employees, send out bills, order new inventory, or produce information to assist managers in decision making. As you recall, data consists of raw facts, such as employee numbers and sales figures. For data to be transformed into useful information, it must first be organized in a meaningful way.

Hierarchy of Data

Data is generally organized in a hierarchy that begins with the smallest piece of data used by computers (a bit) and progresses through the hierarchy to a database. A bit (a binary digit) represents a circuit that is either on or off. Bits can be organized into units called *bytes*. A byte is typically eight bits.

character: A basic building block of most information, consisting of uppercase letters, lowercase letters, numeric digits, or special symbols.

Each byte represents a **character**, which is the basic building block of most information. A character can be an uppercase letter (A, B, C … Z), lowercase letter (a, b, c … z), numeric digit (0, 1, 2 … 9), or special symbol (., !, +, −, /, …).

field: Typically a name, number, or combination of characters that describes an aspect of a business object or activity.

Characters are put together to form a field. A **field** is typically a name, number, or combination of characters that describes an aspect of a business object (such as an employee, a location, or a truck) or activity (such as a sale). In addition to being entered into a database, fields can be computed from other fields. *Computed fields* include the total, average, maximum, and minimum value. A collection of data fields all related to one object, activity, or individual is called a **record**. By combining descriptions of the characteristics of an object, activity, or individual, a record can provide a complete description of it. For instance, an employee record is a collection of fields about one employee. One field includes the employee's name, another field contains the address, and still others the phone number, pay rate, earnings made to date, and so forth. A collection of related records is a **file**—for example, an employee file is a collection of all company employee records. Likewise, an inventory file is a collection of all inventory records for a particular company or organization. Some database software refers to files as tables.

record: A collection of data fields all related to one object, activity, or individual.

file: A collection of related records.

At the highest level of the data hierarchy is a *database*, a collection of integrated and related files. Together, bits, characters, fields, records, files, and databases form the **hierarchy of data**. See Figure 3.1. Characters are combined to make a field, fields are combined to make a record, records are combined to make a file, and files are combined to make a database. A database houses not only all these levels of data but also the relationships among them.

hierarchy of data: Bits, characters, fields, records, files, and databases.

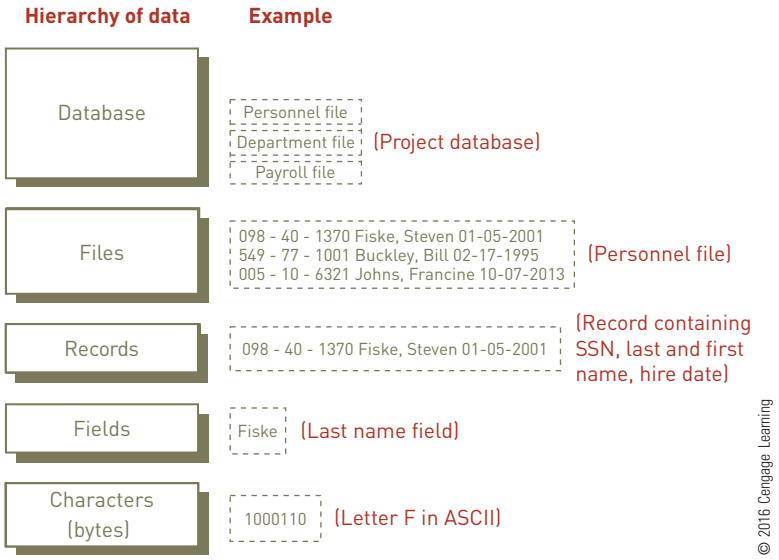


FIGURE **3.1**

Hierarchy of data

Together, bits, characters, fields, records, files, and databases form the hierarchy of data.

Data Entities, Attributes, and Keys

entity: A person, place, or thing for which data is collected, stored, and maintained.

Entities, attributes, and keys are important database concepts. An **entity** is a person, place, or thing (object) for which data is collected, stored, and maintained. Examples of entities include employees, products, and plants. Most organizations organize and store data as entities.

attribute: A characteristic of an entity.

An **attribute** is a characteristic of an entity. For example, employee number, last name, first name, hire date, and department number are attributes for an employee. See Figure 3.2. The inventory number, description, number of units on hand, and location of the inventory item in the warehouse are attributes for items in inventory. Customer number, name, address, phone number, credit rating, and contact person are attributes for customers.

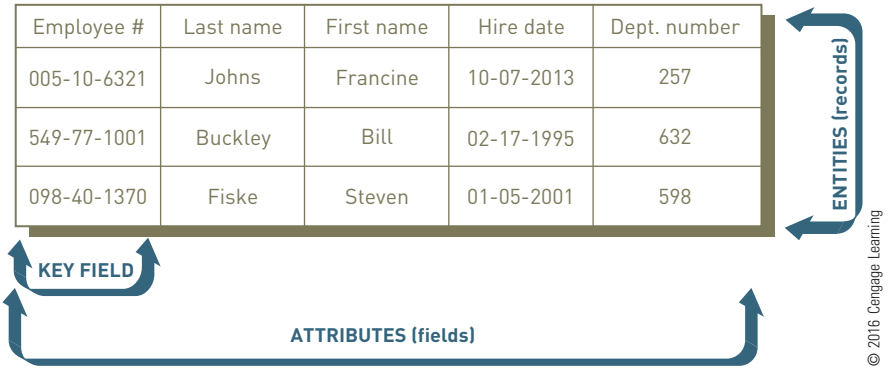


FIGURE **3.2**

Keys and attributes

The key field is the employee number. The attributes include last name, first name, hire date, and department number.

Attributes are usually selected to reflect the relevant characteristics of entities such as employees or customers. The specific value of an attribute, called a **data item**, can be found in the fields of the record describing an entity.

data item: The specific value of an attribute.

Many organizations create databases of attributes and enter data items to store data needed to run their day-to-day operations, as in the following examples.

- The German government implemented a Visa Alert database to be used by immigration officials worldwide to review Visa applications. Immigration authorities, police, and public prosecutor offices upload information on visa overstays, visa fraud, unlawful employment, and criminal offenses to the database. Local police and immigration offices can request access to the database to verify information for local immigration procedures, such as visa extensions and deportation proceedings.[3]
- Wireless network providers are implementing a database using unique smartphone identifying numbers to prevent stolen smartphones from being activated or provided service on their networks.[4]
- dunnhumby, a United Kingdom-based customer analytics company, is building databases that combine individual consumers' TV viewing data with their supermarket purchasing data. The firm can then work with brand marketers responsible for media buying to make their TV advertising purchase decisions based on actual consumer purchase data.[5]
- Zoomlion is a leading Chinese manufacturer of construction equipment and industrial machinery with operations in 80 countries across six continents. A Zoomlion database enables the firm to rank the performance of its after-sales subcontractors and identify where it needs to improve service to avoid losing customers.[6]

primary key: A field or set of fields that uniquely identifies the record.

As discussed earlier, a collection of fields about a specific object is a record. A **primary key** is a field or set of fields that uniquely identifies the record. No other record can have the same primary key. For an employee record, such as the one shown in Figure 3.2, the employee number is an example of a primary key. The primary key is used to distinguish records so that they can be accessed, organized, and manipulated. Primary keys ensure that each record in a file is unique. For example, eBay assigns an "Item number" as its primary key for items to make sure that bids are associated with the correct item. See Figure 3.3.

Locating a particular record that meets a specific set of criteria might be easier and faster using a combination of secondary keys. For example, a customer might call a mail-order company to place an order for clothes. The order clerk can easily access the customer's mailing and billing information by entering the primary key—usually a customer number—but if the customer does not know the correct primary key, a secondary key such as last name can be used. In this case, the order clerk enters the last name, such as Adams. If several customers have a last name of Adams, the clerk can check

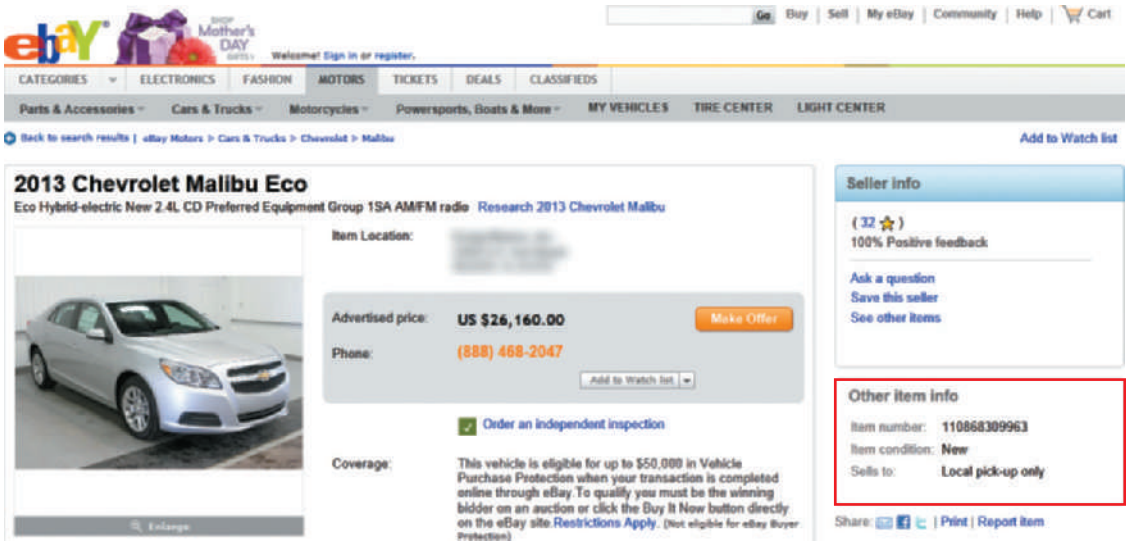


FIGURE **3.3**

Primary key

eBay assigns an Item number as a primary key to keep track of each item in its database.

other fields, such as address, first name, and so on, to find the correct customer record. After locating the correct record, the order can be completed and the clothing items shipped to the customer.

The Database Approach

At one time, information systems referenced specific files containing relevant data. For example, a payroll system would use a payroll file. Each distinct operational system used data files dedicated to that system. This approach to data management is called the **traditional approach to data management**.

traditional approach to data management: An approach to data management whereby each distinct operational system uses data files dedicated to that system.

Today, most organizations use the **database approach to data management**, where multiple information systems share a pool of related data. A database offers the ability to share data and information resources. Federal databases, for example, often include the results of DNA tests as an attribute for convicted criminals. The information can be shared with law enforcement officials around the country. Often, distinct yet related databases are linked to provide enterprise-wide databases. For example, many Walgreens stores include in-store medical clinics for customers. Walgreens uses an electronic health records database that stores the information of all patients across all stores. The database provides information about customers' interactions with the clinics and pharmacies.

database approach to data management: An approach to data management where multiple information systems share a pool of related data.

To use the database approach to data management, additional software—a database management system (DBMS)—is required. As previously discussed, a DBMS consists of a group of programs that can be used as an interface between a database and the user of the database. Typically, this software acts as a buffer between the application programs and the database itself. Figure 3.4 illustrates the database approach.

DATA MODELING AND DATABASE CHARACTERISTICS

Because today's businesses must keep track of and analyze so much data, they must keep the data well organized so that it can be used effectively. A database should be designed to store all data relevant to the business and provide quick access and easy modification. Moreover, it must reflect the

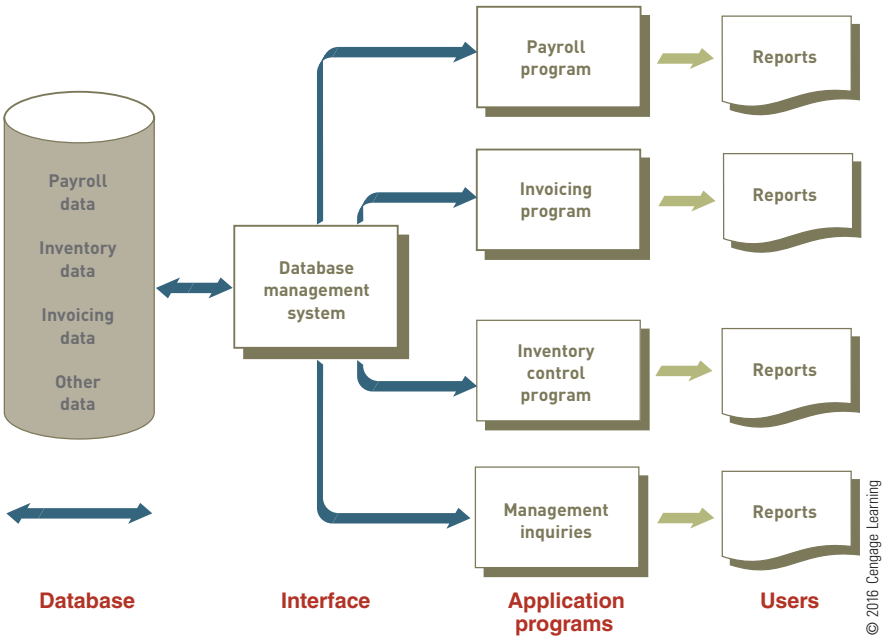


FIGURE **3.4**

Database approach to data management

In a database approach to data management, multiple information systems share a pool of related data.

business processes of the organization. When building a database, an organization must carefully consider these questions:

- **Content.** What data should be collected and at what cost?
- **Access.** What data should be provided to which users and when?
- **Logical structure.** How should data be arranged so that it makes sense to a given user?
- **Physical organization.** Where should data be physically located?

Data Modeling

When organizing a database, key considerations include determining what data to collect, what will be the source of the data, who will have access to it, how they might want to use it, and how to monitor database performance. For example, Harrison College serves a student population of 5,000 with 12 campuses throughout Indiana and Ohio, and online at Harrison.edu. The college uses networking and storage devices from HP, Dell, F5 Networks, and Cisco. The college implemented a database-monitoring tool to gain insight into the status of their database applications and the hardware on which those applications run. During a datacenter power outage, the monitoring tool helped the IT support staff to determine quickly which servers had come back online and take prompt action to restart them without a major loss of services.[7]

data model: A diagram of data entities and their relationships.

enterprise data modeling: Data modeling done at the level of the entire enterprise.

One of the tools database designers use to show the logical relationships among data is a data model. A **data model** is a diagram of entities and their relationships. Data modeling usually involves understanding a specific business problem and analyzing the data and information needed to deliver a solution. When done at the level of the entire organization, this procedure is called enterprise data modeling. **Enterprise data modeling** is an approach that starts by investigating the general data and information needs of the organization at the strategic level and then examines more specific data and information needs for the functional areas and departments within the organization. Various models have been developed to help managers and database designers analyze data and information needs. An entity-relationship diagram is an example of such a data model.

entity-relationship (ER) diagrams: Data models that use basic graphical symbols to show the organization of and relationships between data.

Entity-relationship (ER) diagrams use basic graphical symbols to show the organization of and relationships between data. In other words, ER diagrams show data items in tables (entities) and the ways they are related.

ER diagrams help ensure that the relationships among the data entities in a database are correctly structured so that any application programs developed are consistent with business operations and user needs. In addition, ER diagrams can serve as reference documents after a database is in use. If changes are made to the database, ER diagrams help design them. Figure 3.5 shows an ER diagram for an order database. In this database design, one salesperson serves many customers. This is an example of a one-to-many relationship, as indicated by the one-to-many symbol (the "crow's-foot") shown in Figure 3.5. The ER diagram also shows that each customer can place one-to-many orders, that each order includes one-to-many line items, and that many line items can specify the same product (a many-to-one relationship). This database can also have one-to-one relationships. For example, one order generates one invoice.

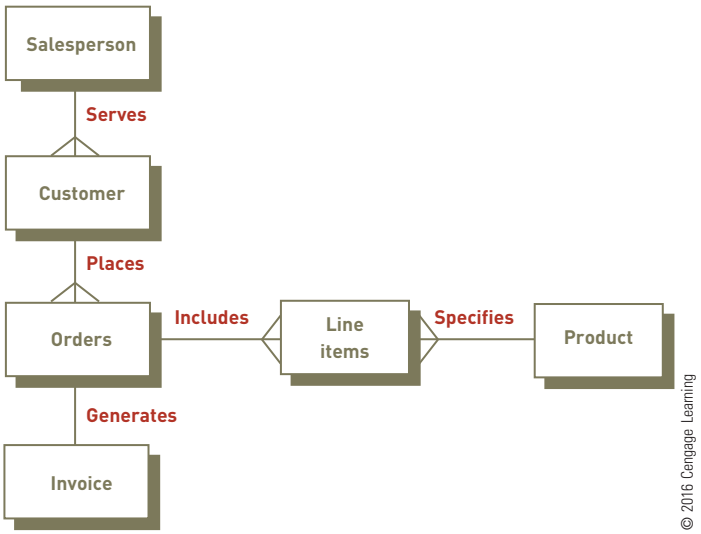


FIGURE **3.5**

Entity-relationship (ER) diagram for a customer order database

Development of ER diagrams helps ensure that the logical structure of application programs is consistent with the data relationships in the database.

Relational Database Model

The relational database model has been an outstanding success and is dominant in the commercial world today, although many organizations are beginning to use new nonrelational models to meet some of their business needs. The **relational model** is a simple but highly useful way to organize data into collections of two dimensional tables called relations. Each row in the table represents an entity, and each column represents an attribute of that entity. See Figure 3.6.

relational model: A simple but highly useful way to organize data into collections of two-dimensional tables called relations.

Databases based on the relational model include Oracle, IBM DB2, Microsoft SQL Server, Microsoft Access, MySQL, and Sybase. Oracle holds 48 percent of the 2012 worldwide relational database management systems market share according to market research firm Gartner. This is a larger market share than its four closest competitors combined (IBM, Microsoft, SAP, and Teradata).[8]

domain: The range of allowable values for a data attribute.

Each attribute can be constrained to a range of allowable values called its **domain**. The domain for a particular attribute indicates what values can be placed in each column of the relational table. For instance, the domain for an attribute such as gender could be limited to the two characters M (male) or F (female). If someone tried to enter a "1" in the gender field, the data would

Data Table 1: Project Table

Project	Description	Dept. number
155	Payroll	257
498	Widgets	632
226	Sales manual	598

Data Table 2: Department Table

Dept.	Dept. name	Manager SSN
257	Accounting	005-10-6321
632	Manufacturing	549-77-1001
598	Marketing	098-40-1370

Data Table 3: Manager Table

SSN	Last name	First name	Hire date	Dept. number
005-10-6321	Johns	Francine	10-07-2013	257
549-77-1001	Buckley	Bill	02-17-1995	632
098-40-1370	Fiske	Steven	01-05-2001	598

FIGURE **3.6**

Relational database model

In the relational model, data is placed in two-dimensional tables, or relations. As long as they share at least one common element, these relations can be linked to provide output useful information.

not be accepted. The domain for pay rate would not include negative numbers. In this way, defining a domain can increase data accuracy.

Manipulating Data

After entering data into a relational database, users can make inquiries and analyze the data. Basic data manipulations include selecting, projecting, and joining. **Selecting** involves eliminating rows according to certain criteria. Suppose an HR manager wants to use an employee table that contains the project number, description, and department number for all projects a company is performing. The manager might want to find the department number for Project 226, a sales manual project. Using selection, the manager can eliminate all rows but the one for Project 226 and see that the department number for the department completing the sales manual project is 598.

selecting: Manipulating data to eliminate rows according to certain criteria.

Projecting involves eliminating columns in a table. For example, a department table might contain the department number, department name, and Social Security number (SSN) of the manager in charge of the project. A sales manager might want to create a new table with only the department number and the Social Security number of the manager in charge of the sales manual project. The sales manager can use projection to eliminate the department name column and create a new table containing only the department number and SSN.

projecting: Manipulating data to eliminate columns in a table.

Joining involves combining two or more tables. For example, you can combine the project table and the department table to create a new table with the project number, project description, department number, department name, and Social Security number for the manager in charge of the project.

joining: Manipulating data to combine two or more tables.

As long as the tables share at least one common data attribute, the tables in a relational database can be linked to provide useful information and

linking: The ability to combine two or more tables through common data attributes to form a new table with only the unique data attributes.

reports. **Linking**, the ability to combine two or more tables through common data attributes to form a new table with only the unique data attributes, is one of the keys to the flexibility and power of relational databases. Suppose the president of a company wants to find out the name of the manager of the sales manual project and the length of time the manager has been with the company. Assume that the company has the manager, department, and project tables shown in Figure 3.6. A simplified ER diagram showing the relationship between these tables is shown in Figure 3.7.

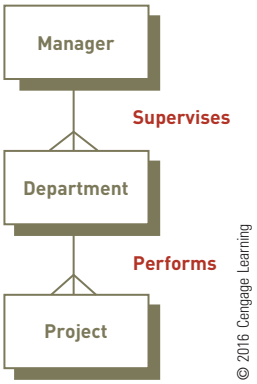


FIGURE **3.7**

Simplified ER diagram

This diagram shows the relationship among the Manager, Department, and Project tables.

Note the crow's-foot by the Project table. This symbol indicates that a department can have many projects. The president would make the inquiry to the database, perhaps via a personal computer. The DBMS would start with the project description and search the Project table to find out the project's department number. It would then use the department number to search the Department table for the manager's Social Security number. The department number is also in the Department table and is the common element that links the Project table to the Department table. The DBMS uses the manager's Social Security number to search the Manager table for the manager's hire date. The manager's Social Security number is the common element between the Department table and the Manager table. The final result is that the manager's name and hire date are presented to the president as a response to the inquiry. See Figure 3.8.

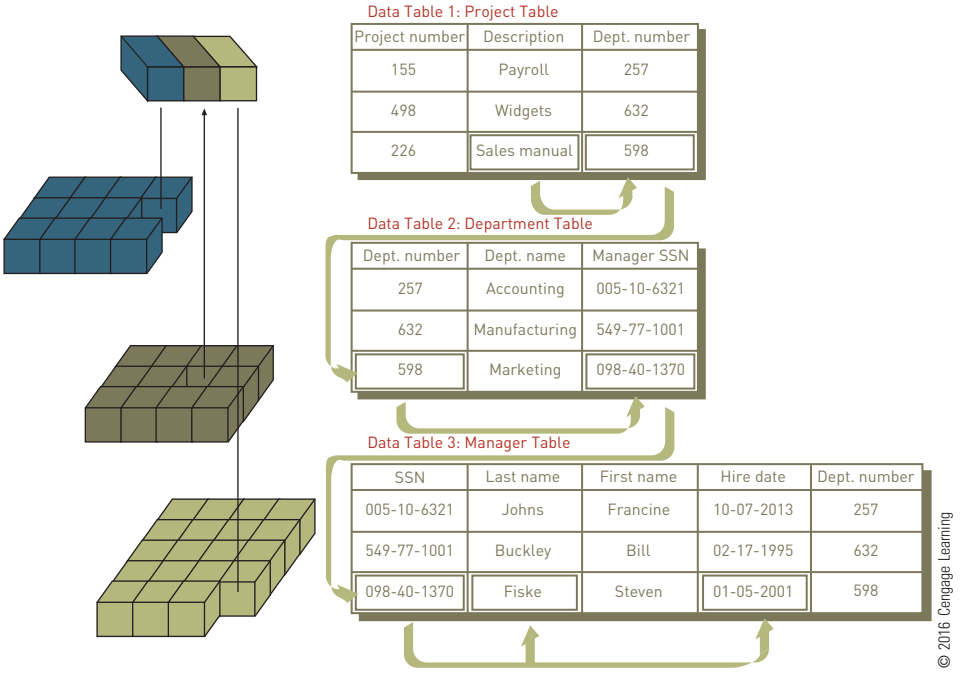


FIGURE **3.8**

Linking data tables to answer an inquiry

For finding the name and hire date of the manager working on the sales manual project, the president needs three tables: Project, Department, and Manager. The project description (Sales manual) leads to the department number (598) in the Project table, which leads to the manager's SSN (098-40-1370) in the Department table, which leads to the manager's name (Fiske) and hire date (01-05-2001) in the Manager table.

One of the primary advantages of a relational database is that it allows tables to be linked, as shown in Figure 3.8. This linkage reduces data redundancy and allows data to be organized more logically. The ability to link to the manager's SSN stored once in the Manager table eliminates the need to store it multiple times in the Project table.

The relational database model is currently the most widely used. It is easier to control, more flexible, and more intuitive than other approaches because it organizes data in tables. As shown in Figure 3.9, a relational database management system, such as Microsoft Access, can be used to store data in rows and columns. In this figure, hyperlinks at the top of the Access database can be used to create, edit, and manipulate the database. The ability to link relational tables also allows users to relate data in new ways without having to redefine complex relationships. Because of the advantages of the relational model, many companies use it for large corporate databases, such as those for marketing and accounting.

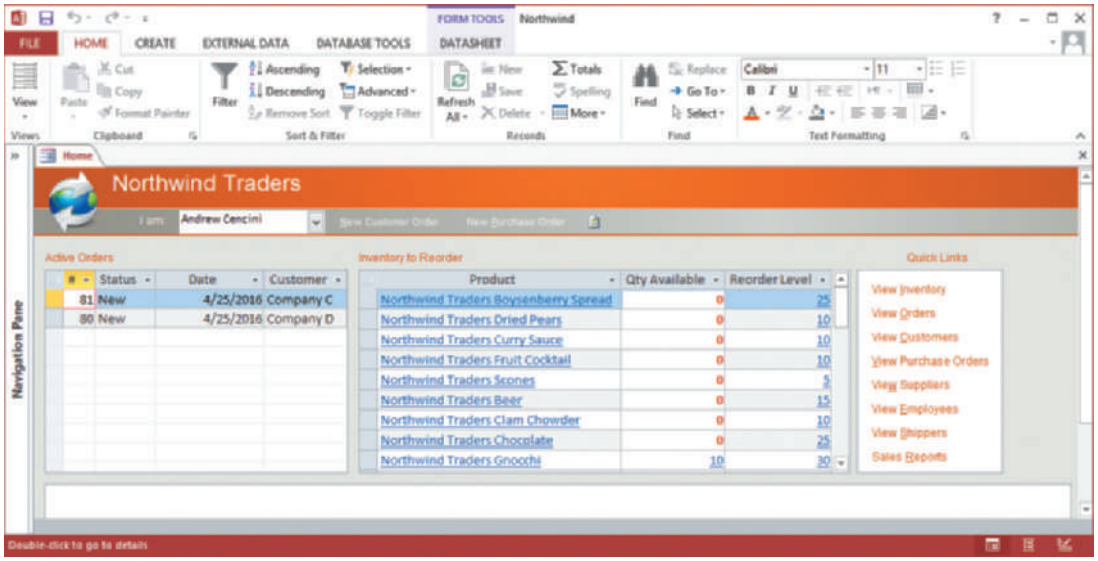


FIGURE 3.9

Building and modifying a relational database

Relational databases provide many tools, tips, and shortcuts to simplify the process of creating and modifying a database.

Data Cleansing

data cleansing (data cleaning or data scrubbing): The process of detecting and then correcting or deleting incomplete, incorrect, inaccurate, irrelevant records that reside in a database.

Data used in decision making must be accurate, complete, economical, flexible, reliable, relevant, simple, timely, verifiable, accessible, and secure. **Data cleansing (data cleaning** or **data scrubbing)** is the process of detecting and then correcting or deleting incomplete, incorrect, inaccurate, irrelevant records that reside in a database. The goal is to improve the quality of the data used in decision making. The "bad data" may have been caused by user data entry errors or by data corruption during data transmission or storage. Data cleansing is different from data validation, which involves the identification of "bad data" and its rejection at the time of data entry.

One data cleansing solution is to identify and correct the data by cross-checking it against a validated data set. For example, street number, street name, city, state, and zip code entries in an organization's database may be cross-checked against the United States Postal Zip Code database. Data cleansing may also involve standardization of data, such as the conversion of various possible abbreviations (St., St, st., st) to one standard name (Street).

Data enhancement augments the data in a database by adding related information such as using the zip code information for a given record to append the county code or census tract code.

DATABASE MANAGEMENT SYSTEMS

Creating and implementing the right database system ensures that the database will support both business activities and goals. But how do we actually create, implement, use, and update a database? The answer is found in the database management system. As discussed earlier, a DBMS is a group of programs used as an interface between a database and application programs or a database and the user. There is a wide range of capabilities and types of database systems.

Overview of Database Types

Database management systems can range from small inexpensive software packages to sophisticated systems costing hundreds of thousands of dollars. The following sections discuss a few popular alternatives. See Figure 3.10 for one example.

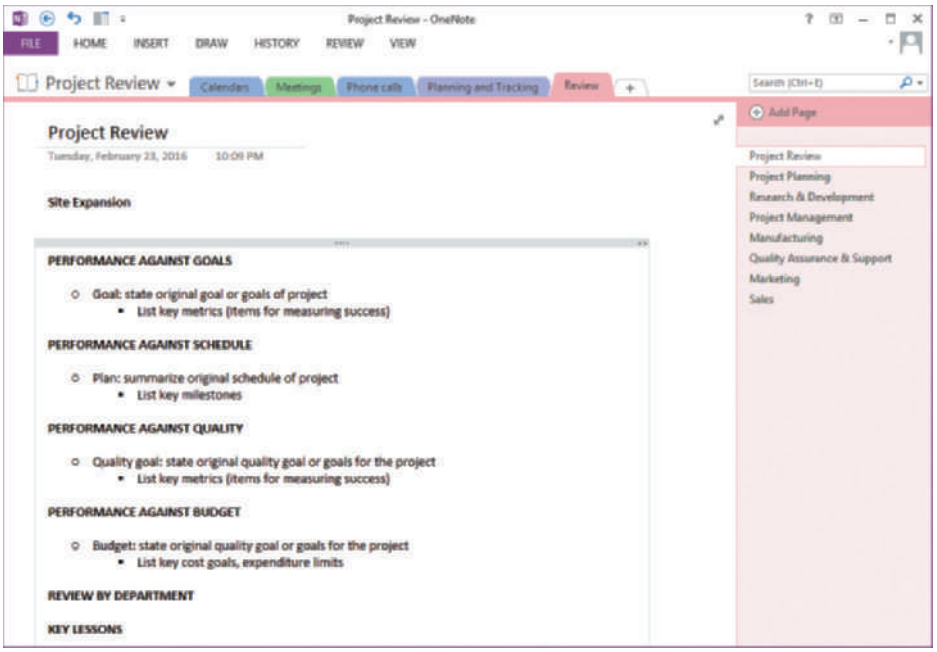


FIGURE **3.10**

Microsoft OneNote

Microsoft OneNote lets you gather any type of information and then retrieve, copy, and paste the information into other applications, such as word-processing and spreadsheet programs.

Single-User DBMS

A database installed on a personal computer is typically meant for a single user. This means that when user A is accessing the database, user B must wait until user A is finished. Microsoft Access and InfoPath, Lotus Approach, Personal Oracle, and DB Everyplace are designed to support single-user implementations.

Multiple-User DBMS

Small, midsize, and large businesses need multiuser DBMSs to share information throughout the organization over a network. These more powerful, expensive systems allow dozens or hundreds of people to access the same database system at the same time. Popular vendors for multiuser database systems include Oracle, Microsoft, Sybase, and IBM. Many single-user databases, such as Microsoft Access, can be implemented for multiuser support over a

network, though they often are limited in the number of users they can support.

Flat Files

A flat file is a simple database program whose records have no relationship to one another. Flat file databases are often used to store and manipulate a single table or file. Many spreadsheet and word-processing programs have flat file capabilities. These software packages can sort records and make simple calculations and comparisons. Microsoft OneNote is designed to let people put ideas, thoughts, and notes into a flat file. Similar to OneNote, Evernote is a free online database service that can store notes and other pieces of information, including photos, voice memos, or handwritten notes. Evernote can be used on computers, smartphones, tablet computers, and other mobile devices.

Intuit, Inc., provides financial management software for small and mid-sized organizations. It has over 4 million active users with the popular QuickBooks one of its leading products. Intuit is continually meeting with its customers to better understand their needs. These discussions led to the discovery of a need to provide increased functionality, improved performance, and better reporting capabilities. The solution that the Intuit engineering team came up with was to convert from the existing flat file data management system to a relational database management system. "We realized that by moving to a true relational database we could enhance the capabilities and the value of QuickBooks for our customers," says Siddharth Ram, Intuit group architect.[9]

SQL Databases

SQL is a special purpose programming language for accessing and manipulating data stored in a relational database. It was originally defined by Donald D. Chamberlin and Raymond Boyce of the IBM Research Center and described in their paper "SEQUEL: A Structured English Query Language," *Proceedings of the ACM SIGFIDET Conference, May 1974*. Their work was based on the relational database model described by Edgar F. Codd in his groundbreaking paper from 1970, "A Relational Model of Data for Large Shared Data Banks."

SQL databases conform to ACID properties (Atomicity, Consistency, Isolation, Durability), defined by Jim Gray soon after Codd's work. These properties guarantee database transactions are processed reliably and ensure the integrity of data in the database. Basically, these principles mean that data is broken down to atomic values (employee_ID, last_name, first_name, address_line_1, address_line_2, city, and so on) while remaining consistent across the database, isolated from other transactions until the current transaction is finished, and durable in the sense that the data should never be lost.[10]

SQL databases rely upon concurrency control by locking database records to ensure that other transactions do not modify the database until the first transaction succeeds or fails. As a result, 100 percent ACID-compliant SQL databases can suffer from slow performance.

In 1986, the American National Standards Institute (ANSI) adopted SQL as the standard query language for relational databases. Since ANSI's acceptance of SQL, interest in making SQL an integral part of relational databases on both mainframe and personal computers has increased. SQL has many built-in functions, such as average (AVG), the largest value (MAX), the smallest value (MIN), and others. Table 3.1 contains examples of SQL commands.

SQL lets programmers learn one powerful query language and use it on systems ranging from PCs to the largest mainframe computers. See Figure 3.11. Programmers and database users also find SQL valuable because SQL statements can be embedded into many programming languages, such as the widely used C++, Java, and other languages. Because SQL uses

TABLE 3.1 Examples of SQL commands

SQL Command	Description
SELECT ClientName, Debt FROM Client WHERE Debt > 1000	This query displays all clients (ClientName) and the amount they owe the company (Debt) from a database table called Client for clients who owe the company more than $1,000 (WHERE Debt > 1000).
SELECT ClientName, ClientNum, OrderNum FROM Client, Order WHERE Client.ClientNum= Order.ClientNum	This command is an example of a join command that combines data from two tables: the Client table and the Order table (FROM Client, Order). The command creates a new table with the client name, client number, and order number (SELECT ClientName, ClientNum, OrderNum). Both tables include the client number, which allows them to be joined. This ability is indicated in the WHERE clause, which states that the client number in the Client table is the same as (equal to) the client number in the Order table (WHERE Client.ClientNum=Order.ClientNum).
GRANT INSERT ON Client to Guthrie	This command is an example of a security command. It allows Bob Guthrie to insert new values or rows into the Client table.

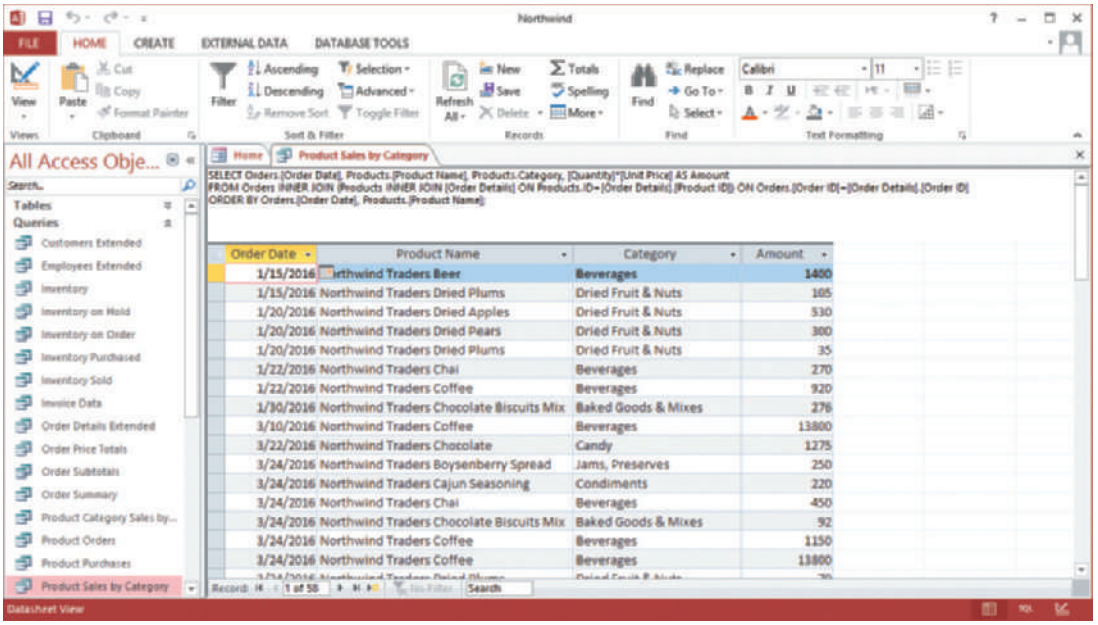


FIGURE 3.11

Structured Query Language

Structured Query Language (SQL) has become an integral part of most relational databases, as shown by this example from Microsoft Access 2013.

standardized and simplified procedures for retrieving, storing, and manipulating data, the popular database query language can be easy to understand and use.

NoSQL Databases

NoSQL database: A database designed to store and retrieve data in a manner that does not rigidly enforce the atomic conditions associated with the relational database model in order to provide faster performance and greater scalability.

A **NoSQL database** is designed to store and retrieve data in a manner that does not rigidly enforce the atomic conditions associated with the relational database model. The goal of a NoSQL database is to provide faster performance and greater scalability. NoSQL databases lack strong data consistency—the ability to ensure that an update to data in one part of the database is *immediately* propagated to all other parts of the database. NoSQL databases are finding significant and growing industry use in dealing with extremely large database and real-time Web applications.

A NoSQL database stores data as highly optimized key-value stores wherein the data is stored in a simple two-column table with one column reserved for the primary key and the other for the value. A NoSQL database is highly scalable, meaning that a large database may be distributed across hundreds, thousands, or even tens of thousands of servers running the same NoSQL database management system. This distribution of the database improves system uptime as the database can still process almost all transactions even if a server or two someplace is down. (Scaling a traditional SQL database is much more complicated.). Facebook employs thousands of servers running the NoSQL database Cassandra to handle millions of queries per second and ensure around the clock processing.

Amazon uses the Dynamo DB NoSQL database to track millions of daily sales transactions. The database employs an *eventually consistent* approach to processing transactions in order to gain speed and increase system uptime.[11]

Hadoop is an open-source software framework including several software modules that provide a means for storing and processing extremely large data sets. For years, Yahoo used Hadoop to better personalize the ads and articles that its visitors see. Now Hadoop is used by many popular Web sites and services (eBay, Etsy, Twitter, and Yelp, to name a few).[12] Hadoop divides the data into subsets and distributes the subsets onto different servers for processing. The Hadoop MapReduce software module is a programming model designed for processing large volumes of data in parallel by dividing the work into a set of independent tasks. This approach creates a very robust computing environment that allows the application to keep running even if individual servers fail.

Visual, Audio, and Other Database Systems

In addition to raw data, organizations are finding a need to store large amounts of visual and audio signals in an organized fashion. Credit card companies, for example, enter pictures of charge slips into an image database using a scanner. The images can be stored in the database and later sorted by customer name, printed, and sent to customers along with their monthly statements. Image databases are also used by physicians to store X-rays and transmit them to clinics away from the main hospital. Financial services, insurance companies, and government branches are using image databases to store vital records and replace paper documents. Drug companies often need to analyze many visual images from laboratories. Visual databases can be stored in some object-relational databases or special-purpose database systems. Many relational databases can also store images.

In addition to visual, audio, and virtual databases, other special-purpose database systems meet particular business needs. For example, *spatial databases* provide location-based services, where business and public sector Web sites embed location and maps into their Web applications and operational systems. Gas, electric, pipeline, and water agencies use spatial databases to support mission-critical applications such as mobile asset maintenance, outage management, network maintenance, and crisis management. See Figure 3.12. Retailers use spatial analytics and map visualization techniques to decide where to locate new stores and where to deploy sales personnel based on customer demographic analysis. Highway agencies, railways, public transport, and delivery services use spatial technology to track and maintain assets, develop delivery and transportation schedules, and optimize routes to reduce transit time and costs. Government agencies such as police and fire departments, land management, homeland security, public works, and urban planning use spatial databases to improve planning and operations.[13]

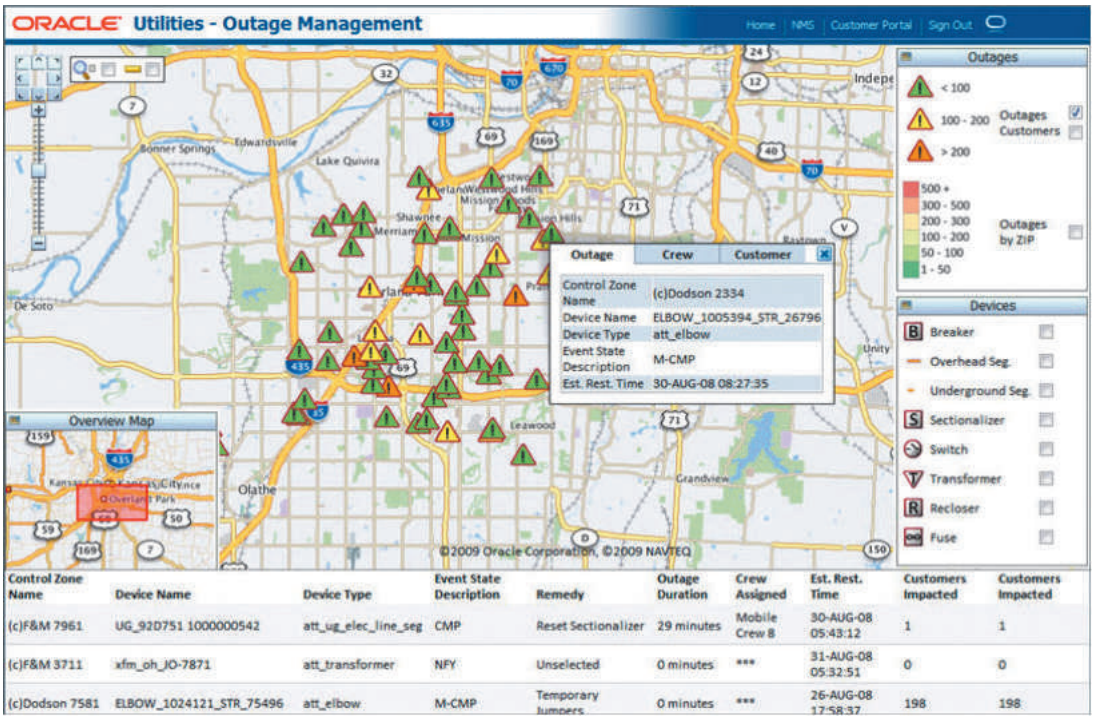


FIGURE **3.12**

Spatial data technology

Oracle Spatial Network Data Model is used by gas, electric, pipeline, and water agencies for live, mission-critical network applications such as mobile asset maintenance, outage management, network maintenance, and crisis management.

Database Activities

You use a database to provide a user view of the database, to add and modify data, store and retrieve data, and to manipulate the data and generate reports. Each of these activities is discussed in more detail in the following sections.

Providing a User View

schema: A description of the entire database.

Because the DBMS is responsible for access to a database, one of the first steps in installing and using a large database involves "telling" the DBMS the logical and physical structure of the data and the relationships among the data for each user. This description is called a **schema** (as in a schematic diagram). Large database systems, such as Oracle, typically use schemas to define the tables and other database features associated with a person or user. A schema can be part of the database or a separate schema file. The DBMS can reference a schema to find where to access the requested data in relation to another piece of data.

Creating and Modifying the Database

data definition language (DDL): A collection of instructions and commands used to define and describe data and relationships in a specific database.

Schemas are entered into the DBMS (usually by database personnel) via a data definition language. A **data definition language (DDL)** is a collection of instructions and commands used to define and describe data and relationships in a specific database. A DDL allows the database's creator to describe the data and relationships that are to be contained in the schema. In general, a DDL describes logical access paths and logical records in the database. Figure 3.13 shows a simplified example of a DDL used to develop a general schema. The use of the letter *X* in Figure 3.13 reveals where specific information concerning the database should be entered. File description, area description, record description, and set description are terms the DDL defines and

```
SCHEMA DESCRIPTION
SCHEMA NAME IS XXXX
AUTHOR        XXXX
DATE          XXXX
FILE DESCRIPTION
      FILE NAME IS XXXX
        ASSIGN XXXX
      FILE NAME IS XXXX
        ASSIGN XXXX
AREA DESCRIPTION
      AREA NAME IS XXXX
RECORD DESCRIPTION
      RECORD NAME IS XXXX
      RECORD ID IS XXXX
      LOCATION MODE IS XXXX
      WITHIN XXXX AREA FROM XXXX THRU XXXX
SET DESCRIPTION
      SET NAME IS XXXX
      ORDER IS XXXX
      MODE IS XXXX
      MEMBER IS XXXX
      .
      .
      .
```


FIGURE **3.13**

Data definition language

You use a data definition language to define a schema.

uses in this example. Other terms and commands can be used, depending on the DBMS employed.

data dictionary: A detailed description of all the data used in the database.

Another important step in creating a database is to establish a **data dictionary**, a detailed description of all data used in the database. The data dictionary contains the following information:

- Name of the data item
- Aliases or other names that may be used to describe the item
- Range of values that can be used
- Type of data (such as alphanumeric or numeric)
- Amount of storage needed for the item
- Notation of the person responsible for updating it and the various users who can access it
- List of reports that use the data item

A data dictionary can also include a description of data flows, the way records are organized, and the data-processing requirements. Figure 3.14 shows a typical data dictionary entry.

```
                NORTHWESTERN MANUFACTURING

PREPARED BY:          D. BORDWELL
DATE:                 04 AUGUST 2016
APPROVED BY:          J. EDWARDS
DATE:                 13 OCTOBER 2016
VERSION:              3.1
PAGE:                 1 OF 1

DATA ELEMENT NAME:    PARTNO
DESCRIPTION:          INVENTORY PART NUMBER
OTHER NAMES:          PTNO
VALUE RANGE:          100 TO 5000
DATA TYPE:            NUMERIC
POSITIONS:            4 POSITIONS OR COLUMNS
```


FIGURE **3.14**

Data dictionary entry

A data dictionary provides a detailed description of all data used in the database.

For example, the information in a data dictionary for the part number of an inventory item can include the following information:

- Name of the person who made the data dictionary entry (D. Bordwell)
- Date the entry was made (August 4, 2016)
- Name of the person who approved the entry (J. Edwards)
- Approval date (October 13, 2016)
- Version number (3.1)
- Number of pages used for the entry (1)
- Part name (PARTNO)
- Other part names that might be used (PTNO)
- Range of values (part numbers can range from 1000 to 5000)
- Type of data (numeric)
- Storage required (four positions are required for the part number)

A data dictionary is valuable in maintaining an efficient database that stores reliable information with no redundancy, and it makes it easy to modify the database when necessary. Data dictionaries also help computer and system programmers who require a detailed description of data elements stored in a database to create the code to access the data.

Adherence to the standards defined in the data dictionary also makes it easy to share data among various organizations. For example, the United States Department of Energy (DOE) developed a data dictionary of terms to provide a standardized approach for the evaluation of energy data. The Building Energy Data Exchange Specification (BEDES) provides a common language of key data elements including data formats, valid ranges, and definitions that will improve communications between contractors, software vendors, finance companies, utilities, and Public Utility Commissions. Adherence to these data standards will allow information to be easily shared and aggregated without the need for extensive data scrubbing and translation. All stakeholders can use this standard set of data to answer key questions related to the energy savings and financial performance of commercial and residential buildings.[14]

Storing and Retrieving Data

One function of a DBMS is to be an interface between an application program and the database. When an application program needs data, it requests the data through the DBMS. Suppose that to calculate the total price of a new car, a pricing program needs price data on the engine option—six cylinders instead of the standard four cylinders. The application program requests this data from the DBMS. In doing so, the application program follows a logical access path. Next, the DBMS, working with various system programs, accesses a storage device, such as disk drives and solid-state storage devices (SSDs), where the data is stored. When the DBMS goes to this storage device to retrieve the data, it follows a path to the physical location (physical access path) where the price of this option is stored. In the pricing example, the DBMS might go to a disk drive to retrieve the price data for six-cylinder engines. This relationship is shown in Figure 3.15.

This same process is used if a user wants to get information from the database. First, the user requests the data from the DBMS. For example, a user might give a command, such as LIST ALL OPTIONS FOR WHICH PRICE IS GREATER THAN $200. This is the logical access path (LAP). Then, the DBMS might go to the options price section of a disk to get the information for the user. This is the physical access path (PAP).

Two or more people or programs attempting to access the same record at the same time can cause a problem. For example, an inventory control program might attempt to reduce the inventory level for a product by 10 units because 10 units were just shipped to a customer. At the same time, a purchasing program might attempt to increase the inventory level for the same product by 200 units because inventory was just received. Without proper database control, one of the inventory updates might be incorrect, resulting

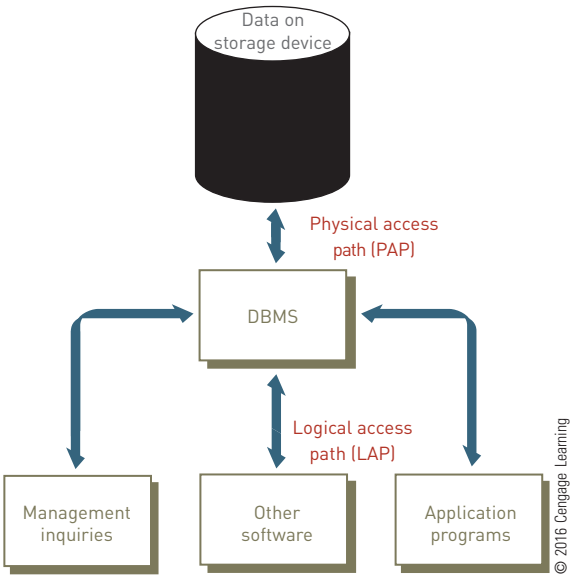


FIGURE **3.15**

Logical and physical access paths

When an application requests data from the DBMS, it follows a logical access path to the data. When the DBMS retrieves the data, it follows a path to the physical access path to the data.

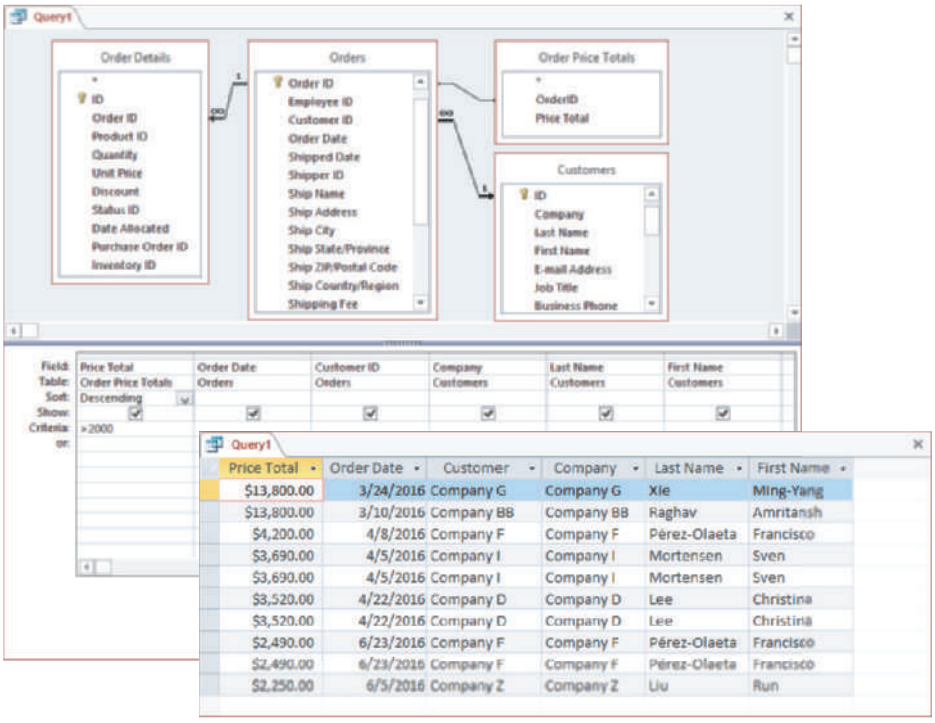
concurrency control: A method of dealing with a situation in which two or more users or applications need to access the same record at the same time.

in an inaccurate inventory level for the product. **Concurrency control** can be used to avoid this potential problem. One approach is to lock out all other application programs from access to a record if the record is being updated or used by another program.

Manipulating Data and Generating Reports

After a DBMS has been installed, employees, managers, and other authorized users can use it to review reports and obtain important information. Using a DBMS, a company can manage this requirement. Some databases use *Query by Example (QBE)*, which is a visual approach to developing database queries or requests. Like Windows and other GUI operating systems, you can perform queries and other database tasks by opening windows and clicking the data or features you want. See Figure 3.16.

In other cases, database commands can be used in a programming language. For example, C++ commands can be used in simple programs that



Microsoft product screenshots used with permission from Microsoft Corporation.

FIGURE **3.16**

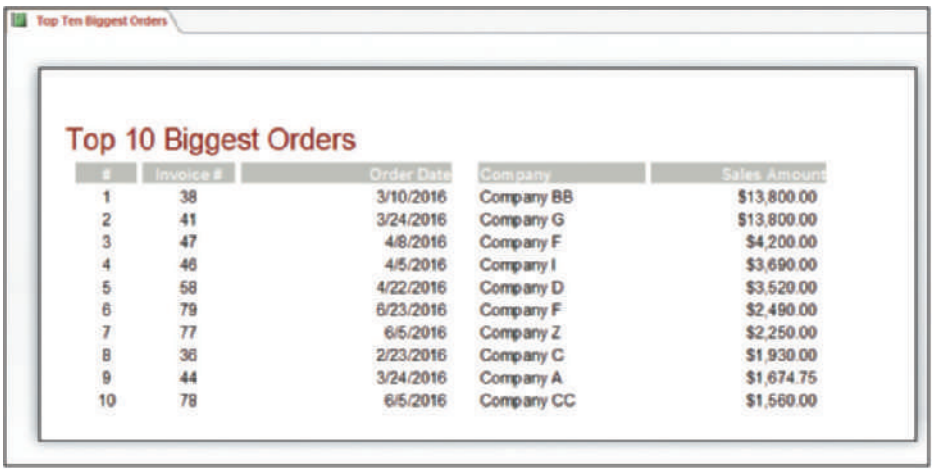
Query by Example

Some databases use Query by Example (QBE) to generate reports and information.

will access or manipulate certain pieces of data in the database. Here's another example of a DBMS query: SELECT * FROM EMPLOYEE WHERE JOB_CLASSIFICATION="C2." The asterisk (*) tells the program to include all columns from the EMPLOYEE table. In general, the commands that are used to manipulate the database are part of the **data manipulation language (DML)**. This specific language, provided with the DBMS, allows managers and other database users to access and modify the data, to make queries, and to generate reports. Again, the application programs go through schemas and the DBMS before getting to the data stored on a device such as a disk.

data manipulation language (DML): A specific language, provided with a DBMS, which allows users to access and modify the data, to make queries, and to generate reports.

After a database has been set up and loaded with data, it can produce desired reports, documents, and other outputs. See Figure 3.17. These outputs usually appear in screen displays or hard copy printouts. The output-control features of a database program allow you to select the records and fields you want to appear in reports. You can also make calculations specifically for the report by manipulating database fields. Formatting controls and organization options (such as report headings) help you to customize reports and create flexible, convenient, and powerful information-handling tools.



Microsoft product screenshots used with permission from Microsoft Corporation.

FIGURE **3.17**

Database output

A database application offers sophisticated formatting and organization options to produce the right information in the right format.

A DBMS can produce a wide variety of documents, reports, and other output that can help organizations achieve their goals. The most common reports select and organize data to present summary information about some aspect of company operations. For example, accounting reports often summarize financial data such as current and past due accounts. Many companies base their routine operating decisions on regular status reports that show the progress of specific orders toward completion and delivery.

Database Administration

Database administrators (DBA) are skilled and trained IS professionals who hold discussions with users to define their data needs; apply database programming languages to craft a set of databases to meet those needs; test and evaluate databases; implement changes to improve their performance; and assure that data is secure from unauthorized access. Database systems require a skilled database administrator (DBA), who is expected to have a clear understanding of the fundamental business of the organization, be proficient in the use of selected database management systems, and stay abreast of emerging technologies and new design approaches. The role of the DBA is to plan, design, create, operate, secure, monitor, and maintain databases. Typically, a DBA has a degree in computer science or management information systems and some on-the-job training with a particular database product or more extensive experience with a range of database products. See Figure 3.18.

database administrators (DBAs): Skilled and trained IS professionals who hold discussions with users to define their data needs; apply database programming languages to craft a set of databases to meet those needs; test and evaluate databases; implement changes to improve their performance; and assure that data are secure from unauthorized access.

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FIGURE **3.18**

Database administrator

The role of the database administrator (DBA) is to plan, design, create, operate, secure, monitor, and maintain databases.

The DBA works with users to decide the content of the database—to determine exactly what entities are of interest and what attributes are to be recorded about those entities. Thus, personnel outside of IS must have some idea of what the DBA does and why this function is important. The DBA can play a crucial role in the development of effective information systems to benefit the organization, employees, and managers.

The DBA also works with programmers as they build applications to ensure that their programs comply with database management system standards and conventions. After the database is built and operating, the DBA monitors operations logs for security violations. Database performance is also monitored to ensure that the system's response time meets users' needs and that it operates efficiently. If there is a problem, the DBA attempts to correct it before it becomes serious.

A large responsibility of a DBA is to protect the database from attack or other forms of failure. DBAs use security software, preventive measures, and redundant systems to keep data safe and accessible. In spite of the DBA's best efforts, database security breaches are all too common. An individual was accused of hacking into numerous United States government databases in a year-long series of attacks. Large amounts of military data and personal identification information was stolen from databases belonging to the army, the US Missile Defense Agency, NASA, the Environmental Protection Agency, and others. The hacker's motivation was to disrupt the operations and infrastructure of the US government.[15]

data administrator: A nontechnical position responsible for defining and implementing consistent principles for a variety of data issues.

Some organizations have also created a position called the **data administrator**, a nontechnical, but important position responsible for defining and implementing consistent principles for a variety of data issues, including setting data standards and data definitions that apply across all the databases in an organization. For example, the data administrator would ensure that a term such as "customer" is defined and treated consistently in all corporate databases. This person also works with business managers to identify who should have read or update access to certain databases and to selected attributes within those databases. This information is then communicated to the database administrator for implementation. The data administrator can be a high-level position reporting to top-level managers.

Popular Database Management Systems

Many popular database management systems address a wide range of individual, workgroup, and enterprise needs as shown in Table 3.2. The complete DBMS market encompasses software used by people ranging from nontechnical individuals to highly trained, professional programmers and runs on all types of

TABLE 3.2 Popular database management systems

Open-Source Relational DBMS	Relational DBMS for Individuals and Workgroups	Relational DBMS for Workgroups and Enterprise	NoSQL DBMS
MySQL	Microsoft Access	Oracle	Mongo DB
PostgreSQL	IBM Lotus Approach	IBM DB2	Cassandra
MariaDB	Google Base	Sybase	Redis
SQL Lite	OpenOffice Base	Teradata	CouchDB
		Microsoft SQL Server	
		Progress OpenEdge	

computers from tablets to supercomputers. The entire market generates billions of dollars per year in revenue for companies such as IBM, Oracle, and Microsoft.

Like other software products, numerous open-source database systems are also available. CouchDB by Couchbase is an open-source database system used by Zynga, the developer of the popular Internet game FarmVille, to process 250 million visitors a month.

Database as a Service (DaaS or Database 2.0) is similar to Software as a Service (SaaS). With DaaS, the database is stored on a service provider's servers and accessed by the client over a network, typically the Internet, with the database administration handled by the service provider. More than a dozen companies are moving in the DaaS direction including Amazon, Database.com, Google, Heroku, IBM, Intuit, Microsoft, MyOwnDB, Oracle, and Trackvia.

Amazon Relational Database Service (Amazon RDS) is a Database as a Service that enables organizations to set up and operate their choice of a MySQL, Microsoft SQL, Oracle, or PostgreSQL relational database in the cloud. The service automatically backs up the database and stores those backups based on a user-defined retention period. Fairfax Media is a major media company in Australia and New Zealand that publishes some of the region's biggest newspapers and magazines. The firm employs Amazon RDS to avoid the cost of acquiring and maintaining its own database software and computing hardware. Management also believes that the DaaS environment enables it to bring new products to market more quickly and to better respond to changing customer preferences.[16]

Using Databases with Other Software

Database management systems are often used with other software and with the Internet. A DBMS can act as a front-end application or a back-end application. A *front-end application* is one that people interact with directly. Marketing researchers often use a database as a front end to a statistical analysis program. The researchers enter the results of market questionnaires or surveys into a database. The data is then transferred to a statistical analysis program to perform analysis such as to determine the potential for a new product or the effectiveness of an advertising campaign. A *back-end application* interacts with other programs or applications; it only indirectly interacts with people or users. When people request information from a Web site, the site can interact with a database (the back end) that supplies the desired information. For example, you can connect to a university Web site to find out whether the university's library has a book you want to read. The site then interacts with a database that contains a catalog of library books and articles to determine whether the book you want is available. See Figure 3.19.

www.loc.gov

FIGURE 3.19

Library of Congress Web site

The Library of Congress (LOC) provides Web access to its databases, which include references to books and digital media in the LOC collection.

DATABASE APPLICATIONS

Databases have proven to be an extremely valuable asset for organizations. The existence of databases has spun off numerous database applications including big data, data warehouses and data marts, and business intelligence. These topics will now be covered.

Big Data

big data: The term used to describe data collections that are so large and complex that traditional data management software, hardware, and analysis processes are incapable of dealing with them.

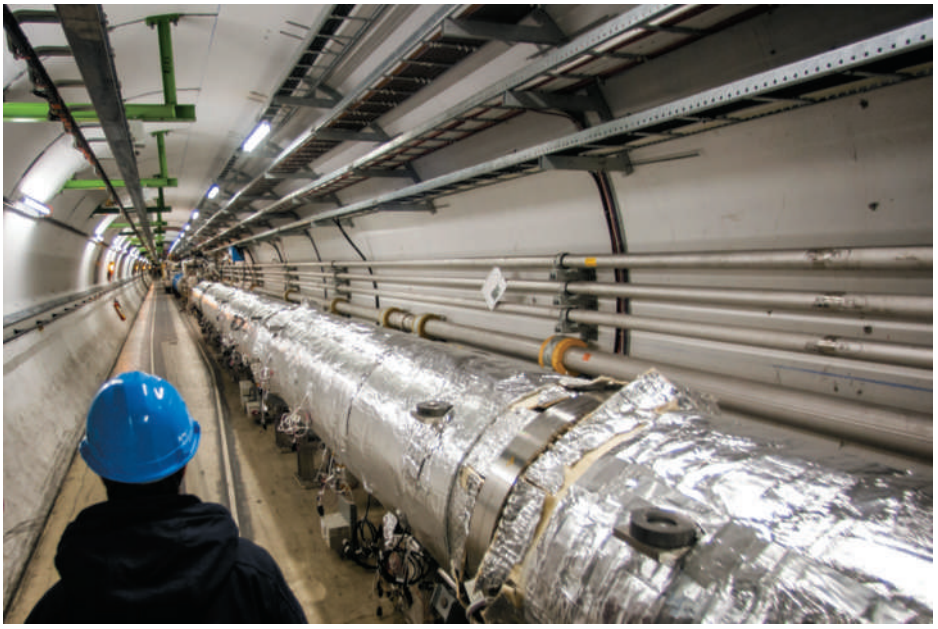
Big data is the term used to describe data collections that are so enormous (terabytes or more) and complex (from sensor data to social media data) that traditional data management software, hardware, and analysis processes are incapable of dealing with them. Computer technology analyst Doug Laney associated the three characteristics of volume, velocity, and variety with big data:[17]

- **Volume**. In 2012, IBM estimated that the volume of data that exists in the digital universe was 2.7 zetabytes.[18]
- **Velocity**. The velocity at which data is currently coming at us exceeds 5 trillion bits per second.[19] This rate will accelerate so that the volume of digital data is expected to double every two years between now and 2020.[20] Table 3.3 lists just a few of the generators of large amounts of data.

TABLE 3.3 Big data generators

Source	Magnitude of Data Generated
Large Hadron particle accelerator at CERN	40 terabytes of data per second
Commercial aircraft engines	More than 1 petabyte per day of sensor data
Cell phones	More than 5 billion people worldwide are making cell phone calls, exchanging text messages, and accessing Web sites
YouTube	48 hours of video uploaded per minute
Facebook	100 terabytes uploaded per day
Twitter	500 million tweets per day
RFID tags	1,000 times the volume of data generated by bar codes

- **Variety**. Data today comes in a variety of formats. Some of the data is what computer scientists call structured data whose format is known in advance and fits nicely into traditional databases. An example of structured data is the well-defined business transactions that are used to update corporate databases containing customer, product, inventory, financial, and employee data. However, most of the data that an organization must deal with is unstructured data, meaning that it is not organized in any predefined manner.[21] Unstructured data comes from sources such as word-processing documents, social media, email, surveillance video, phone messages, and scientific research. For example, Figure 3.20 shows the Large Hadron Collider (LHC) tunnel at CERN (European Organization For Nuclear Research). The LHC generates 40 TB of data per second for scientific analysis.[22]



Vladimir Simicek/sifa/Getty Images

FIGURE **3.20**

Large Hadron Collider (LHC)

The LHC at CERN generates 40 TB of data per second, amounting to tens of petabytes per year. The data is analyzed by a grid network that connects 140 computing centers in 35 countries and is provided to scientists seeking to answer complex questions in physics.

Challenges of Big Data

Individuals, organizations, and indeed society itself must find a way to deal with this ever-growing data tsunami or they will be paralyzed by information overload. The challenge is manifold—how to choose what subset of this data to store, where and how to store this data, how to find those nuggets of data that are relevant to the decision making at hand, and how to derive value from the relevant data. Optimists believe that we can conquer these challenges and that more data will lead to more accurate analyses and better decision making, which in turn will result in deliberate actions that improve matters. Some organizations are obtaining good results from a combination of big data and high-powered analytics as shown in Table 3.4.

Not everyone, however, is happy with big data applications. Some people have privacy concerns that corporations are harvesting huge amounts of personal data that can be shared with other organizations. With all this data, organizations can develop extensive profiles of people without their knowledge or consent. Big data also introduces security concerns. Can an organization keep big data secure from competitors and malicious hackers? Some experts believe companies that collect and store big data could be open to liability suits from individuals and organizations. Even with these potential disadvantages, many companies are rushing into big data with its potential treasure trove of information and new applications.

TABLE 3.4 Big data and analytics applications

Organization	How It Uses Big Data and Analytics
Apple	To gain a better understanding of its customers across its product groups
Continental Airlines	To determine each flyer's lifetime value and make decisions that affect individual customers
Disney	To understand its customers better so it can enhance their park experience and enable its employees to interact with visitors in a more personalized manner
Google Trends	To analyze a portion of the Google Web searches to help marketers to identify search trends and advertize or market accordingly
Harrah's	To know how much individual gamblers can afford to lose in a day before they won't come back the next day
Polkomtel (Polish wireless communications provider)	To reduce its credit-scoring expenses, speed the approval process for new customers, and fine-tune its collections operations
Walmart	To enable its suppliers to optimize the shelf space they are allocated in its stores

in-memory database: A database management system that stores the entire database in Random Access Memory (RAM).

In-Memory Databases

An **in-memory database (IMDB)** is a database management system that stores the entire database in random access memory (RAM). This approach provides access to data at rates of up to 100,000 times faster than storing data on some form of secondary storage (e.g., a hard drive or flash drive) as is done with traditional database management systems. IMDB is an enabler for the analysis of big data and other challenging data processing applications. IMDBs have become feasible because of the increase in RAM capacities and a corresponding decrease in RAM costs. In addition, in-memory databases perform best on multiple multicore CPUs that can process parallel requests to the data, further speeding access to and processing of large amounts of data.[23] Furthermore, the advent of 64-bit processors enabled the direct addressing of larger amounts of main memory. Some of the leading providers of IMDBs are shown in Table 3.5.

TABLE 3.5 IMDB providers

Database Software Manufacturer	Product Name	Major Customers
Altibase	HDB	E*Trade, China Telecom
Oracle	Times Ten	Lockheed Martin, Verizon Wireless
SAP	High Performance Analytic Appliance (HANA)	eBay, Colgate
Software AG	Terracotta Big Memory	AdJuggler

The United States Postal Service (USPS) delivers more mail to more addresses in a larger geographical area than any other postal service in the world. Its 522,000 employees process 160 billion pieces of mail going to more than 152 million homes, businesses, and Post Office boxes in every state, city, town, and borough in this country.[24] In-memory database processing enables the USPS to optimize the routing of letters and packages from sender to receiver, provide same-day delivery, and quickly determine if a mail piece has the correct postage. "The main business benefits of in-memory databases are in their ability to provide very quick, near real-time, answers while looking across vast amounts of data," according to Dan Houston Jr., manager of data management services at USPS, and Scot Atkins, product information specialist at USPS.[25]

ETHICAL & SOCIETAL ISSUES

The NSA Tackles Big Data

On June 5, 2013, Glen Greenwald of the British newspaper, *The Guardian*, revealed that the National Security Agency (NSA), one of the largest U.S. intelligence organizations, had secured a secret court order forcing Verizon to hand over data for phone numbers, call location, duration, and times of all calls made each day within the U.S. and between the U.S. and other countries. *The Guardian* published a copy of the secret court order as well as the Obama administration's justification for the invasion of the privacy of individuals not under suspicion. The following day, the *Washington Post* broke the even bigger story that U.S. and British intelligence had been secretly working with nine major U.S. Internet companies in an operation code-named PRISM. Since 2007, the NSA had been collecting data from Microsoft, Yahoo, Google, Facebook, PalTalk, AOL, Skype, YouTube, and Apple. One mystery these publications raised was just how the U.S. government had managed to keep these programs a secret from its citizens.

Another one of the biggest mysteries about the NSA's operations was how the agency has been able to collect and analyze this vast amount of data. In 2007, no databases existed with the capability to store such a large amount of unstructured data. It turned out the NSA itself had developed its own massive open-source database called Accumulo. Accumulo is running on thousands of servers located in various NSA data centers around the country with each server capable of accessing tens of petabytes of data in a variety of formats.

Once the data is collected, the NSA then runs graph analyses of the data to find whom a suspected terrorist has been in contact with, when they have been in contact with these individuals, how often, and where they and their contacts are located. This information can then be used to determine whether a suspect has been in touch with known operatives or groups. In addition, the NSA can perform pattern recognition programs, just like companies that target online ads to specific individuals based on the Web sites they have visited in the past. For example, the NSA can run a program to find out who is calling Yemen at a certain time, hanging up, and then receiving a call from a different Yemeni phone number within a few hours.

The fear with this second type of analysis is that the government is targeting individuals without having probable cause, thus violating the Fourth Amendment. Furthermore, many people and organizations feel that collecting this data compromises individuals' right to privacy.

One other question IT experts are asking is how the NSA can store such large amounts of data with such a small budget. The government has a mere $20 million to store standard data as well as chats, Skype calls, videos, and other heavy, unstructured data. Yahoo! spends $100 million annually on data storage for its hundreds of petabytes. One answer to this question may lie in the fact that while Verizon is handing over domestic and foreign call data to NSA, PRISM focuses only on foreign communication traffic. So, the NSA has less unstructured data to store than if it were collecting domestic-only communication data. This knowledge, however, is unlikely to pacify privacy advocates who have worked to limit government's intrusion into individual privacy in the past and will no doubt continue to do so in the future.

Discussion Questions

1. What type of data is the National Security Agency collecting?
2. Should the NSA be allowed to collect this data? What are the advantages and disadvantages?

Critical Thinking Questions

1. What analyses does the NSA perform on the data it is collecting?
2. Should the NSA be allowed to perform these types of analyses? Why or why not?

SOURCES: Greenwald, Glenn, "NSA Collecting Phone Records of Millions of Verizon Customers Daily," *The Guardian*, June 5, 2013; Gellman, Barton and Poitras, Laura, "U.S., British Intelligence Mining Data from Nine U.S. Internet Companies in Broad Secret Program," *The Washington Post*, June 6, 2013; Harris, Derrick, "Under the Covers of the NSA's Big Data Effort," Gigaom, June 7, 2013, *http://gigaom.com/2013/06/07/under-the-covers-of-the-nsas-big-data-effort/*; Harris, Derrick, "Here's How the NSA Analyzes All that Call Data," Gigaom, June 6, 2013, *http://gigaom.com/2013/06/06/heres-how-the-nsa-analyzes-all-that-call-data/*.

Data Warehouses and Data Marts

The raw data necessary to make sound business decisions is stored in a variety of locations and formats. This data is initially captured, stored, and managed by transaction processing systems that are designed to support the day-to-day operations of the organization. For decades, organizations have collected operational, sales, and financial data with their online transaction processing (OLTP) systems. The data can be used to support decision making through data warehouses, data marts, and data mining.

Data Warehouses

data warehouse: A large database that collects business information from many sources in the enterprise, covering all aspects of the company's processes, products, and customers, in support of management decision making.

A **data warehouse** is a database that holds business information from many sources in the enterprise, covering all aspects of the company's processes, products, and customers. Data warehouses allow managers to *drill down* to get more detail or *roll up* to take detailed data and generate aggregate or summary reports. The primary purpose is to relate information in innovative ways and help managers and executives make better decisions. A data warehouse stores historical data that has been extracted from operational systems and external data sources. See Figure 3.21.

Data warehouses are used for decision making, so the quality of their data is vital to avoid wrong conclusions. For instance, duplicated or missing information will produce incorrect or misleading statistics ("garbage in, garbage out"). Due to the wide range of possible data inconsistencies and the sheer data volume, data quality is considered one of the biggest issues in data warehousing.

Data warehouses are continuously refreshed with huge amounts of data from a variety of sources so the probability that some of the sources contain "dirty data" is high. The ETL (extract, transform, load) process takes data from a variety of sources, edits and transforms it into the form to be used in the data warehouse, and then loads this data into the warehouse. This process is essential in ensuring the quality of the data in the data warehouse.

- **Extract.** Source data for the data warehouse comes from many sources and systems. The data may be represented a variety of forms such as relational databases, flat files, or other formats. The goal of this process is to extract the source data from all the various sources and convert it into a single format suitable for processing. During the extract step, data that fails to meet expected patterns or values may be rejected from further processing (e.g., blank or nonnumeric data in net sales field, a product code outside the defined range of valid codes).
- **Transform.** During this stage of the ETL process, a series of rules or algorithms are applied to the extracted data to derive the data that will be stored in the data warehouse. A common transformation that may be made is to convert the customer's street address, city, state, and zip code to an organization-assigned sales district or government census tract. Also,

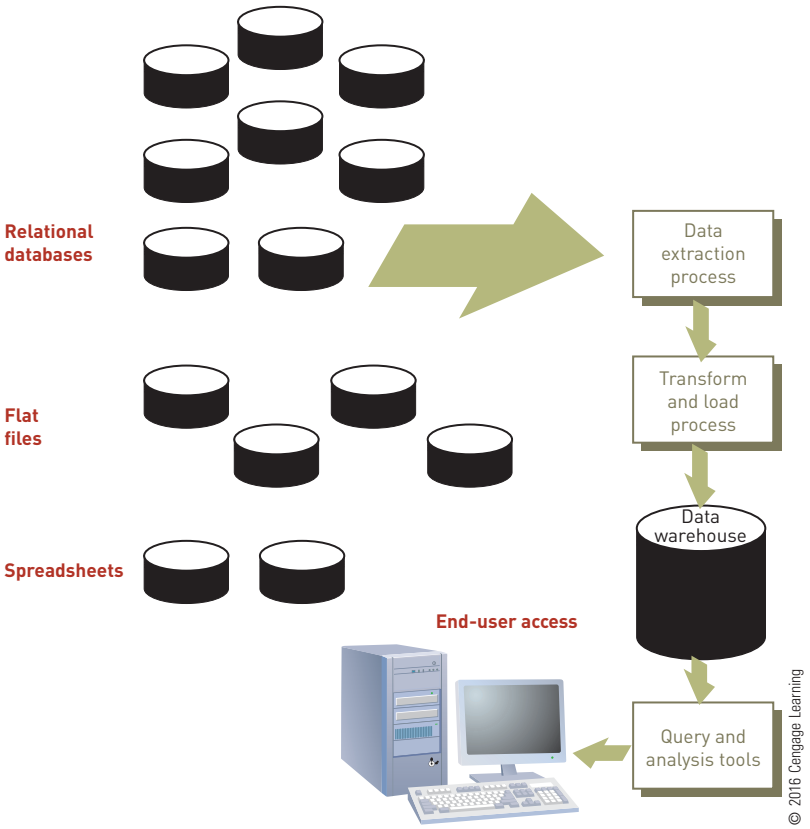


FIGURE **3.21**

Elements of a data warehouse

A data warehouse can help managers and executives relate information in innovative ways and make better decisions.

data is often aggregated to reduce the processing time required to create anticipated reports. For example, total sales may be accumulated by store or sales district.

- **Load.** During this stage of the ETL process, the extracted and transformed data is loaded into the data warehouse. As the data is being loaded into the data warehouse, new indices are created and the data is checked against the constraints defined in the database schema to ensure its quality. As a result, the data load stage for a large data warehouse can take days.

A large number of software tools are available to support these ETL tasks including Ab Initio, IBM InfoSphere Datastage, Oracle Data Integrator, and the SAP Data Integrator. See Figure 3.22. Several open-source ETL tools are also available, including Apatar, Clover ETL, Pentaho, and Talend. Unfortunately much of the ETL work must be done by low-level proprietary programs that are difficult to write and maintain.

FIGURE **3.22**

Data warehouse tools

Data warehouses can use tools such as Oracle's Warehouse Management software to acquire data from unique sources such as scans of RFID tags.

Data Marts

data mart: A subset of a data warehouse that is used by small and medium-sized businesses and departments within large companies to support decision making.

A **data mart** is a subset of a data warehouse. Data marts bring the data warehouse concept—online analysis of sales, inventory, and other vital business data that has been gathered from transaction processing systems—to small and medium-sized businesses and to departments within larger companies. Rather than store all enterprise data in one monolithic database, data marts contain a subset of the data for a single aspect of a company's business—for example, finance, inventory, or personnel. In fact, a specific area in the data mart might contain more detailed data than the data warehouse.

Business Intelligence

business intelligence (BI): A broad range of technologies and applications that enable an organization to transform mostly structured data obtained from information systems to perform analysis, generate information, and improve the decision making of the organization.

Business intelligence (BI) is a broad range of technologies and applications that enable an organization to transform mostly structured data obtained from information systems to perform analysis, generate information, and improve the decision making of the organization.[26] BI technologies include data mining, online analytical processing, predictive analytics, data visualization, and competitive intelligence. Some key BI vendors are IBM Cognos, Information Builders, Microsoft, Micro Strategy, Oracle, SAP, and SAS.

Data Mining

data mining: An information-analysis tool that involves the automated discovery of patterns and relationships in a data warehouse.

Data mining is an information-analysis process that involves the automated discovery of patterns and relationships in a data warehouse. Like gold mining, data mining sifts through mountains of data to find a few nuggets of valuable information. For example, a midwest grocery chain used data mining to analyze its customers' buying patterns. Data mining revealed that when men bought diapers on Thursdays, they also tended to buy beer. The grocery chain used this newly discovered information to increase revenue by moving the beer display closer to the diaper display or by ensuring that beer and diapers were sold at full price on Thursdays.[27]

Sprouts Farmers Market employs data mining to view retail data from multiple sources to gain insights into business performance. People across the entire organization can drill down or drill across the data using various devices including smartphones and tablet computers.[28] Jansen Pharmaceutical mined discussions and patient reviews in social media regarding Xanax, a drug used to treat anxiety and panic disorder, to segment customer insights, improve advertising and branding, and discover new patient concerns.[29] Samsung's newest TVs track what viewers watch on cable, satellite, and premium view-on-demand services over the past six months and then applies data mining techniques to offer them personalized viewing recommendations.[30]

Online Analytical Processing (OLAP)

online analytical processing (OLAP): A form of analysis that allows users to explore data from a number of perspectives enabling a style of analysis known as "slicing and dicing."

Online analytical processing (OLAP) allows users to explore data from a number of perspectives enabling a style of analysis known as "slicing and dicing." OLAP databases support business intelligence discussed earlier and have been optimized to provide useful reports and analysis. The leading OLAP database vendors include Microsoft, IBM Cognos, SAP, Business Objects, MicroStrategy, Applix, Infor, and Oracle.

Unlike data mining that provides bottom-up, discovery-driven analysis, OLAP provides top-down, query-driven data analysis. Whereas data mining requires no assumptions and instead identifies facts and conclusions based on patterns discovered, OLAP requires repetitive testing of user-originated theories. OLAP, or multidimensional analysis, requires a great deal of human ingenuity and interaction with the database to find information in the database. A user of a data-mining tool does not need to figure out what questions to ask; instead, the approach is "Here's the data; tell me what interesting patterns

emerge." For example, a data-mining tool in a credit card company's customer database can construct a profile of fraudulent activity from historical information. Then, this profile can be applied to all incoming transaction data to identify and stop fraudulent behavior, which might otherwise go undetected. Verafin develops data-mining software for financial institutions that analyzes transactions and detects financial crimes. See Figure 3.23.

verafin.com

FIGURE **3.23**

Data-mining software

To meet its mission of helping financial institutions fight fraud, Verafin develops data mining software to analyze transactions and detect financial crimes.

Table 3.6 compares OLAP and data mining.

TABLE 3.6 Comparison of OLAP and data mining

Characteristic	OLAP	Data Mining
Purpose	Supports data analysis and decision making	Supports data analysis and decision making
Type of analysis supported	Top-down, query-driven data analysis	Bottom-up, discovery-driven data analysis
Skills required of user	Must be very knowledgeable of the data and its business context	Must trust in data-mining tools to uncover valid and worthwhile hypotheses

Predictive Analysis

predictive analysis (also called predictive analytics): A form of data mining that combines historical data with assumptions about future conditions to predict outcomes of events, such as future product sales or the probability that a customer will default on a loan.

Predictive analysis is a form of data mining that combines historical data with assumptions about future conditions to predict outcomes of events, such as future product sales or the probability that a customer will default on a loan. The key element in predictive analytics is the *predictor*, one or more variables that can be measured for an individual to predict future behavior. For example, a life insurance company is likely to take into account potential life expectancy predictors such as age, gender, and health record when issuing life insurance policies.

The FICO score is a widely used credit score model based on predictive analysis. Credit reporting bureaus such as Experian, Equifax, and TransUnion calculate a consumer's FICO score based on their credit history. The score provides a prediction of the likelihood of the consumer to repay a

loan and is used by banks and other financial institutions to make lending decisions. Consumers with higher FICO scores might be offered better interest rates on mortgages or automobile loans as well as higher credit limit amounts.

Data Visualization

One of the best ways to gain insights into data is through data visualization techniques that can help quickly draw conclusions and see relationships among the data. The analysis of big data brings additional challenges of trying to make sense out of the data. Excel, SAS Visual Analytics, and other software is available to prepare charts and graphs to make it easier to see trends and patterns and to identify opportunities for further analysis. Line charts, bar charts, scatter diagrams, bubble charts, and pie charts are frequently used.

Social media networks are generating enormous amounts of data that progressive organizations are using to gain competitive advantage by better understanding customer needs and brand experience. **Social graph analysis** is a data visualization technique in which data is represented as networks where the vertices are the individual data points (social network users) and the edges are the connections among them.[31] Facebook is performing social graph analysis with billions of nodes and trillions of edges. Social graph analysis is also being used in fraud detection, influence analysis, sentiment monitoring, market segmentation, engagement optimization, experience optimization, and other applications where complex behavioral patterns must be rapidly identified. Figure 3.24 represents millions of pieces of social media data indicating connections among millions of people.

social graph analysis: A data visualization technique in which data is represented as networks where the vertices are the individual data points (social network users) and the edges are the connections among them.

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FIGURE **3.24**

Social graph analysis

Data is represented as networks where the vertices are the individual data points (social network users) and the edges are the connections among them.

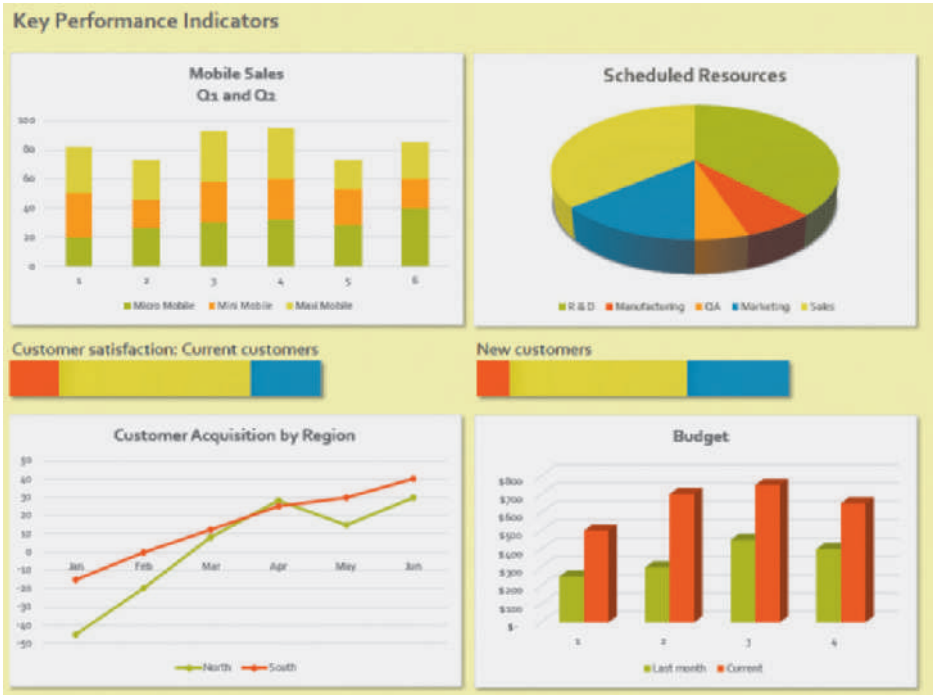
Key performance indicators (KPIs) are quantifiable measurements that assess progress toward organizational goals and reflect the critical success factors of an organization. They differ from one organization to another and from department to department within a given organization. Manufacturing KPIs

key performance indicators (KPIs): Quantifiable measurements that assess progress toward organizational goals and reflect the critical success factors of an organization.

might include the percentage of on-time deliveries and the number of customer complaints per 100 orders.

dashboard: A data visualization tool that displays the current status of the key performance indicators (KPIs) for an organization.

A business intelligence **dashboard** is a data visualization tool that displays the current status of the KPIs for an organization. The dashboard may be tailored to display metrics targeted for a single point or department. Figure 3.25 shows an example of a dashboard highlighting the KPIs for a supply chain.



Microsoft product screenshots used with permission from Microsoft Corporation

FIGURE **3.25**

KPI dashboard

This dashboard highlights the current status of the key performance indicators (KPIs) for sales, resources, customers, and budget.

Competitive Intelligence

competitive intelligence: One aspect of business intelligence and encompasses information about competitors and the ways that knowledge affects strategy, tactics, and operations.

Competitive intelligence is one aspect of business intelligence and encompasses information about competitors and the ways that knowledge affects strategy, tactics, and operations. Competitive intelligence is a critical part of a company's ability to see and respond quickly and appropriately to the changing marketplace. Competitive intelligence is not espionage—the use of illegal means to gather information. In fact, almost all the information a competitive-intelligence professional needs can be collected by examining published information sources, conducting interviews, and using other legal and ethical methods. Using a variety of analytical tools, a skilled competitive-intelligence professional can by deduction fill the gaps in information already gathered. For example, Omgili is a search engine that focuses on only Internet message boards and allows its users to find topics on discussion boards that are relevant to their interests.

Fuld & Company is a research and consulting firm in the field of competitive intelligence. A leading UK bank hired Fuld to examine new entrants and nontraditional business models that could threaten its market position. Based on results of this study, the client moved quickly to change its direction and to educate its executives on critical strategic threats.[32]

counterintelligence: The steps an organization takes to protect information sought by "hostile" intelligence gatherers.

The term **counterintelligence** describes the steps an organization takes to protect information sought by "hostile" intelligence gatherers. One of the most effective counterintelligence measures is to define "trade secret" information relevant to the company and control its dissemination.

INFORMATION SYSTEMS @ WORK

Brandwatch: Applying Business Intelligence to Social Media Data to Make Advertising Decisions

Social networks are big in professional sports. About 5.3 million people follow the National Football League (NFL) on Twitter, and about 8.5 million "like" its Facebook page. The 2012 NFL championship game, Super Bowl 46 between the New York Giants and the New England Patriots, was watched by about 100 million television viewers. During the game, people posted 7,366,400 tweets about it. Of those, 324,221 mentioned one or more advertisers. With social media attention on such a large scale, it's no wonder that advertisers analyze social media as one indicator of whether their money was well spent.

Aside from sheer volume, the data from social media is unstructured. That puts this social media activity squarely into the "big data" category. What can advertisers learn from it?

If you measure advertising effectiveness by cost per tweet, Swedish high-fashion clothing chain H&M did best. According to Brandwatch, a firm that analyzes big data on the Web, H&M's 30-second commercial was mentioned in 17,190 tweets and cost $3.5 million, or $204 per tweet. Pepsi, which had the second-highest number of tweets with 28,996, ran two such commercials for a second-lowest $253 per tweet. Budweiser, the highest-spending brand in the 10 most-tweeted about commercials (for an estimated total of $35 million), had only 13,910 tweets for a cost of $2,265 each.

Do these findings mean that Budweiser wasted its money? Not necessarily. Perhaps beer drinkers tweet less than high-fashion customers or cola drinkers. It's more useful to compare within a category. Coca-Cola spent half again as much as Pepsi but had slightly more than half as many tweets (17,334). Similarly, Volkswagen had 20,818 tweets for $7 million worth of air time, or $336 per tweet. Hyundai, with 4,325 tweets for the same cost, was far less effective in generating Twitter buzz.

You can also look for the sentiment of tweets. The way words are used can affect their meaning, but when taken over a large number of messages and compared across advertisers, the results of sentiment analysis are informative. Most tweets are neutral, and most advertisers show a small excess of positive over negative tweets. For example, Pepsi had 7 percent positive tweets, 2 percent negative, with the rest neutral. More negative Twitter sentiment suggests a problem. Skechers had 11 percent negative tweets and only 4 percent positive. The data don't say why, but they suggest that Skechers ought to look into the reason. (It may have been due to a protest based on their commercial having been filmed at a location where dogs were allegedly mistreated. If that's the reason, it's unlikely to affect shoe sales.)

The Brandwatch process begins by gathering data. Brandwatch monitors blogs, microblogs such as Twitter, social sites such as Facebook, image sites such as Flickr, video sites such as YouTube and Vimeo, discussion forums, and news sites. Clients can choose the site they want to monitor.

Brandwatch then cleans the data. It removes duplicates, eliminates navigation text and ads, separates actual mentions of a brand from uses of the same word (an apple isn't necessarily an Apple), and analyzes the site to determine its date so that trends can be tracked.

The third step is data analysis, including sentiment analysis. Combined with date information, data analysis gives sentiment trends over time.

Finally, Brandwatch presents the data in several ways, including a digital dashboard. The net result is insight into the success of an ad campaign that could probably not be obtained any other way.

Discussion Questions

1. Brandwatch can create a graph of Twitter activity over time. The time at which a commercial airs can be indicated on that graph. What could an advertiser do with this information?
2. Is Brandwatch as helpful for small companies as it is for large companies? Why or why not?

Critical Thinking Questions

1. Draw an entity-relationship diagram for the tables that a database would need to store information about tweets related to Super Bowl ads after data cleaning is complete. List the attributes that the database must store for each entity.
2. How accurate do you think sentiment analysis is? How do you think it is carried out?

SOURCES: Brandwatch Web site, *www.brandwatch.com*, accessed May 16, 2012; Staff, "Visualizing Big Social Media Data," Brandwatch, *www.brandwatch.com/wp-content/uploads/brandwatch/The-Brandwatch-Super-Bowl-2012.pdf*, March 14, 2012; Staff, "Brandwatch Superbowl 2012," Brandwatch, *labs.brandwatch.com/superbowl*, accessed May 16, 2012; Horovitz,B., "Even without Kardashian, Skechers Ad Stirs Controversy," *USA Today*, *www.usatoday.com/money/advertising/story/2012–01-11/kim-kardashian-skechers-super-bowl-ad/52506236/1*, January 12, 2012; Tofel, K., "Super Bowl 46 Mobility by the Numbers," *gigaom.com/mobile/super-bowl-46-mobility-by-the-numbers*, February 5, 2012.

SUMMARY

Principle:

Data management and modeling are key aspects of organizing data and information.

Data is one of the most valuable resources that a firm possesses. It is organized into a hierarchy that builds from the smallest element to the largest. The smallest element is the bit, a binary digit. A byte (a character such as a letter or numeric digit) is made up of eight bits. A group of characters, such as a name or number, is called a field (an object). A collection of related fields is a record; a collection of related records is called a file. The database, at the top of the hierarchy, is an integrated collection of records and files.

An entity is a generalized class of objects for which data is collected, stored, and maintained. An attribute is a characteristic of an entity. Specific values of attributes—called data items—can be found in the fields of the record describing an entity. A primary key uniquely identifies a record, while a secondary key is a field in a record that does not uniquely identify the record.

When building a database, an organization must consider content, access, logical structure, and physical organization of the database. One of the tools that database designers use to show the logical structure and relationships among data is a data model. A data model is a map or diagram of entities and their relationships. Enterprise data modeling involves analyzing the data and information needs of an entire organization. Entity-relationship (ER) diagrams can be used to show the relationships among entities in the organization.

The relational model places data in two-dimensional tables. Tables can be linked by common data elements, which are used to access data when the database is queried. Each row represents a record, and each column represents an attribute (or field). Allowable values for these attributes are called the domain. Basic data manipulations include selecting, projecting, and joining. The relational model is easier to control, more flexible, and more intuitive than the other models because it organizes data in tables.

Data cleansing is the process of detecting, correcting or deleting incomplete, incorrect, inaccurate, or irrelevant records that reside in the database. The goal is to improve the quality of the data used in decision making.

Principle:

A well-designed and well-managed database is an extremely valuable tool in supporting decision making.

A DBMS is a group of programs used as an interface between a database and its users and other application programs. When an application program requests data from the database, it follows a logical access path. The actual retrieval of the data follows a physical access path. Records can be considered in the same way: a logical record is what the record contains; a physical record is where the record is stored on storage devices. Schemas are used to describe the entire database, its record types, and their relationships to the DBMS.

There are both single-user and multiple-user DBMS systems, and flat files, SQL databases, NoSQL databases, and visual, audio, and other database systems.

A DBMS provides four basic functions: offering user views, creating and modifying the database, storing and retrieving data, and manipulating data and generating reports. Schemas are entered into the computer via a data definition language, which describes the data and relationships in a specific database. Another tool used in database management is the data dictionary, which contains detailed descriptions of all data in the database.

After a DBMS has been installed, the database can be accessed, modified, and queried via a data manipulation language. A more specialized data manipulation language is the query language, the most common being

Structured Query Language (SQL). SQL is used in several popular database packages today and can be installed on PCs and mainframes.

A database administrator (DBA) plans, designs, creates, operates, secures, monitors, and maintains databases. A data administrator is a nontechnical position responsible for defining and implementing consistent principles for a variety of data issues, including setting data standards and data definitions that apply across all the databases in an organization. Selecting a DBMS begins by analyzing the information needs of the organization. Important characteristics of databases include the size of the database, the number of concurrent users, performance of the database, the ability of the DBMS to be integrated with other systems, the features of the DBMS, the vendor considerations, and the cost of the database management system.

Many popular database management systems are available to address a wide range of individual, workgroup, and enterprise needs.

Database as a Service (DaaS) is a new form of database service in which clients lease use of a database on a service provider's site. In DaaS, the database is stored on a service provider's servers and accessed by the client over a network, typically the Internet. In DaaS, database administration is provided by the service provider.

Principle:

The number and types of database applications will continue to evolve and yield real business benefits.

Big data is the term used to describe data collections that are so enormous and complex that traditional data management software, hardware, and analysis processes are incapable of dealing with them.

An in-memory database is a database management system that stores the entire database in random access memory to improve storage and retrieval speed.

Traditional online transaction processing (OLTP) systems put data into databases very quickly, reliably, and efficiently, but they do not support the types of data analysis that today's businesses and organizations require. To address this need, organizations are building data warehouses specifically designed to support management decision making.

An extract, transform, load process takes data from a variety of sources, edits and transforms it in to the form to be used in the data warehouse, and then loads the data into the warehouse.

Data marts are subdivisions of data warehouses and are commonly devoted to specific purposes or functional business areas.

Business intelligence is a broad range of technologies and applications that enable an organization to transform mostly structured data obtained from information systems to perform analysis, generate information, and improve the decision making of the organization.

Data mining, which is the automated discovery of patterns and relationships in a data warehouse, is a practical approach to generating hypotheses about the data that can be used to predict future behavior.

Online analytical processing (OLAP) allows users to explore data from a number of perspectives, enabling a style of analysis known as "slicing and dicing."

Predictive analysis is a form of data mining that combines historical data with assumptions about future conditions to forecast outcomes of events.

Data visualization employs a variety of techniques such as social graph analysis and dashboards to help quickly draw conclusions and see relationships among the data.

Competitive intelligence is one aspect of business intelligence limited to information about competitors and the ways that information affects strategy, tactics, and operations. Competitive intelligence is not espionage—the use of illegal means to gather information. Counterintelligence describes the steps an organization takes to protect information sought by "hostile" intelligence gatherers.

KEY TERMS

attribute
big data
business intelligence (BI)
character
competitive intelligence
concurrency control
counterintelligence
dashboard
data administrator
data cleansing (data cleaning or data scrubbing)
data definition language (DDL)
data dictionary
data item
data manipulation language (DML)
data mart
data mining
data model
data warehouse
database administrators (DBAs)
database approach to data management
database management system (DBMS)
domain
enterprise data modeling
entity
entity-relationship (ER) diagrams
field
file
hierarchy of data
in-memory database
joining
key performance indicators (KPIs)
linking
NoSQL database
online analytical processing (OLAP)
predictive analysis (also called predictive analytics)
primary key
projecting
record
relational model
schema
selecting
social graph analysis
traditional approach to data management

CHAPTER 3: SELF-ASSESSMENT TEST

Data management and modeling are key aspects of organizing data and information.

1. _____ is a skilled and trained IS professional who holds discussions with users to define their data needs; applies database programming languages to craft a set of databases to meet those needs; tests and evaluates databases; implements changes to improve their performance; and assures that data is secure from unauthorized access.
2. A collection of data fields all related to one object, activity, or individual is called a(n) _____.
   a. attribute
   b. byte
   c. record
   d. column
3. Multiple records can have the same primary key. True or False?
4. A(n) _____ is a field or set of fields that uniquely identifies a database record.
   a. attribute
   b. data item
   c. key
   d. primary key
5. A(n) _____ is a diagram of entities and their relationships.
   a. database
   b. data model
   c. data entity
   d. database management system
6. The _____ is a simple but highly useful way to organize data into collections of two-dimensional tables called relations.

A well-designed and well-managed database is an extremely valuable tool in supporting decision making.

7. _____ involves eliminating columns in a table.
   a. Projecting
   b. Joining
   c. Selecting
   d. Linking
8. Because the DBMS is responsible for providing access to a database, one of the first steps in installing and using a database involves telling the DBMS the logical and physical structure of the data and relationships among the data in the

database. This description of an entire database is called a(n) _____.

9. _____ is a special purpose programming language for accessing and manipulating data stored in a relational database.
10. SQL databases conform to ACID properties that guarantee database transactions are processed reliably and ensure the integrity of data in the database. True or False?
11. A(n) _____ is a collection of instructions and commands used to define and describe data and relationships in a specific database.
    a. data manipulation language
    b. schema
    c. data model
    d. data definition language
12. The _____ is a nontechnical, but important position responsible for defining and implementing consistent principles for a variety of data issues, including setting data standards and data definitions that apply across all the databases in an organization.
    a. database administrator
    b. systems analyst
    c. programmer
    d. data administrator
13. A trend in database management, known as Database as a Service, places the responsibility of storing and managing a database on a service provider. True or False?

The number and types of database applications will continue to evolve and yield real business benefits.

14. _____ is a term used to describe data collections that are so large and complex that traditional data management software, hardware, and analysis processes are incapable of dealing with them.
15. An in-memory database (IMDB) is a database management system that stores the entire database in _____.
    a. random access memory
    b. read only memory
    c. distributed servers
    d. virtual memory
16. A(n) _____ is a database that holds business information from many sources in the enterprise covering all aspects of the company's processes, products, and customers.
17. An information-analysis process that involves the automated discovery of patterns and relationships in a data warehouse is called _____.
    a. a data mart
    b. data mining
    c. predictive analysis
    d. business intelligence
18. _____ allows users to explore data from a number of perspectives enabling a style of analysis known as "slicing and dicing."
    a. Data mining
    b. Online analytical processing (OLAP)
    c. Predictive analysis
    d. None of the above
19. _____ is a form of data mining that combines historical data with assumptions about future conditions to predict outcomes of events.
20. _____ is a data visualization technique in which data is represented as networks where the vertices are the individual data points (social network users) and the edges are the connections among them.

CHAPTER 3: SELF-ASSESSMENT TEST ANSWERS

1. Database administrator
2. c
3. False
4. d
5. b
6. relational model
7. Projecting
8. schema
9. SQL
10. True
11. d
12. d
13. True
14. Big data
15. a
16. data warehouse
17. b
18. b
19. Predictive analysis
20. Social graph analysis

REVIEW QUESTIONS

1. Identify all the components in the data hierarchy from the bit to the database.
2. What is the difference between a data attribute and a data item?

3. What is the purpose of a primary key? What field or fields might be the primary key in an airline reservation system used to identify a specific seat on a specific flight for a specific airline on a specific day?
4. What is enterprise data modeling?
5. What is an entity-relationship model and what is its purpose?
6. What is data cleansing?
7. What is SQL and how is it used?
8. What are the essential differences between an SQL database and a NoSQL database?
9. What is Database as a Service (DaaS)? What are the advantages and disadvantages of using the DaaS approach?
10. What is Hadoop?
11. What is a schema and how is it used?
12. What is concurrency control? Why is it important?
13. What is in-memory database processing and what advantages does it provide?
14. What is the difference between projecting and joining?
15. What is big data? Identify three characteristics associated with big data.
16. What is a data warehouse, and how is it different from a traditional database used to support OLTP?
17. What is meant by the "front end" and the "back end" of a DBMS?
18. What is the relationship between the Internet and databases?
19. What is data mining? What is OLAP? How are they different?
20. What is business intelligence? Identify five specific business intelligence technologies.
21. What is predictive analysis? Give an example where this could be used.

DISCUSSION QUESTIONS

1. When building a database, an organization must carefully consider these topics: content, access, logical structure, and physical organization. Elaborate on these points.
2. Outline some specific steps an organization might take to perform data cleansing to ensure the accuracy and completeness of its customer database before adding this data to a data warehouse. How would you decide when the data is accurate enough?
3. Briefly describe the ACID properties to which an SQL database must conform. Identify one advantage and one disadvantage associated with ACID conformance.
4. Briefly describe how a NoSQL database operates.
5. Identify and briefly describe some of the challenges and issues associated with big data.
6. Identify and briefly describe the steps in the ETL process. What is the goal of the ETL process?
7. You are the vice president of information technology for a large multinational consumer packaged goods company (such as Procter & Gamble or Unilever). You must make a presentation to persuade the board of directors to invest $25 million to establish a state-of-the-art competitive-intelligence organization—including people, data-gathering services, and software tools. What key points do you need to make in favor of this investment? What arguments can you anticipate that the board might make?
8. What counter-intelligence strategy might a large multinational consumer packaged goods company employ? Identify at least three specific actions that might be taken.
9. Your luxury car dealership wants to identify likely future customers in your local geographic area. What key pieces of data might be useful in making this determination? What are some possible sources for this data? How could data mining be used to accomplish this objective?
10. Make a list of the databases in which data about you exists. How is the data in each database captured? Who updates each database and how often? Is it possible for you to request a printout of the contents of your data record from each database? What data privacy concerns do you have?
11. If you were the database administrator for the iTunes store, how might you use predictive analysis to determine which artists and movies will sell the most next year?
12. Identity theft, where people steal personal information, continues to be a problem for consumers and businesses. Assume that you are the database administrator for a corporation with a large database that is accessible from the Web. What steps would you implement to prevent people from stealing personal information from the corporate database?
13. You have been hired to set up a database for a company similar to Netflix that rents movies over the Internet. Describe what type of database management system you would recommend for this application.

PROBLEM-SOLVING EXERCISES

1. Develop a simple data model for the music you have on your digital music player or in your CD collection. The data model includes three tables: songs, artists, and awards earned by the song. For each table, what attributes should you capture? What will be the primary key and foreign keys for the tables in your database? Use a relational database management system to create this database for a dozen or so songs and artists.
2. An online video movie rental store is using a relational database to store information on movies to answer customer questions. Each entry in the database contains the following items: Movie Number (the primary key), Movie Title, Year Made, Movie Type, MPAA Rating, Starring actor #1, Starring actor #2. Movie Types are comedy, family, drama, horror, science fiction, and western. MPAA ratings are G, PG, PG-13, R, NC-17, and NR (not rated). Use a single-user database management system to build a data-entry screen to enter this data. Build a small database with at least 10 entries.
3. To improve service to their customers, the workers at the online video rental store have proposed a list of changes being considered for the database in the previous exercise. From this list, choose two database modifications and modify the data-entry screen to capture and store this new information.
   Proposed changes are as follows:
   a. To help customers locate the newest releases, add the date that the movie was first available.
   b. Add the director's name.
   c. Add a customer rating of one, two, three, or four stars based on number of rentals.
   d. Add the number of Academy Award nominations.
4. Using a graphics program, develop an entity-relationship diagram for a database application for an Internet bookstore where students buy textbooks from a salesperson and receive invoices for their purchases. Use Figure 3.5 as a guide.

TEAM ACTIVITIES

1. You and your team have been selected to represent the student body in defining the user requirements for a new student database for your school. What actions would you take to ensure that the student reporting needs and data privacy concerns of the students are fully identified? What other resources might you enlist to help you in defining these requirements?
2. As a team of three or four classmates, interview managers from three different organizations that have implemented a customer database. What data entities and data attributes are contained in each database? What database management system did each company select to implement their database and why? How do they access the database to perform analysis? Have they received training in any query or reporting tools? What do they like about their databases, and what could be improved? Do any of them use data-mining or OLAP techniques? Weighing the information obtained, identify which company has implemented the best customer database.
3. Imagine that you and your classmates are a research team developing a system based on predictive analysis to identify "at risk" students who are likely to withdraw from school because of poor academic performance rather than complete their course of studies. Prepare a brief report for your instructor addressing these questions:
   a. What data do you need for each student?
   b. Where might you get this data?
   c. Take a first cut at designing a database for this application. Using the material in this chapter on designing a database, draw the logical structure of the relational tables for this proposed database. In your design, include the data attributes you believe are necessary for this database and show the primary keys in your tables. Keep the size of the fields and tables as small as possible to minimize required disk drive storage space. Fill in the database tables with the sample data for demonstration purposes (10 records). After your design is complete, implement it using a relational DBMS.

WEB EXERCISES

1. Use a Web search engine to find information on social graph analysis. Identify at least three organizations that are using this technique to analyze big data and discuss their findings.
2. Do research to find three different estimates of the rate at which the amount of data is growing. Discuss why there are differences in these estimates.

CAREER EXERCISES

1. Do research to find what career opportunities are available in the field of competitive intelligence. Identify colleges or universities that offer courses in competitive intelligence and what certifications are available. What is the expected growth in the number of such positions and what are typical salaries?
2. How could you use business intelligence (BI) to do a better job at work? Give some specific examples of how BI can give you a competitive advantage.

CASE STUDIES

Case One

Medihelp: Transforming Traditional Databases into Business Intelligence

Medihelp is South Africa's third largest health insurance company. It covers about 220,000 people with plans ranging from R828 to R2,700 (about U.S. $80 to $260) per month per person. Medihelp needed a better way to access and analyze data on customers, claims, and third-party providers in order to monitor the effectiveness of its insurance products and to fine-tune and create new products as needed.

Medihelp's problem was that its data was stored in a traditional database. As discussed in this chapter, traditional databases are not designed to support decision making. They're not efficient at the types of information retrieval that decision making uses. With Medihelp's existing database, reports took unacceptably long times to run. Reports based on the content of the full database couldn't be run at all. This inefficiency detracted from Medihelp's ability to make informed business decisions.

For example, Medihelp's claim file had about 55 million rows. Each row contained about 35 data values describing medical conditions, treatments, and payments. Each row was associated with one of 15 million rows of historical member data, which held another 15 or so data values describing the member and his or her coverage. For claim processing, accessing the data for a single claim was fast and efficient. Combining data from thousands of rows, as decision support calls for, was not.

"Logging into our [traditional] database … was not providing us the information we needed to make the best business decisions," explains Jan Steyl, senior manager of business intelligence at Medihelp. "We needed a dedicated, high-performance data warehouse."

After looking at several options, Medihelp made a preliminary selection of Sybase IQ as the basis for its data warehouse. Working with B.I. Practice, a Sybase subsidiary in South Africa, Medihelp carried out a proof of concept to confirm that Sybase IQ could deliver the needed performance at an acceptable cost. This procedure involved loading a subset of the tables from the operational database into Sybase IQ, executing queries that used only that subset of the data, and evaluating the results.

Because these queries now used a database designed for queries, performance improved dramatically. Response time was reduced by an average of 71.5 percent. Response time for ad hoc queries, those which were not programmed into the database system ahead of time, was reduced by an average of 74.1 percent. One query's response time dropped by 92.8 percent.

Theo Els, Medihelp's senior manager of client relations, likes the new system. "Health insurers supply data to employer groups. These demographic and claims profiles are essential for employer groups seeking to understand their employees' health risks … and the consequent impact that risk can have on business productivity. Brokers and healthcare consultants also use this information in their annual client reviews to ensure that employees receive the most suitable coverage. It is imperative that the … data warehouse provide accurate information in a format that is easily understood."

The biggest beneficiary of Medihelp's data warehouse is its product development team. The team uses data from the data warehouse to understand trends in claims by benefit code, condition, area, age group, and other factors. Medihelp also uses its data warehouse to determine what financial effects changes to a benefit in a specific product will have. This provides the sales force with the right offering at the right price for specific target markets in South Africa.

Discussion Questions

1. How did Medihelp's use of a traditional database limit what it could do with its data?
2. How does Medihelp's Salesforce now use the information in the company's data warehouse?

Critical Thinking Questions

1. How did B.I. Practice improve the efficiency of queries run by Medihelp employees?
2. How does the new query system help Medihelp make better decisions for the company? Does Medihelp also use the system to help their clients make better decisions? If so, how?

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Case Two

HanaTour: Gaining Customer Trust Through Increased Security

HanaTour International Service is South Korea's largest provider of overseas travel services and air tickets. HanaTour employs nearly 2,500 people in Korea and travel agents outside Korea to provide clients with travel information for about 26 regions worldwide.

HanaTour customers who book travel provide the company with personal details, including their addresses,

contact phone numbers, dates of birth, passport numbers, and payment information. These details, along with their airline and tour bookings and travel itineraries, are stored in HanaTour's database. The confidential nature of this information means HanaTour must have security measures in place to protect the database from unauthorized access.

In addition to these marketplace requirements, HanaTour must comply with South Korea's Electronic Communication Privacy Act. That act requires industries to take measures to protect the privacy of personal information. Thus, protecting customer data is not only good business, but also a legal requirement.

To improve database security, HanaTour added data encryption, both in the database and during transmission. The company also implemented access control based on individual authorizations and assigned tasks. To discourage hacker attacks, HanaTour blocked database access even if a hacker obtained top-level administrator privileges for the system. They created an audit trail of database access to spot suspicious activities so that action could be taken immediately. They also published reports to show compliance with security requirements and used audit information to develop further security plans.

Like most small and medium-sized firms, HanaTour does not need the skills that this security upgrade called for on a permanent full-time basis. Rather than hiring and training staff members to address short-term needs and then releasing or finding other work for these employees, HanaTour engaged specialists. The company worked with Korean database consulting firm Wizbase. HanaTour had worked with Wizbase previously, so they didn't have to spend time explaining basic information about how HanaTour's business works.

The net result of these actions was to make it much more difficult for unauthorized people to see any of the personal information that HanaTour customers supplied. Did this help HanaTour? According to Kim Jin-hwan, director of the HanaTour's IT department, "Our business is based on service. We do not want anything to go wrong on a customer's holiday that will inconvenience them. Lost data or any disruptions to our system would affect our ability to provide optimum service. We upgraded our database to improve performance and take advantage of new security features, which would minimize the risk of losing confidential customer data and strengthen our database and systems from unlawful access."

Discussion Questions

1. From the user side, Mr. Kim said that HanaTour upgraded to a new release of its database management software due to its improved security features. What are the business advantages of improved security?
2. How does HanaTour use the data it collects from the audit to increase the security of its data?

Critical Thinking Questions

1. HanaTour chose Wizbase as its implementation partner in part because of prior experience with that firm. Many small-to-medium companies need to outsource security tasks because they lack the expertise. Does this present an added security risk? Why or why not?
2. Think of the data that your university's database has about students as a large table, with a row for each student and a column for each data element. Group the data into major categories such as contact data, medical data, financial data, academic data and so on. Which groups of people, by job, should have access to each category? Within a group, who should have access to only one row, who should have access to more than one row but not all rows, and who should have access to all rows of the table? Should anyone be allowed to see data but not change it?

SOURCES: Forrester Research, "Formulate a Database Security Strategy To Ensure Investments Will Actually Prevent Data Breaches and Satisfy Regulatory Requirements," *www.oracle.com/us/corporate/analystreports/infrastructure/forrester-thlp-db-security-1445564.pdf*, July 13, 2011; HanaTour Web site, *www.hanatour.com*, accessed May 8, 2012; Staff, "HanaTour International Service Tightens Customer Data Security by Introducing Data Encryption, Access Control, and Audit Solutions," *Oracle*, *www.oracle.com/us/corporate/customers/customersearch/hanatour-intl-1-database-cs-1521219.html*, accessed February 13, 2012.

Questions for Web Case

See the Web site for this book to read about the Altitude Online case for this chapter. Following are questions concerning this Web case.

Altitude Online: Database Systems, Data Centers, and Business Intelligence

Discussion Questions

1. What work is involved in merging multiple databases into one central database, as Altitude Online is doing?
2. Why do you think Altitude Online found it necessary to hire a database administrator? How will the ERP affect the responsibilities of IS personnel across the organization?

Critical Thinking Questions

1. In a major move such as this, what opportunities can Altitude Online take advantage of as it totally revamps its database system that it perhaps wouldn't have considered before?
2. Why do you think Altitude Online is beginning work on its database prior to selecting an ERP vendor?

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4 Telecommunications and Networks

Principles	Learning Objectives
• A telecommunications system has many fundamental components that must be carefully selected and work together effectively to enable people to meet personal and organization objectives.	• Identify and describe the fundamental components of a telecommunications system. • Identify several network types and describe the uses and limitations of each. • Name three basic processing alternatives for organizations that require two or more computer systems and discuss their fundamental features.
• The Internet provides a critical infrastructure for delivering and accessing information and services.	• Briefly describe how the Internet works, including methods for connecting to it and the role of Internet service providers.
• Originally developed as a document-management system, the World Wide Web has grown to become a primary source of news and information, an indispensable conduit for commerce, and a popular hub for social interaction, entertainment, and communication.	• Describe the World Wide Web and how it works. • Explain the use of markup languages, Web browsers, and Web servers. • Identify and briefly describe the process of creating software applications for the Web.
• The Internet and Web provide numerous resources for finding information, communicating and collaborating, socializing, conducting business and shopping, and being entertained.	• List and describe several sources of information on the Web. • Describe methods of finding information on the Web. • List and describe several forms of online communication, along with the benefits and drawbacks of each, in terms of convenience and effectiveness. • Explain Web 2.0 and provide examples of Web 2.0 sites. • List and describe sources of online media and entertainment. • Explain how Web resources are used to support shopping and travel. • Briefly name and describe two useful Internet utilities.
• Popular Internet and Web technologies have been applied to business networks in the form of intranets and extranets.	• Explain how intranets and extranets use Internet and Web technologies, and describe how the two differ.

Information Systems in the Global Economy
WESTERMO, SWEDEN

Working to Reduce Railway Accidents

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In the early morning hours of Sunday, December 1, 2013, train engineer William Rockefeller succumbed to what his lawyer called "highway hypnosis." Dozing off for a minute or so, Rockefeller didn't slow the Hudson line train as it came around a sharp bend at the intersection of the Harlem and Hudson rivers. The speed limit at the bend was 30 miles an hour. The train derailed from the track at 82 miles per hour, killing four and injuring dozens of others. The city and the nation were in shock and some began asking why an alarm did not sound when the train exceeded the speed limit to alert a control room or wake the engineer.

Around the world—in Egypt, Chile, South Africa, Japan, and many other countries—hundreds of people die or are injured in railway accidents. To reduce derailments and collisions, the railway industry has been looking for affordable strategies. Some companies are increasingly turning to new Ethernet technologies, a family of computer network technologies that specify the communications media and signaling to be used on a local area network.

Westermo, a global industrial data communications company based in Sweden, is at the forefront of developing these technologies. Electronic devices located along the track and within the train car send input about a train's speed, position, status, track shifters, and gates to a control room, located in the station. This station is often located far from these devices, and the control room must receive and analyze a large amount of data simultaneously. The data must be sent through a speedy and reliable system.

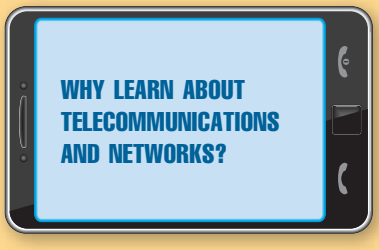
Previously, this communication was carried out through analog devices. Unlike digital devices, analog devices communicate through signals that represent physical quantities that change continuously and degrade as they are transmitted over long distances. Westermo's Ethernet solutions, however, provide for a massive 100 Mbits data flow of digital signals along the cables. Its Ethernet switches are built tough, with metal housing that allows the switches to withstand extreme temperatures and temporary power glitches. The company uses Fast Reconfiguration of Networks Topology (FRNT) to overcome failures in network links and switches.

Ferrovie Nord Milano, the second largest railway company in Italy, recently installed Westermo's Ethernet solutions in 32 stations along fiber optic cables, which support faster communications, but are more expensive than telephone wires. However, Westermo technology can also be used to run Ethernet networks over old copper wires. The Massachusetts Bay Commuter Railroad, servicing a 500-mile area within and around the city of Boston, used Westermo Ethernet extenders, devices that can physically extend an Ethernet or a network beyond its standard 330-foot limitation, to run a network on copper wires that had been installed in the Worcester area 35 years ago. The networks run over long distances with data rates as high as 15.3 Mbits.

Ethernet networks are key to helping major railroad companies gather and interpret data so that they can increase efficiency, reduce costs, and increase safety. Although the railway system in New York did not have a system in place to prevent the tragic derailment in December 2013, companies such as Westermo are developing solutions that railway companies around the world will be able to leverage to prevent accidents like this in the future.

As you read this chapter, consider the following:

- What role do telecommunications play in connecting organizations and growing the global economy?
- In what ways are the Internet and Web used by individuals to improve our quality of life and by business to improve the bottom line?



Today's decision makers need to access data wherever it resides. They must be able to establish fast, reliable connections to exchange messages, upload and download data and software, route business transactions to processors, connect to databases and network services, and send output to wherever it is needed. Regardless of your chosen major or future career field, you will need the communications capabilities provided by telecommunications and networks including the Internet, intranets, and extranets especially if your work involves the supply chain. Among all business functions, supply chain management might use telecommunications and networks the most because an effective supply chain requires cooperation and communications among workers in inbound logistics, warehouse and storage, production, finished product storage, outbound logistics, and, most importantly, with customers, suppliers, and shippers. Many supply chain organizations make use of the Web to purchase raw materials, parts, and supplies at competitive prices. All members of the supply chain must work together effectively to increase the value perceived by the customer, so partners must communicate well. Other employees in human resources, finance, research and development, marketing, and sales positions must also use communications technology to communicate with people inside and outside the organization. To be a successful member of any organization, you must be able to take advantage of the capabilities that these technologies offer you. This chapter begins by discussing the importance of effective communications.

In today's high-speed global business world, organizations need always-on, always-connected computing for traveling employees and for network connections to their key business partners and customers. Forward-thinking organizations strive to increase revenue, reduce time to market, and enable collaboration with their suppliers, customers, and business partners by using telecommunications systems. Here are just a few examples of organizations using telecommunications and networks to move ahead:

- Wasko S.A., a leading Polish information systems organization, designed and implemented a major computing center to serve the BIOPHARMA consortium consisting of the Silesian University of Technology, the Maria Sklodowska-Curie Memorial Cancer Center, the Medical University of Silesia, and the University of Silesia. The cluster consists of 105 blade servers and a large data storage system interconnected via a telecommunications backbone capable of transporting data at 10 Gb/sec. The system is used to support scientists in their search for an effective cure for cancer. The computing center is designed to perform extremely fast calculations and provide security and backup to prevent data loss.[1]
- Telecommunications and networks make it possible for you to access a wealth of educational material and earn certifications or an online degree. A wide range of courses are available online from such leading educational institutions as Cornell, Carnegie Mellon, Harvard, MIT, UCLA, and Yale. Many education organizations such as Coursera, ed2Go, and Khan Academy offer continuing education, certification programs, and professional development courses. Schools such as the

University of Phoenix and Strayer University enable students to earn online degrees.

- US Storage Centers is a self-storage operator with over 70 facilities in 12 states. It is the first firm in the storage industry to offer an electronic cash-transaction service to its tenants. The service runs on the PayNearMe network and enables tenants to pay their rent at any of 10,000 retail locations nationwide. Tenants submit a barcoded PayNearMe PaySlip along with their payment to the cashier, and their account is immediately credited.[2]
- The New Orleans Ernest N. Morial Convention Center with 1.1 million square feet of exhibit space is the sixth largest convention center in the nation and a consistent Top 10 host of the largest number of conventions and tradeshows annually. The convention center implemented a wireless network to provide a high-density, portable Wi-Fi connectivity solution, supporting voice, video, and data access across a large area to serve thousands of users simultaneously.[3]

AN OVERVIEW OF TELECOMMUNICATIONS

Telecommunications refers to the electronic transmission of signals for communications, by such means as telephone, radio, and television. Telecommunications is creating profound changes in business because it lessens the barriers of time and distance. It is changing not only the way businesses operate, but the nature of commerce itself. As networks are connected with one another and transmit information more freely, a competitive marketplace demands excellent quality and service from all organizations.

Figure 4.1 shows a general model of telecommunications. The model starts with a sending unit (1), such as a person, a computer system, a terminal, or another device, that originates the message. The sending unit transmits a signal (2) to a modem (3) that can perform many tasks, which can include converting the signal into a different form or from one type to another. The modem then sends the signal through a medium (4). A **telecommunications medium** is any material substance that carries an electronic signal to support communications between a sending and a receiving device. Another modem (5) connected to the receiving device (6) receives the signal. The process can be reversed, and the receiving unit (6) can send another message to the original sending unit (1). An important characteristic of telecommunications is the speed at which information is transmitted, which is measured in bits per second (bps). Common speeds are in the range of thousands of bits per second (Kbps) to millions of bits per second (Mbps) and even billions of bits per second (Gbps).

telecommunications medium: Any material substance that carries an electronic signal to support communications between a sending and a receiving device.

Advances in telecommunications technology allow us to communicate rapidly with clients and coworkers almost anywhere in the world. Telecommunications also reduces the amount of time needed to transmit information that can drive and conclude business actions. See Figure 4.2.

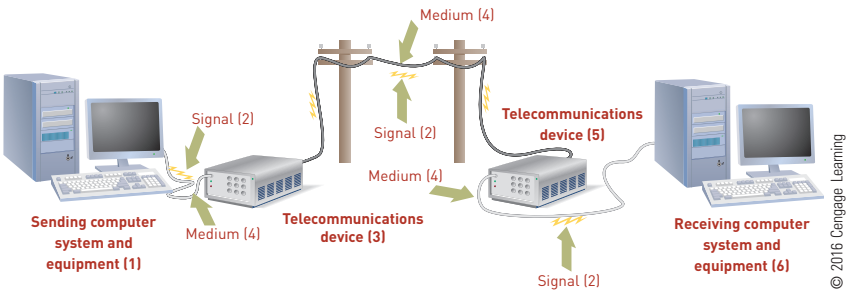


FIGURE **4.1**

Elements of a telecommunications system

Telecommunications devices relay signals between computer systems and transmission media.

FIGURE **4.2**

Telecommunications increases collaboration

Telecommunications technology enables businesspeople to communicate with coworkers and clients from remote locations.

Channel Bandwidth

channel bandwidth: The rate at which data is exchanged, usually measured in bits per second (bps).

broadband communications: A relative term but generally means a telecommunications system that can exchange data very quickly.

Telecommunications professionals consider the capacity of the communications path or channel when they recommend transmission media for a business. **Channel bandwidth** refers to the rate at which data is exchanged, usually measured in bits per second (bps)—the broader the bandwidth, the more information can be exchanged at one time. **Broadband communications** is a relative term but generally means a telecommunications system that can exchange data very quickly. For example, for wireless networks, broadband lets you send data at a rate greater than 1.5 Mbps. In general, today's organizations need more bandwidth for increased transmission speed to carry out their daily functions.

Communications Media

In designing a telecommunications system, the transmission media selected depends on the amount of information to be exchanged, the speed at which data must be exchanged, the level of concern for data privacy, whether the users are stationary or mobile, and many other business requirements. Transmission media can be divided into two broad categories: *guided* (also called *wired*) *transmission media*, in which communications signals are guided along a solid medium, and *wireless*, in which the communications signal is broadcast over airwaves as a form of electromagnetic radiation.

Guided Transmission Media Types

There are many different guided transmission media types. Table 4.1 summarizes the guided media types by physical media form. Common guided transmission media types are shown in Figure 4.3.

10-Gigabit Ethernet is a standard for transmitting data in full-duplex mode at the speed of 10 billion bps for limited distances over Category 5 or 6 twisted-pair wire. The 10-Gigabit Ethernet cable can be used for the high-speed links that connect groups of computers or to move data stored in large databases on large computers to stand-alone storage devices.

Chi-X Japan provides investors with an alternative venue for trading in Tokyo-listed stocks. Its goal is to attract new international investors, in turn increasing overall Japanese market volumes, reducing transaction costs, and

TABLE 4.1 Guided transmission media types

Media Form	Description	Advantages	Disadvantages
Twisted-pair wire	Twisted pairs of copper wire, shielded or unshielded	Used for telephone service; widely available	Transmission speed and distance limitations
Coaxial cable	Inner conductor wire surrounded by insulation	Cleaner and faster data transmission than twisted-pair wire	More expensive than twisted-pair wire
Fiber-optic cable	Many extremely thin strands of glass bound together in a sheathing; uses light beams to transmit signals	Diameter of cable is much smaller than coaxial cable; less distortion of signal; capable of high transmission rates	Expensive to purchase and install

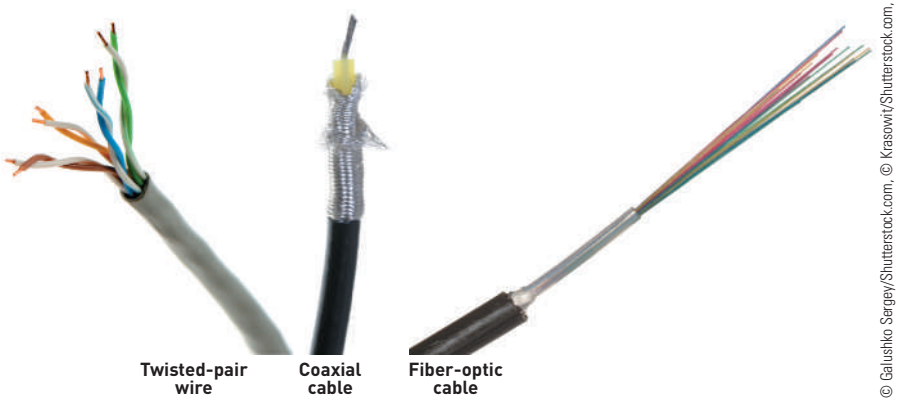


FIGURE **4.3**

Types of guided transmission media

Common guided transmission media include twisted-pair wire, coaxial cable, and fiber-optic cable.

improving investment performance.[4] The firm implemented 10 Gbps Ethernet network adapters to upgrade its network and provide customers minimal transaction processing delays. "We are excited about our upgrade to 10GbE, as it will introduce greater trading efficiencies and enhancements for all participants from day one," said Samson Yuen, CTO, Chi-X Japan. "As we look ahead, Chi-X Japan is committed to technology investments that reduce trading costs and introduce greater trading efficiencies to our customers."[5]

Wireless Technologies

Wireless communications coupled with the Internet are revolutionizing how and where we gather and share information, collaborate in teams, listen to music or watch video, and stay in touch with our families and co-workers while on the road. With wireless capability, a coffee shop can become our living room, or the bleachers at a ball park can become our office. The many advantages and freedom provided by wireless communications are causing many organizations to consider moving to an all-wireless environment.

Wireless telecommunications involves the broadcast of communications in one of three frequency ranges: microwave, radio, and infrared, as shown in Table 4.2.

Some of the more widely used wireless communications options are discussed next.

near field communication (NFC): A very short-range wireless connectivity technology designed for cell phones and credit cards.

Near field communication (NFC) is a very short-range wireless connectivity technology designed for cell phones and credit cards. With NFC, consumers can swipe their credit cards or even cell phones within a few inches of NFC point-of-sale terminals to pay for purchases. Assa Abloy AB is a global leader in providing door-opening solutions with over 37,000 employees and a headquarters in Sweden. The firm is piloting the use of near field communications to enable BlackBerry smartphone users to swipe their phones past a door card reader to gain access to a building or their home or to open a garage door.

TABLE 4.2 Frequency ranges used for wireless communications

Technology	Description	Advantages	Disadvantages
Radio frequency range	Operates in the 3 KHz–300 MHz range	Supports mobile users; costs are dropping	Signal highly susceptible to interception
Microwave—terrestrial and satellite frequency range	High-frequency radio signal (300 MHz–300 GHz) sent through atmosphere and space (often involves communications satellites)	Avoids cost and effort to lay cable or wires; capable of high-speed transmission	Must have unobstructed line of sight between sender and receiver; signal highly susceptible to interception
Infrared frequency range	Signals in the 300 GHz to 400 THz frequency range sent through air as light waves	Lets you move, remove, and install devices without expensive wiring	Must have unobstructed line of sight between sender and receiver; transmission effective only for short distances

France-based Store Electronic Systems is deploying millions of NFC tags in electronic retail chains throughout France. Shoppers can tap their NFC phones to view product information including allergens and nutritional data as well as information on the product's origins and manufacturing chain. See Figure 4.4. Shoppers can also gain access to loyalty programs to earn points, view marketing information, and share content and interact with brands via social media.[6]

ADAM HUNGER/Reuters/Landov

FIGURE 4.4
NFC-enabled shelf tags
Shoppers can tap their NFC phones to view product information including price, allergens, and nutritional data.

Bluetooth: A wireless communications specification that describes how cell phones, computers, faxes, printers, and other electronic devices can be interconnected over distances of 10 to 30 feet at a rate of about 2 Mbps.

Bluetooth is a wireless communications specification that describes how cell phones, computers, printers, and other electronic devices can be interconnected over distances of 10 to 30 feet at a rate of about 2 Mbps and allows users of multifunctional devices to synchronize with information in a desktop computer, send or receive faxes, print, and in general, coordinate all mobile and fixed computer devices. The Bluetooth technology is named after the tenth-century Danish King Harald Blatand, or Harold Bluetooth in English. He had been instrumental in uniting warring factions in parts of what is now Norway, Sweden, and Denmark, just as the technology named after him is designed to allow collaboration among differing devices such as computers, phones, and other electronic devices.

The Bluetooth G-Shock watch enables you to make a connection between your watch and phone. For example, you can control the phone's music player from the watch and watch's timekeeping functions from the phone.

ultra wideband (UWB): A form of short-range communications that employs extremely short electromagnetic pulses lasting just 50 to 1,000 picoseconds that are transmitted across a broad range of radio frequencies of several gigahertz.

Ultra wideband (UWB) communications involves the transmission of extremely short electromagnetic pulses lasting just 50 to 1,000 picoseconds. (One picosecond is one trillionth or one-millionth of one-millionth of a second.) The pulses are capable of supporting data transmission rates of 480 to 1,320 Mbps over a relatively short range of 10 to 50 meters.[7] UWB provides several advantages over other communications methods including a high throughput rate, the ability to transmit virtually undetected and impervious to interception or jamming, and a lack of interference with current communications services.

Potential UWB applications include wirelessly connecting printers and other devices to desktop computers or enabling completely wireless home multimedia networks. Manufacturers of medical instruments are using UWB for video endoscopes, laryngoscopes, and ultrasound transducers.[8]

Wi-Fi: A medium-range wireless telecommunications technology brand owned by the Wi-Fi Alliance.

Wi-Fi is a wireless telecommunications technology brand owned by the Wi-Fi Alliance, which consists of about 300 technology companies, including AT&T, Dell, Microsoft, Nokia, and Qualcomm. The alliance exists to improve the interoperability of wireless local area network products based on the IEEE 802.11 series of telecommunications standards. IEEE stands for the Institute of Electrical and Electronic Engineers, a nonprofit organization and one of the leading standards-setting organizations. Table 4.3 summarizes several variations of this standard.

TABLE 4.3 IEEE 802.11 wireless local area networking standards

Wireless Networking Protocol	Maximum Data Rate per Data Stream	Comments
IEEE 802.11a	54 Mbps	Transmits at 5 GHz so that it is incompatible with 802.11b and 802.11g
IEEE 802.11b	11 Mbps	First widely accepted wireless network standard and transmits at 2.4 GHz; equipment using this protocol may occasionally suffer from interference from microwave ovens, cordless telephones, and Bluetooth devices
IEEE 802.11g	54 Mbps	Equipment using this protocol transmits at 2.4 GHz and may occasionally suffer from interference from microwave ovens, cordless telephones, and Bluetooth devices
IEEE 802.11n	300 Mbps	Employs multiple input, multiple output (MIMO) technology that allows multiple data streams to be transmitted over the same channel using the same bandwidth used for only a single data stream in 802.11a/b/g
IEEE 802.11ac	400 Mbps–1.3 Gbps	An emerging 802.11 standard that provides higher data transmission speeds and more stable connections. It can transmit at either 2.4 GHz or 5 GHz

With a Wi-Fi wireless network, the user's computer, smartphone, or other mobile device has a wireless adapter that translates data into a radio signal and transmits it using an antenna. A wireless access point, which consists of a transmitter with an antenna, receives the signal and decodes it. The access point then sends the information to the Internet over a wired connection. See Figure 4.5. When receiving data, the wireless access point takes the information from the Internet, translates it into a radio signal, and sends it to the device's wireless adapter. These devices typically come with built-in wireless transmitters and software to enable them to alert the user to the existence of a Wi-Fi network. The area covered by one or more interconnected wireless access points is called a "hot spot." Current Wi-Fi access points have a maximum range of about 300 feet outdoors and 100 feet within a dry-walled building. Wi-Fi has proven so popular that hot spots are popping up in places such as airports, coffee shops, college campuses, libraries, and restaurants.

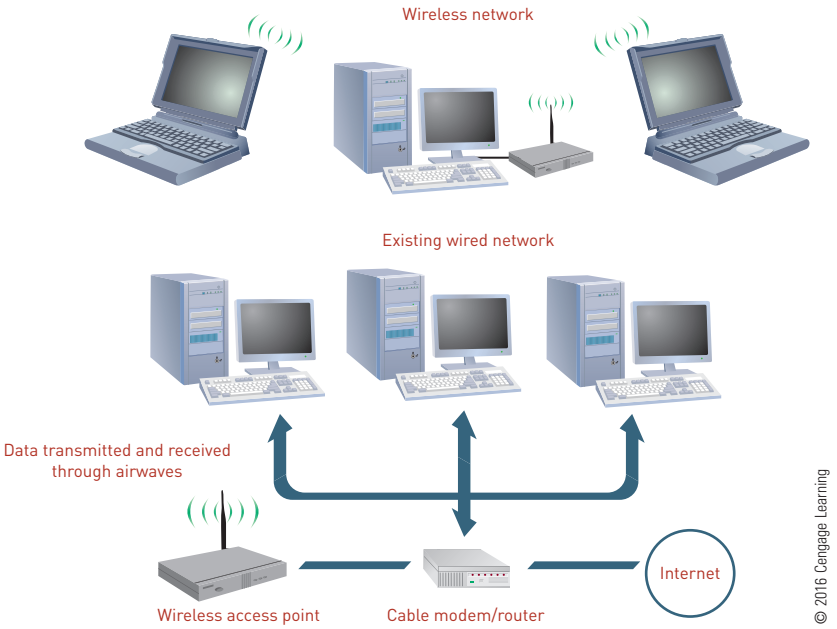


FIGURE **4.5**

Wi-Fi network

In a Wi-Fi network, the user's computer, smartphone, or cell phone has a wireless adapter that translates data into a radio signal and transmits it using an antenna.

The availability of free Wi-Fi within a hotel's premises has become very popular with business travelers. Many hotels offer free Wi-Fi including Best Western, Carlson Rezidor, Choice Hotels, Hilton, Hyatt, Holiday Inn, Starwood, The Four Seasons Hotels and Resorts, and Wyndham hotels.[9] Meanwhile, hundreds of cities in the United States have implemented municipal Wi-Fi networks for use by meter readers and other municipal workers and to provide Internet access to their citizens and visitors.

Microwave Transmission

Microwave is a high-frequency (300 MHz–300 GHz) signal sent through the air. Terrestrial (Earth-bound) microwaves are transmitted by line-of-sight devices, so the line of sight between the transmitter and receiver must be unobstructed. Typically, microwave stations are placed in a series—one station receives a signal, amplifies it, and retransmits it to the next microwave transmission tower. Such stations can be located roughly 30 miles apart before the curvature of the Earth makes it impossible for the towers to "see" one another. Microwave signals can carry thousands of channels at the same time. Because they are line-of-sight transmission devices, microwave dishes are frequently placed in relatively high locations, such as mountains, towers, or tall buildings.

A communications satellite also operates in the microwave frequency range. See Figure 4.6. The satellite receives the signal from the Earth station, amplifies the relatively weak signal, and then rebroadcasts it at a different frequency. The advantage of satellite communications is that satellites can receive and broadcast over large geographic regions. Such problems as the curvature of the Earth, mountains, and other structures that block the line-of-sight microwave transmission make satellites an attractive alternative. Geostationary, low-Earth orbit, and small mobile satellite stations are the most common forms of satellite communications.

A *geostationary satellite* orbits the Earth directly over the equator, approximately 22,300 miles above the Earth, so that it appears stationary. The U.S. National Weather Service relies on the Geostationary Operational Environmental Satellite program for weather imagery and quantitative data to support weather forecasting, severe storm tracking, and meteorological research.

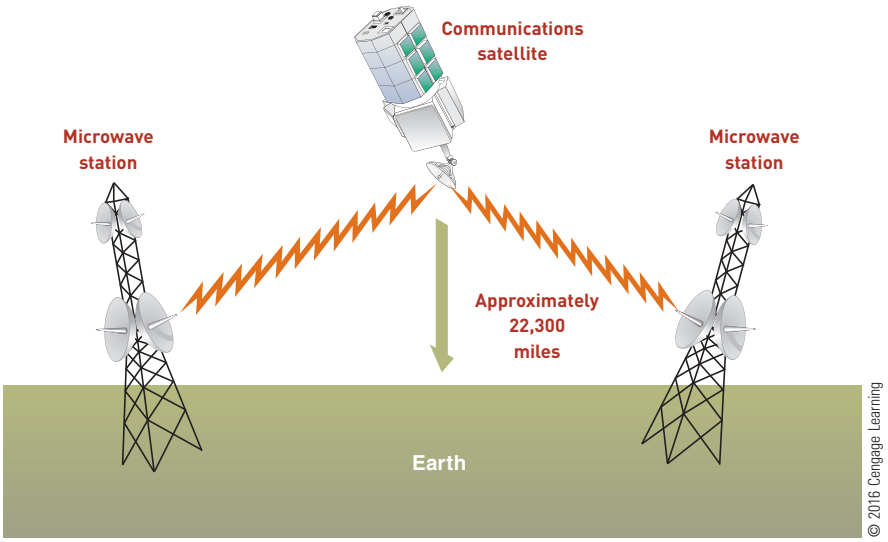


FIGURE **4.6**

Satellite transmission

Communications satellites are relay stations that receive signals from one Earth station and rebroadcast them to another.

A *low earth orbit* (*LEO*) *satellite* system employs many satellites, each in an orbit at an altitude of less than 1,000 miles. The satellites are spaced so that, from any point on the Earth at any time, at least one satellite is on a line of sight. Iridium Communications, Inc., provides a global communications network that spans the entire Earth using 66 satellites in a near polar orbit at an altitude of 485 miles. Calls are routed among the satellites to create a reliable connection between call participants that cannot be disrupted by natural disasters such as earthquakes, tsunamis, or hurricanes that knock out ground-based wireless towers and wire- or cable-based networks.[10] Sarah Outen, while attempting to become the first woman to row solo across the dangerous north Pacific Ocean, was hit by a tropical storm with winds of 65 knots and waves of 15 feet. After two days, her boat was so damaged that she had no choice but to call for an emergency pickup using her satellite phone to keep in contact with the rescue team as it took 30 hours to reach her.[11]

A *very small aperture terminal* (*VSAT*) is a satellite ground station with a dish antenna smaller than 3 meters in diameter. Carnival Corporation uses VSAT to provide communications for crew and passengers onboard its 100 cruise chips. Richard Ames, senior vice president of business services, says: "At Carnival, our most important goal is to give our guests a great experience. For many guests, this means staying connected by phone and Internet, even when they're on our ships in the middle of the sea."[12]

4G Wireless Communications

Wireless communications has evolved through four generations of technology and services. The 1G (first generation) of wireless communications standards originated in the 1980s and was based on analog communications. The 2G (second generation) employed fully digital networks that superseded 1G networks in the early 1990s. Phone conversations were encrypted, mobile phone usage was expanded, and short message services (SMS), or texting, was introduced. 3G wireless communications supports wireless voice and broadband speed data communications in a mobile environment at speeds of 2–4 Mbps. Additional capabilities include mobile video, mobile e-commerce, location-based services, mobile gaming, and the downloading and playing of songs.

4G broadband mobile wireless is expected to deliver more advanced versions of enhanced multimedia, smooth streaming video, universal access, portability across all types of devices, and, eventually, worldwide roaming. 4G will also deliver 3 to 20 times the speed of 3G networks for mobile devices such as smartphones, tablets, laptops, and wireless hotspots.[13]

Long Term Evolution (LTE): A standard for wireless communications for mobile phones based on packet switching.

Each of the four major U.S. wireless network operators (AT&T, Verizon, Sprint, and T-Mobile) is rapidly expanding its 4G networks based on the Long Term Evolution (LTE) standard. **Long Term Evolution (LTE)** is a standard for wireless communications for mobile phones based on packet switching, which is an entirely different approach from the circuit-switching approach employed in 3G telecommunications networks. Carriers must reengineer their voice call networks to convert to the LTE standard.

The biggest benefit of LTE is how quickly a mobile device can connect to the Internet and how much data it can download or upload in a given amount of time. LTE makes it reasonable to stream video to your phone, using services such as Hulu Plus, Netflix, or YouTube. It also speeds up Web browsing, with most pages loading in seconds. LTE enables video calling using services such as Skype or Google+ Hangouts. LTE's faster speed also makes sharing photos and videos from your phone quick and easy.

Worldwide Interoperability for Microwave Access (WiMAX): A 4G alternative based on a set of IEEE 802.16 metropolitan area network standards that support various types of communications access.

Worldwide Interoperability for Microwave Access (WiMAX) is a 4G alternative based on a set of IEEE 802.16 wireless metropolitan area network standards that support various types of communications access. In many respects, WiMAX operates like Wi-Fi, only over greater distances and at faster transmission speeds. Fewer WiMAX base stations (towers) are required to cover the same geographical area than when Wi-Fi technology is used. While Wi-Fi's range is limited to hundreds of feet, WiMAX has a range of 30 miles due to the frequencies used (2 to 11 GHz and 10 to 66 GHz).

Most telecommunications experts agree that WiMAX is an attractive option for developing countries with little or no wireless telephone infrastructure. However, as mentioned earlier, the major U.S. carriers have selected 4G LTE.

5G Wireless Communications

A new mobile telecommunications generation has come on the scene about every 10 years since the first 1G system. 5G is a term used to identify the next major phase of mobile telecommunications standards beyond 4G. No 5G mobile standard has been formally defined yet, but some industry observers predict the new 5G standards may be introduced in the early 2020s. 5G may bring with it higher data transmission rates, lower power consumption, higher connect reliability with fewer dropped calls, increased geographic coverage, and lower infrastructure costs.[14]

Growth in Wireless Data Traffic

Over the next several years, the growth in the amount of wireless data traffic will create many opportunities for innovators to solve network capacity problems and avoid user service issues. The volume of mobile data traffic reached 8.1 exabytes worldwide in 2012, and some predict a compound average growth rate of roughly 44 percent over the next five years. (One exabyte is 1000^6 bytes or sufficient storage to hold 50,000 years of DVD-quality video.)[15] Cisco estimates that worldwide wireless data traffic will grow at a higher average rate of 66 percent per year from 2013 to 2017 when smartphones are expected to represent 27 percent of the connected devices consuming 68 percent of the data. Video is expected to make up as much as two-thirds of the data volume.[16] Although 4G LTE networks have 20 times the data-carrying capacity of 3G networks, even 4G networks may not be able to keep pace with such rapid growth rates.

NETWORKS AND DISTRIBUTED PROCESSING

computer network: The communications media, devices, and software needed to connect two or more computer systems or devices.

A **computer network** consists of communications media, devices, and software needed to connect two or more computer systems or devices. The computers and devices on the networks are also called *network nodes*. After they are connected, the nodes can share data, information, work processes and

allow employees to collaborate on projects. If a company uses networks effectively, it can grow into an agile, powerful, and creative organization, giving it a long-term competitive advantage. Organizations can use networks to share hardware, programs, and databases. Networks can transmit and receive information to improve organizational effectiveness and efficiency. They enable geographically separated workgroups to share documents and opinions, which fosters teamwork, innovative ideas, and new business strategies.

Network Topology

network topology: The shape or structure of a network that indicates how the communications links and hardware devices of the network are arranged.

Network topology indicates how the communications links and hardware devices of the network are arranged. The topology is the shape or structure of the network so that the transmission rates, distances between devices, signal types, and physical interconnection may differ between networks, but they may all have the same topology. The three most common network topologies in use today are the star, bus, and mesh.

star network: A network in which all network devices connect to one another through a single central device called the hub node.

In a **star network**, all network devices connect to one another through a single central device called the hub node. See Figure 4.7. Many home networks employ the star topology. A failure in any link of the star network will isolate only the device connected to that link. However, should the hub fail, all devices on the entire network are unable to communicate.

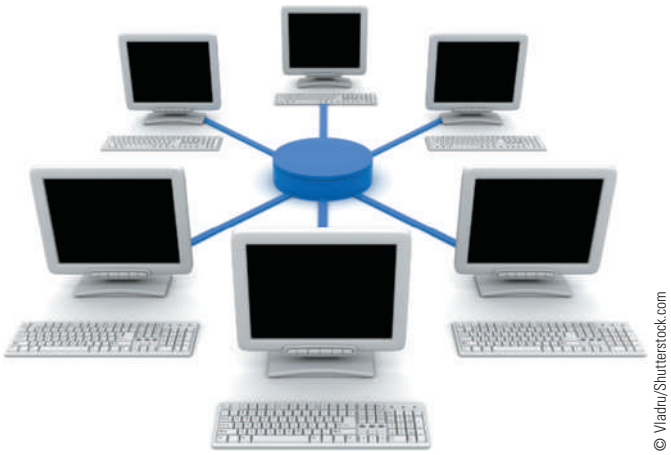


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FIGURE **4.7**

Star network

In a star network, all network devices connect to one another through a single central hub node.

bus network: A network in which all network devices are connected to a common backbone that serves as a shared communications medium.

In a **bus network**, all network devices are connected to a common backbone that serves as a shared communications medium. See Figure 4.8. To communicate with any other device on the network, a device sends a broadcast message onto the communications medium. All devices on the network can "see" the message, but only the intended recipient actually accepts and processes the message.

mesh network: A network that uses multiple access points to link a series of devices that speak to each other to form a network connection across a large area.

Mesh networks use multiple access points to link a series of devices that speak to each other to form a network connection across a large area. See Figure 4.9. Communications are routed among network nodes by allowing for continuous connections and bypassing blocked paths by "hopping" from node to node until a connection can be established. Mesh networks are very robust: if one node fails, all the other nodes can still communicate with each other, directly or through one or more intermediate nodes.

The Piedmont City School District, located in rural Alabama, implemented a city-wide wireless mesh network to enable its 1,200 students to access computer services. Many of the families could not afford Internet access from their homes. The network enables all students to access Odyssey, a Web-based learning system for reading, language, and math. They can also participate in distance learning and advanced placement classes.[17]

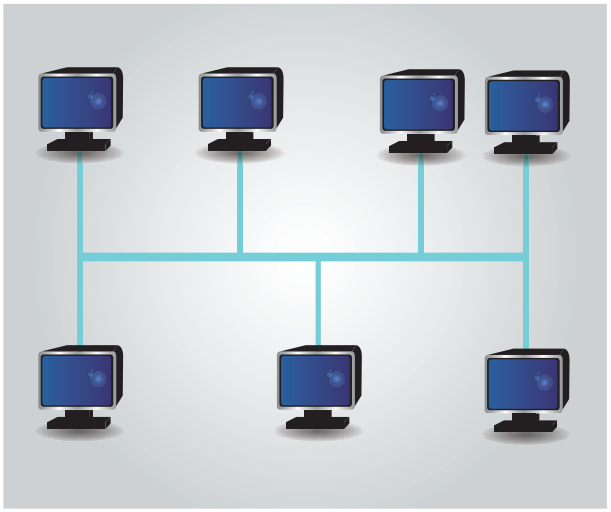


FIGURE **4.8**

Bus network

In a bus network, all network devices are connected to a common backbone that serves as a shared communications medium.

FIGURE **4.9**

Mesh network

Mesh networks use multiple access points to link a series of devices that speak to each other to form a network connection across a large area.

Network Types

Depending on the physical distance between nodes on a network and the communications and services it provides, networks can be classified as personal area, local area, metropolitan area and wide area network.

Personal Area Networks

personal area network (PAN): A network that supports the interconnection of information technology devices close to one person.

A **personal area network (PAN)** is a wireless network that connects information technology devices close to one person. With a PAN, you can connect a laptop, digital camera, and portable printer without cables. You can download digital image data from the camera to the laptop and then print it on a high-quality printer—all wirelessly. Additionally, a PAN enables data captured by sensors placed on your body to be transmitted to your smartphone as input to applications that can serve as calorie trackers, heart monitors, glucose monitors, and pedometers.

Local Area Networks

local area network (LAN): A network that connects computer systems and devices within a small area, such as an office, home, or several floors in a building.

A network that connects computer systems and devices within a small area, such as an office, home, or several floors in a building is a **local area network (LAN)**. Typically, LANs are wired into office buildings and factories, as shown

in Figure 4.10. Although LANs often use unshielded twisted-pair wire, other media—including fiber-optic cable—is also popular. Increasingly, LANs are using some form of wireless communications. You can build LANs to connect personal computers, laptop computers, or powerful mainframe computers.

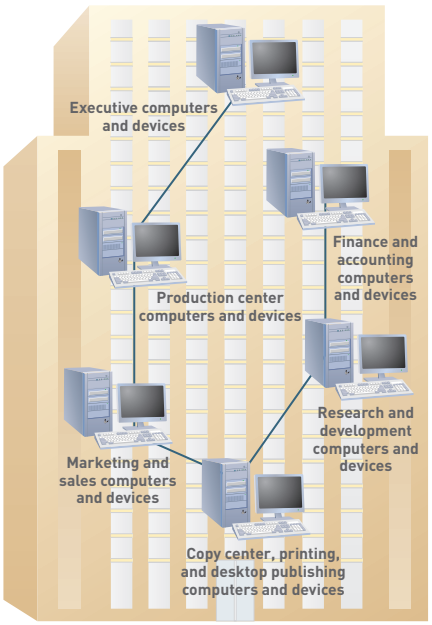


FIGURE **4.10**

Typical LAN

All network users within an office building can connect to each other's devices for rapid communication. For instance, a user in research and development could send a document from her computer to be printed at a printer located in the desktop publishing center. Most computer labs employ a LAN to enable the users to share the use of high-speed and/or color printers and plotters as well as to download software applications and save files.

A basic type of LAN is a simple peer-to-peer network that a small business might use to share files and hardware devices such as printers. In a peer-to-peer network, you set up each computer as an independent computer, but you let other computers access specific files on its hard drive or share its printer. These types of networks have no server. Instead, each computer is connected to the next machine. Examples of peer-to-peer networks include Windows for Workgroups, Windows NT, Windows 2000, AppleShare, and Windows 7 Homegroup. Performance of the computers on a peer-to-peer network is usually slower because one computer is actually sharing the resources of another computer.

With more people working at home, connecting home computing devices and equipment into a unified network is on the rise. Small businesses are also connecting their systems and equipment. A home or small business can connect network, computers, printers, scanners, and other devices. A person working on one computer, for example, can use data and programs stored on another computer's hard disk. In addition, several computers on the network can share a single printer. To make home and small business networking a reality, many companies are offering standards, devices, and procedures.

Metropolitan Area Networks

metropolitan area network (MAN): A telecommunications network that connects users and their computers in a geographical area that spans a campus or city.

A **metropolitan area network (MAN)** is a telecommunications network that connects users and their computers in a geographical area that spans a campus or city. A MAN might redefine the many networks within a city into a single larger network or connect several LANs into a single campus LAN. Often the MAN is owned either by a consortium of users or by a single network provider who sells the service to users. PIONIER is a Polish national research and education network created to provide high-speed Internet access and to conduct network-based research. The network connects 21 MANs and 5 high-performance computing centers using fiber optic transmission media over a distance of 6,467 km.[18]

Wide Area Networks

wide area network (WAN): A telecommunications network that connects large geographic regions.

A **wide area network (WAN)** is a telecommunications network that connects large geographic regions. A WAN might be privately owned or rented and includes public (shared-users) networks. When you make a long-distance phone call or access the Internet, you are using a WAN. WANs usually consist of computer equipment owned by the user, together with data communications equipment and telecommunications links provided by various carriers and service providers. The Schools 100 Mbit/s High-Speed Programme is an Irish government project to connect all 730 post-primary schools across the country to a high-speed WAN and enable students to learn and collaborate online.[19]

WANs often provide communications across national borders, which involves national and international laws regulating the electronic flow of data across international boundaries, often called *transborder dataflow*. Some countries have strict laws limiting the use of telecommunications and databases, making normal business transactions such as payroll costly, slow, or even impossible.

Basic Processing Alternatives

When an organization needs to use two or more computer systems, it can implement one of three basic processing alternatives: centralized, decentralized, or distributed. With **centralized processing**, all processing occurs in a single location or facility. This approach offers the highest degree of control because a single centrally managed computer performs all data processing. The Ticketmaster reservation service is an example of a centralized system. One central computer with a database stores information about all events and records the purchases of seats. Ticket clerks at various ticket selling locations can enter order data and print the results, or customers can place orders directly over the Internet.

centralized processing: An approach to processing wherein all processing occurs in a single location or facility.

decentralized processing: An approach to processing wherein processing devices are placed at various remote locations.

With **decentralized processing**, processing devices are placed at various remote locations. Each processing device is isolated and does not communicate with any other processing device. Decentralized systems are suitable for companies that have independent operating units, such as 7-Eleven, where each of its 8,700 stores in the United States and Canada is managed to meet local retail conditions.[20] Each store has a computer that runs more than 50 business applications, such as cash register operations, gasoline pump monitoring, and merchandising.

distributed processing: An approach to processing wherein processing devices are placed at remote locations but are connected to each other via a network.

With **distributed processing**, processing devices are placed at remote locations but are connected to each other via a network. One benefit of distributed processing is that managers can allocate data to the locations that can process it most efficiently.

Kroger operates over 2,424 supermarkets and multi-department stores, each with its own computer to support store operations such as customer checkout and inventory management. These computers are connected to a network so that sales data gathered by each store's computer can be sent to a huge data repository on a mainframe computer for efficient analysis by marketing analysts and product supply chain managers.

Client/Server Systems

client/server architecture: An approach to computing wherein multiple computer platforms are dedicated to special functions, such as database management, printing, communications, and program execution.

In **client/server architecture**, multiple computer platforms are dedicated to special functions, such as database management, printing, communications, and program execution. These platforms are called *servers*. Each server is accessible by all computers on the network. Servers can be computers of all sizes; they store both application programs and data files and are equipped with operating system software to manage the activities of the network. The server distributes programs and data to the other computers (clients) on the network as they request them. An application server holds the programs and data files for a particular application, such as an inventory database. The client or the server can do the processing.

ETHICAL & SOCIETAL ISSUES

Safaricom's Moves against Hate Speech

On December 30, 2007, Kenya held its breath as it awaited the results of its presidential election. Many were sure that Raila Odinga, the challenger, had ousted incumbent Mwai Kibaki. The election was too close to call, and three days later, when officials announced Kibaki's victory, the nation descended into violent clashes between the party and tribal supporters of each of the two candidates. The clashes claimed 1,200 lives and displaced over half a million people. In the inquiries that followed, officials found that hate speech posted to blogs and delivered over SMS was rampant prior to the election and during the violence.

Unlike many developed European and North American countries, mobile telephony dominates the Internet and communications technology sector in Africa. Prepaid and pay-as-you-go plans make up about 99 percent of all mobile plans, and mobile phones provide Internet access to those who cannot afford laptops and Internet services. As Kenya headed into its March 2013 national election, many worried about the possibility of another outbreak of violence. Safaricom, a leading telecommunications company in East Africa and the leading mobile network provider, took a radical step to eliminate hate speech transmitted over its network. It issued guidelines to its clients that transmitted bulk SMS from political candidates and parties, vetted the SMS content, and retained the right to refuse to transfer messages with content that attacked members of a particular party or tribe.

The guidelines specified that senders, the political party representatives or political candidates, had to identify themselves and provide registration documents or ID numbers. The message could only be sent in one of the two official languages in Kenya, Swahili or English. The content could not use abusive or profane language, incite people to violence, ridicule members of a particular group, or attack individuals, their families, or their tribes. In creating these guidelines, Safaricom had to traverse carefully between the hate speech provisions in the new Kenyan constitution, privacy rights, and customer expectations. Since Safaricom was only intercepting bulk SMS rather than peer-to-peer SMS, privacy rights were not a concern. For-profit companies, political parties, and other organizations pay to send bulk SMS messages. Because these messages are not considered personal communications, they are not subject to privacy laws. However, Safaricom later noticed an increase in SMS sent from outside of Kenya and, in the final days of the election, blocked messages sent to over 100 recipients.

In all, Safaricom refused 18 requests and 13 of these were modified, resubmitted, and approved. Only one request was blocked due to its content. Initial reports have pointed out that Safaricom was able to eliminate only one of the many options available: Many people still received messages containing hate speech through peer-to-peer SMS and others posted hate speech on social media sites such as Facebook.

Still, the March 2013 Kenyan election passed with only one attack, which killed six police officers. By comparison to 2007, the election was a great success for democracy and those who support peaceful change, and some of the credit is due to Safaricom and other groups that worked to stop the spread of hate speech and incitement.

Discussion Questions

1. What steps did Safaricom take to prevent hate speech during the 2013 elections? Did Safaricom act ethically? Why or why not?
2. Were these steps effective? Why or why not?

Critical Thinking Questions

1. Violence broke out a few months prior to the elections. Should Safaricom and other organizations do more to stop hate speech? If so, what measures should they take?
2. Should Safaricom be allowed to intercept and vet peer-to-peer messages? Or should the right to privacy trump the need to stop hate crime?

SOURCES: "Kenya Election Violence: ICC Names Suspects," BBC, December 15, 2010; Purdon, Lucy, "Corporate Responses to Hate Speech in the 2013 Kenyan Presidential Elections," Case Study Number 1: November 2013, Institution for Human Rights and Business; Okutoyi, Elly, "Safaricom Spearheads Fight Against Campaign Hate Speech with Tough New Rules," humanipo, Home to African Tech, June 18, 2012.

A client is any computer (often a user's personal computer) that sends messages requesting services from the servers on the network. A client can converse with many servers concurrently. For example, a user at a personal computer initiates a request to extract data that resides in a database somewhere on the network. A data request server intercepts the request and determines on which database server the data resides. The server then formats the user's request into a message that the database server will understand. When it receives the message, the database server extracts and formats the requested data and sends the results to the client. The database server sends only the data that satisfies a specific query—not the entire file. As with the file server approach, when the downloaded data is on the user's machine, it can then be analyzed, manipulated, formatted, and displayed by a program that runs on the user's personal computer.

Telecommunications Hardware

Networks require various telecommunications hardware devices to operate, including modems, multiplexers, front-end processors, private branch exchanges, switches, bridges, routers, and gateways, which are described in Table 4.4.

TABLE 4.4 Common telecommunications devices

Device	Function
Modem	Translates data from a digital form (as it is stored in the computer) into an analog signal that can be transmitted over ordinary telephone lines.
Fax modem	Facsimile devices, commonly called fax devices, allow businesses to transmit text, graphs, photographs, and other digital files via standard telephone lines. A fax modem is a very popular device that combines a fax with a modem, giving users a powerful communications tool.
Multiplexer	Allows several telecommunications signals to be transmitted over a single communications medium at the same time, thus saving expensive long-distance communications costs.
PBX	A communications system that manages both voice and data transfer within a building and to outside lines. In a PBX system, switching PBXs can be used to connect hundreds of internal phone lines to a few phone company lines.
Front-end processor	Special-purpose computer that manages communications to and from a computer system serving many people.
Switch	Uses the physical device address in each incoming message on the network to determine which output port it should forward the message to reach another device on the same network
Bridge	Connects one LAN to another LAN that uses the same telecommunications protocol.
Router	Forwards data packets across two or more distinct networks toward their destinations through a process known as routing. Often an Internet service provider (ISP) installs a router in a subscriber's home that connects the ISP's network to the network within the home.
Gateway	A network device that serves as an entrance to another network.

Telecommunications Software

network operating system (NOS): Systems software that controls the computer systems and devices on a network and allows them to communicate with each other.

A **network operating system (NOS)** is systems software that controls the computer systems and devices on a network and allows them to communicate with each other. The NOS performs similar functions for the network as operating system software does for a computer, such as memory and task management and coordination of hardware. When network equipment (such as printers, plotters, and disk drives) is required, the NOS makes sure that these resources are used correctly. Novell NetWare, Windows 2000, Windows 2003, and Windows 2008 are common network operating systems.

Standard Chartered Bank operates with 89,000 employees in over 1,700 branches and outlets in 68 countries around the world. It derives 90 percent of its income and profits from operations in Asia, Africa, and the Middle East.[21] For any bank, processing and telecommunications system availability is essential. Standard Chartered implemented a telecommunications infrastructure consisting of switches and gateways running under the Junos network operating system to lower the cost and complexity of managing its networks and to provide full redundancy.[22]

Because companies use networks to communicate with customers, business partners, and employees, network outages or slow performance can mean a loss of business. Network management includes a wide range of technologies and processes that monitor the network and help identify and address problems before they can create a serious impact.

network-management software: Software that enables a manager on a networked desktop to monitor the use of individual computers and shared hardware (such as printers), scan for viruses, and ensure compliance with software licenses.

Software tools and utilities are available for managing networks. With **network-management software**, a manager on a networked personal computer can monitor the use of individual computers and shared hardware (such as printers), scan for viruses, and ensure compliance with software licenses. Network-management software also simplifies the process of updating files and programs on computers on the network—a manager can make changes through a communications server instead of having to visit each individual computer. In addition, network-management software protects software from being copied, modified, or downloaded illegally. It can also locate telecommunications errors and potential network problems. Some of the many benefits of network-management software include fewer hours spent on routine tasks (such as installing new software), faster response to problems, and greater overall network control.

Banks use a special form of network-management software to monitor the performance of their automated teller machines (ATMs). Status messages can be sent over the network to a central monitoring location to inform support people about situations such as low cash or receipt paper levels, card reader problems, and printer paper jams. Once a status message is received, a service provider or branch location employee can be dispatched to fix the ATM problem.

Today, most IS organizations use network-management software to ensure that their network remains up and running and that every network component and application is performing acceptably. The software enables IS staff to identify and resolve fault and performance issues before they affect customers and service. The latest network-management technology even incorporates automatic fixes: The network-management system identifies a problem, notifies the IS manager, and automatically corrects the problem before anyone outside the IS department notices it.

The Covell Group is a small IT consulting group in San Diego that provides server and Web site monitoring for primarily small and medium-sized companies. The firm uses network-monitoring software to watch sensors and remote probes that track CPU, disk space, and Windows services. Constant monitoring enables the firm to detect if a communications line is down or if there is a power failure overnight so that everything is up and ready by the start of the next work day.[23]

Software Defined Networking (SDN)

software defined networking: An emerging approach to networking that allows network administrators to have programmable central control of the network via a controller without requiring physical access to all the network devices.

In today's current network environment, each network device must be configured individually, usually via manual keyboard input. For a network of any size, this becomes a labor-intensive and error-prone effort, making it difficult to change the network so it can meet the needs of the organization. **Software defined networking (SDN)** is an emerging approach to networking that allows network administrators to manage a network via a controller that does not require physical access to all the network devices. This approach automates tasks such as configuration and policy management and enables the network to dynamically respond to application requirements. As a pioneer in the use of SDN, Google is so pleased with its benefits that the company plans to extend its current international SDN-based inter-data center network and build other new networks using the same capabilities.[24]

USE AND FUNCTIONING OF THE INTERNET

The Internet has grown rapidly (see Figure 4.11) and is truly international in scope, with users on every continent—including Antarctica. Although the United States has high Internet penetration among its population, it does not constitute the majority of people online. Of all the people using the Internet, citizens of Asian countries make up about 45 percent, Europeans about 22 percent, and North Americans about 11 percent. China has by far the most Internet users with 538 million, which is more users than the next three countries combined (United States 245 million, India 137 million, and Japan 101 million).[25] See Figure 4.12. Being connected to the Internet provides global economic opportunity to individuals, businesses, and countries.

The Internet and social media Web sites have emerged as important new channels for learning about world events, protesting the actions of organizations and governments, and urging others to support one's favorite causes or candidates. For example, some believe that Barack Obama's effective use of the Internet and social media provided him with a distinct advantage over his opponents in the presidential elections of 2008 and 2012.[26] In another example, Syrian rebels used the Internet to communicate about events within the country and to provide a useful link to others around the world.[27]

Internet censorship: The control or suppression of the publishing or accessing of information on the Internet.

On the other hand, **Internet censorship**, the control or suppression of the publishing or accessing of information on the Internet, is a growing issue. For example, riot police in Istanbul used water cannons to disperse protesters who objected to a draft law that would grant the government sweeping new powers over Turkish Internet service providers.[28]

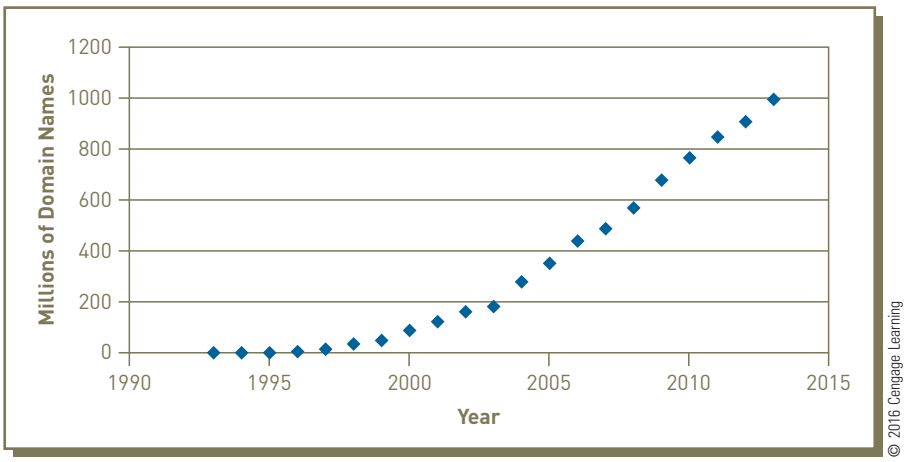


FIGURE **4.11**

Internet growth: Number of Internet hosts

The number of worldwide Internet hosts is expected to continue growing.

Source: Data from "2012 The Internet Domain Survey," *https://www.isc.org/services/survey/references/*

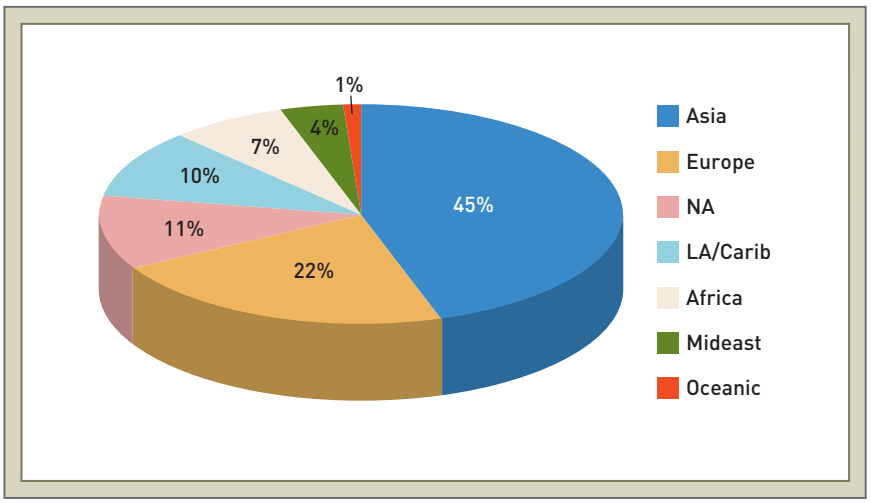


FIGURE **4.12**

Distribution of Internet users

China has more Internet users than the next three countries combined.

Source: Data from "Internet World Stats," *www.internetworldstats.com /stats.htm*

ARPANET: A project started by the U.S. Department of Defense (DoD) in 1969 as both an experiment in reliable networking and a means to link the DoD and military research contractors, including many universities doing military-funded research.

The ancestor of the Internet was the **ARPANET**, a project started by the U.S. Department of Defense (DoD) in 1969. The ARPANET was both an experiment in reliable networking and a means to link DoD and military research contractors, including many universities doing military-funded research. (*ARPA* stands for the Advanced Research Projects Agency, the branch of the DoD in charge of awarding grant money. The agency is now known as DARPA—the added *D* is for *Defense*) The ARPANET was highly successful, and every university in the country wanted to use it. This wildfire growth made it difficult to manage the ARPANET, particularly its large and rapidly growing number of university sites. So, the ARPANET was broken into two networks: MILNET, which included all military sites, and a new, smaller ARPANET, which included all the nonmilitary sites. The two networks remained connected, however, through use of the **Internet Protocol (IP)**, which enables traffic to be routed from one network to another as needed. All the networks connected to the Internet use IP, so they all can exchange messages.

Internet Protocol (IP): A communication standard that enables computers to route communications traffic from one network to another as needed.

To speed Internet access, a group of corporations and universities called the University Corporation for Advanced Internet Development (UCAID) is working on a faster alternative Internet called Internet2 (I2). The Internet2 offers the potential of faster Internet speeds—up to 10 Gbps or more. The goal is to enable collaboration with anyone, anywhere without constraints.[29] The National LambdaRail (NLR) is a cross-country, high-speed (10 Gbps) fiber-optic network dedicated to research in high-speed networking applications.[30] The NLR provides a "unique national networking infrastructure" to advance networking research and next-generation network-based applications in science, engineering, and medicine. This new high-speed fiber-optic network will support the ever-increasing need of scientists to gather, transfer, and analyze massive amounts of scientific data.

How the Internet Works

In the early days of the Internet, the major telecommunications (telecom) companies around the world agreed to connect their networks so that users on all the networks could share information over the Internet. These large telecom companies are called *network service providers* (*NSPs*). Examples include Verizon, Sprint, British Telecom, and AT&T. The cables, routers, switching stations, communication towers, and satellites that make up these networks are the hardware over which Internet traffic flows. The combined hardware of these and other NSPs—the fiber-optic cables that span the globe over land and under sea—make up the **Internet backbone**.

Internet backbone: One of the Internet's high-speed, long-distance communications links.

The Internet transmits data from one computer (called a *host*) to another. See Figure 4.13. If the receiving computer is on a network to which the first computer is directly connected, it can send the message directly. If the receiving and sending computers are not directly connected to the same network, the sending computer relays the message to another computer that can forward it. The message is typically sent through one or more routers to reach its destination. It is not unusual for a message to pass through a dozen or more routers on its way from one part of the Internet to another.

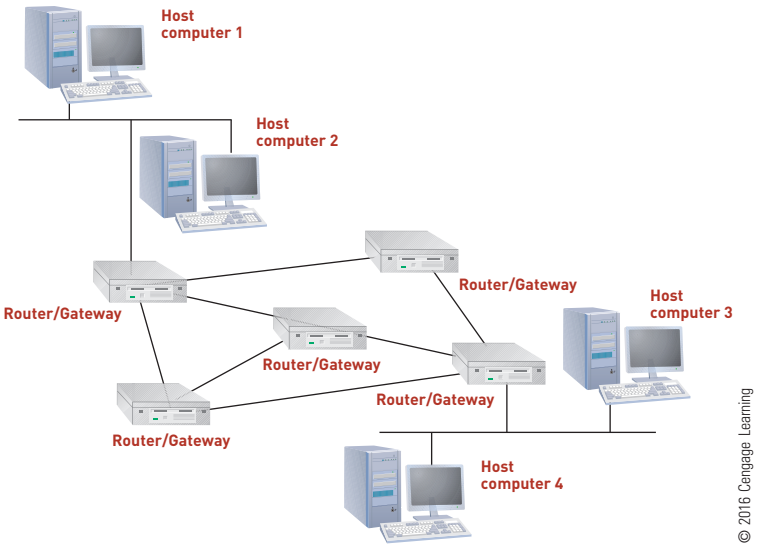


FIGURE **4.13**

Routing messages over the Internet

Data is transmitted from one host computer to another on the Internet.

The various telecommunications networks that are linked to form the Internet work much the same way—they pass data around in chunks called packets, each of which carries the addresses of its sender and its receiver along with other technical information. The set of rules used to pass packets from one host to another is the IP protocol. Many other communications protocols are used in connection with IP. The best known is the Transmission Control Protocol (TCP). Many people use TCP/IP as an abbreviation for the combination of TCP and IP used by most Internet applications. After a network following these standards links to the Internet's backbone, it becomes part of the worldwide Internet community.

IP address: A 64-bit number that identifies a computer on the Internet.

Each computer on the Internet has an assigned address, called its IP address, that identifies it on the Internet. An **IP address** is a 64-bit number that identifies a computer on the Internet. The 64-bit number is typically divided into four bytes and translated to decimal; for example, 69.32.133.11. The Internet is migrating to Internet Protocol version 6 (IPv6), which uses 128-bit addresses to provide for many more devices, however, this change is expected to take years. As of mid-2013, the volume of Internet traffic using IPv6 is small, but growing, with Google reporting that just 1.37 percent of its traffic comes in over IPv6.[31]

Because people prefer to work with words rather than numbers, a system called the Domain Name System (DNS) was created. Domain names such as *www.cengage.com* are mapped to IP addresses such as 69.32.133.11 using the DNS. If you type either *www.cengage.com* or 69.32.133.11 into your Web browser, you will access the same Web site. To make room for more Web addresses, efforts are underway to increase the number of available domain names.

Uniform Resource Locator (URL): A Web address that specifies the exact location of a Web page using letters and words that map to an IP address and a location on the host.

A **Uniform Resource Locator (URL)** is a Web address that specifies the exact location of a Web page using letters and words that map to an IP address

and a location on the host. The URL gives those who provide information over the Internet a standard way to designate where Internet resources such as servers and documents are located. Consider the URL for Course Technology, *http://www.cengage.com/coursetechnology*.

The "http" specifies the access method and tells your software to access a file using the Hypertext Transfer Protocol. This is the primary method for interacting with the Internet. In many cases, you don't need to include http:// in a URL because it is the default protocol. The "www" part of the address sometimes, but not always, signifies that the address is associated with the World Wide Web service. The URL *www.cengage.com* is the domain name that identifies the Internet host site. The part of the address following the domain name—/coursetechnology—specifies an exact location on the host site.

Domain names must adhere to strict rules. They always have at least two parts, with each part separated by a dot (period). For some Internet addresses, the far right part of the domain name is the country code, such as au for Australia, ca for Canada, dk for Denmark, fr for France, de (Deutschland) for Germany, and jp for Japan. Many Internet addresses have a code denoting affiliation categories, such as com for business sites and edu for education sites. (Table 4.5 contains a few popular categories.) The far left part of the domain name identifies the host network or host provider, which might be the name of a university or business. Other countries outside the United States use different top-level domain affiliations from the ones described in the table.

TABLE 4.5 U.S. top-level domain affiliations

Affiliation ID	Affiliation	Number of Hosts
com	Business sites	112,259,193
edu	Post-secondary educational sites	7,500
gov	Government sites	2,174
net	Networking sites	15,221,763
org	Nonprofit organization sites	10,395,604

Source: Whois Source Domain Counts & Internet Statistics (January 7, 2014), *www.whois.sc/internet-statistics*

Note that some other countries outside the United States use different top-level domain affiliations from the ones described in Table 4.5.

The Internet Corporation for Assigned Names and Numbers (ICANN) is responsible for managing IP addresses and Internet domain names. One of its primary concerns is to make sure that each domain name represents only one individual or entity—the one that legally registers it. For example, if your teacher wanted to use *www.cengage.com* for a course Web site, he or she would discover that domain name has already been registered by Cengage Learning and is not available. ICANN uses companies called *accredited domain name registrars* to handle the business of registering domain names. For example, you can visit *www.namecheap.com*, an accredited registrar, to find out if a particular name has already been registered. If not, you can register the name for around $9 per year. Once you do so, ICANN will not allow anyone else to use that domain name as long as you pay the yearly fee.

Accessing the Internet

You can connect to the Internet in numerous ways. See Figure 4.14. Which access method you choose is determined by the size and capability of your organization or system.

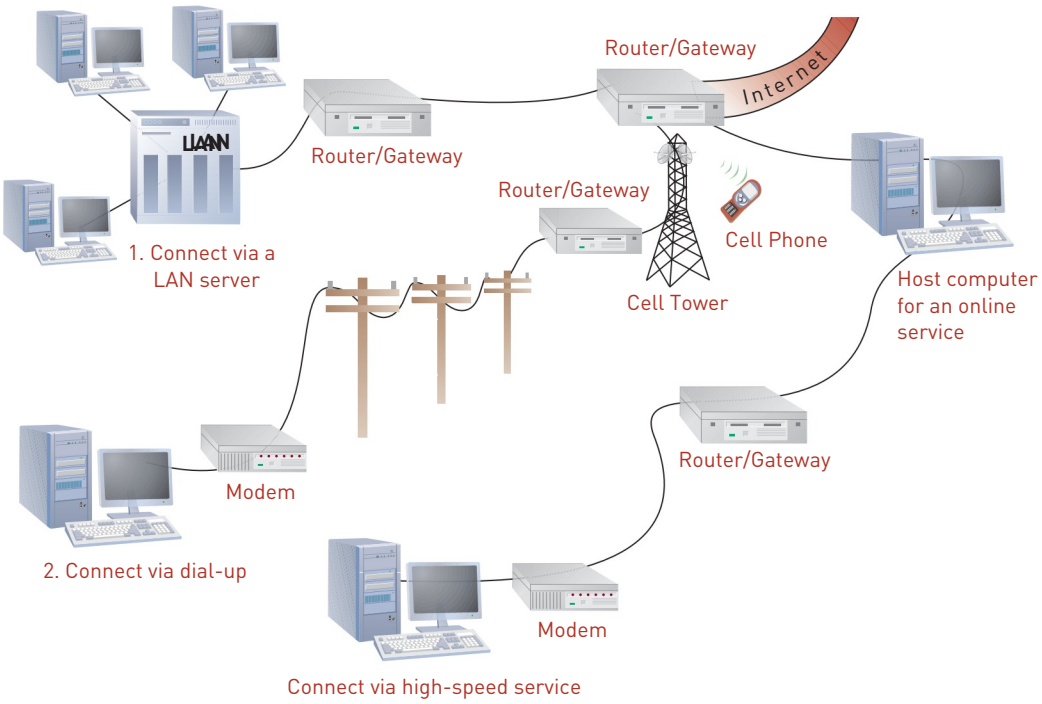


FIGURE **4.14**

Several ways to access the Internet

Users can access the Internet in several ways, including using a LAN server, telephone lines, a high-speed service, or a wireless network.

Connect via LAN Server

This approach is used by businesses and organizations that manage a local area network (LAN). By connecting a server on the LAN to the Internet using a router, all users on the LAN are provided access to the Internet. Business LAN servers are typically connected to the Internet at very fast data rates, sometimes in the hundreds of Mbps. In addition, you can share the higher cost of this service among several dozen LAN users to allow a reasonable cost per user.

Connecting via Internet Service Providers

Internet service provider (ISP): Any organization that provides Internet access to people.

Companies and residences unable to connect directly to the Internet through a LAN server must access the Internet through an Internet service provider. An **Internet service provider (ISP)** is any organization that provides Internet access to people. Thousands of organizations serve as ISPs, ranging from universities that make the Internet available to students and faculty, to small Internet businesses, to major telecommunications giants such as AT&T and Comcast. To connect to the Internet through an ISP, you must have an account with the service provider (for which you usually pay) along with software (such as a browser) and devices (such as a computer or smartphone) that support a connection via TCP/IP.

Perhaps the least expensive but slowest connection provided by ISPs is a dial-up connection. A *dial-up Internet connection* uses a modem and standard phone line to "dial-up" and connect to the ISP server. Dial-up is considered the slowest of connections because it is restricted by the 56 Kbps limitation of traditional phone line service. A dial-up connection also ties up the phone line so that it is unavailable for voice calls. While dial-up was originally the only way to connect to the Internet from home, it is rapidly becoming replaced by high-speed services.

Several "high-speed" Internet services are available for home and business. They include cable modem connections from cable television companies, DSL connections from phone companies, and satellite connections from satellite television companies.

In addition to connecting to the Internet through wired systems such as phone lines and television cables, wireless Internet over cellular and Wi-Fi networks has become common. Thousands of public Wi-Fi services are available in coffee shops, airports, hotels, and elsewhere, where Internet access is provided free, for an hourly rate, or for a monthly subscription fee. Wi-Fi is even making its way into aircraft, allowing business travelers to be productive during air travel by accessing email and corporate networks.

Cell phone carriers also provide Internet access for handsets, notebooks, and tablets. New 4G mobile phone services rival wired high-speed connections enjoyed at home and work. Sprint, Verizon, AT&T, and other popular carriers are working to bring 4G service to subscribers, beginning in large metropolitan areas.

When Apple introduced the iPhone, one of its slogans was the "Internet in your pocket." The iPhone proves the popularity of and the potential for Internet services over a handset. Many other smartphones followed hot on the heels of the iPhone, offering similar services on all of the cellular networks. More recently, the iPhone brought video calling into vogue, while the iPad and other tablets provide anywhere, anytime access to all types of Internet services on a larger display. See Figure 4.15.

© iStockphoto.com/hocus focus

FIGURE **4.15**

Connecting wirelessly

The iPad connects to the Internet over cellular or Wi-Fi networks.

Cloud Computing

cloud computing: A computing environment where software and storage are provided as an Internet service and are accessed with a Web browser.

Cloud computing refers to a computing environment where software and storage are provided as an Internet service and accessed with a Web browser. See Figure 4.16. Google and Yahoo!, for example, store the email of many users, along with calendars, contacts, and to-do lists. Apple Computer has developed a service called iCloud to allow people to store their documents, music, photos, apps, and other content on its server.[32] Facebook provides social interaction and can store personal photos, as can Flickr and a dozen other photo sites. Pandora delivers music, and Hulu and YouTube deliver movies. Google Docs, Zoho, 37signals, Flypaper, Adobe Buzzword, and others provide Web-delivered

FIGURE **4.16**

Cloud computing

Cloud computing uses applications and resources delivered via the Web.

productivity and information management software. With its Office 365 software product, Microsoft is emphasizing cloud computing to a greater extent. Office 365 competes with other online software suites such as Apache Open Office, Google Apps, and NeoOffice.[33] Communications, contacts, photos, documents, music, and media are available to you from any Internet-connected device with cloud computing.

Cloud computing offers many advantages to businesses. By outsourcing business information systems to the cloud, a business saves on system design, installation, and maintenance. The New York Stock Exchange (NYSE), for example, is starting to offer cloud-computing applications that let customers pay for the services and data they use on Euronext, a European market for stocks, bonds, and other investments.

Cloud computing can have several methods of deployment. Those that have been discussed thus far are considered public cloud services. *Public cloud* refers to service providers that offer their cloud-based services to the general public, whether that is an individual using Google Calendar or a corporation using the Salesforce.com application. In a *private cloud* deployment, cloud technology is used within the confines of a private network.

Since 1992, The College Network and its partner universities have provided accessible educational programs for individuals seeking degrees or professional certificates, entirely through distance learning. The College Network chose EarthLink to provide a customized private cloud with dedicated servers. Conversion to the private network reduced the capital required for computer hardware and software, increased systems availability and avoided outages, and reallocated its valuable IT resources while EarthLink resources troubleshoot any systems issues.[34]

THE WORLD WIDE WEB

The World Wide Web was developed by Tim Berners-Lee at CERN, the European Organization for Nuclear Research in Geneva. He originally conceived of it as an internal document-management system. From this modest beginning, the Web has grown to become a primary source of news and information, an indispensable conduit for commerce, and a popular hub for social interaction, entertainment, and communication.

How the Web Works

While the terms Internet and Web are often used interchangeably, technically, the two are different technologies. The Internet is the infrastructure on which

the Web exists. The Internet is made up of computers, network hardware such as routers and fiber-optic cables, software, and the TCP/IP protocols. The **Web**, on the other hand, consists of server and client software, the hypertext transfer protocol (http), standards, and mark-up languages that combine to deliver information and services over the Internet.

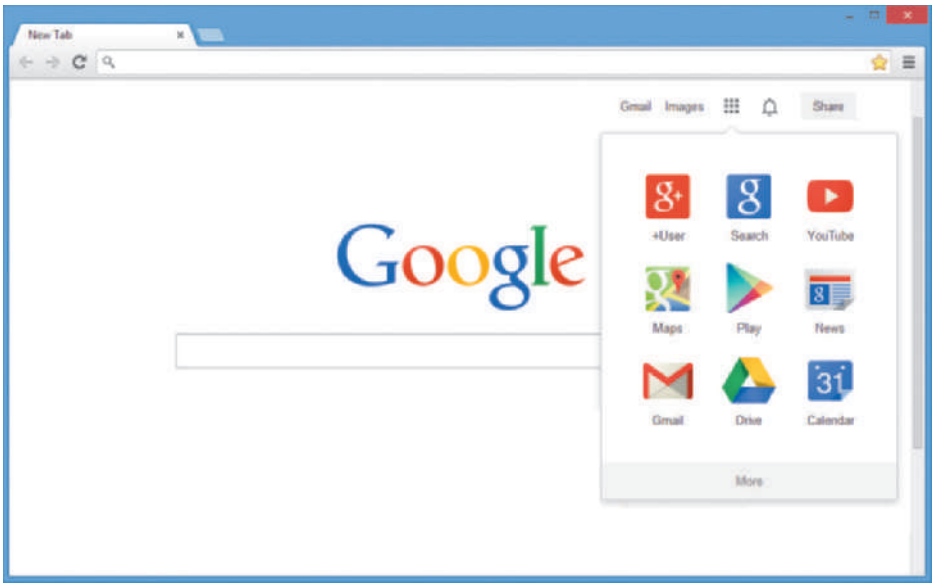
Web: Server and client software, the hypertext transfer protocol (http), standards, and mark-up languages that combine to deliver information and services over the Internet.

The Web was designed to make information easy to find and organize. It connects billions of documents, which are now called Web pages, stored on millions of servers around the world. These are connected to each other using **hyperlinks**, specially denoted text or graphics on a Web page, that, when clicked, open a new Web page containing related content. Using hyperlinks, users can jump between Web pages stored on various Web servers—creating the illusion of interacting with one big computer. Because of the vast amount of information available on the Web and the wide variety of media, the Web has become the most popular means of information access in the world today.

hyperlink: Highlighted text or graphics in a Web document that, when clicked, opens a new Web page containing related content.

In short, the Web is a hyperlink-based system that uses the client/server model. It organizes Internet resources throughout the world into a series of linked files, called pages, accessed and viewed using Web client software called a **Web browser**. Google Chrome, Mozilla Firefox, Internet Explorer, Apple Safari, and Opera Software's Opera are popular Web browsers. See Figure 4.17. A collection of pages on one particular topic, accessed under one Web domain, is called a Web site. The Web was originally designed to support formatted text and pictures on a page. It has evolved to support many more types of information and communication including user interactivity, animation, and video. Web *plug-ins* help provide additional features to standard Web sites. Adobe Flash and Real Player are examples of Web plug-ins.

Web browser: Web client software such as Internet Explorer, Firefox, Chrome, and Safari are used to view Web pages.



Courtesy of Google

FIGURE **4.17**

Google Chrome

Web browsers such as Google Chrome let you access Internet resources such as email and other online applications.

Hypertext Markup Language (HTML): The standard page description language for Web pages.

Hypertext Markup Language (HTML) is the standard page description language for Web pages. HTML is defined by the World Wide Web Consortium (referred to as "W3C") and has developed through numerous revisions. It is currently in its fifth revision—HTML5. HTML tells the browser how to display font characteristics, paragraph formatting, page layout, image placement, hyperlinks, and the content of a Web page. HTML uses **tags**, which are codes that tell the browser how to format the text or graphics: as a heading, list, or body text, for example. Web site creators "mark up" a page by placing HTML tags before and after one or more words. For example, to have the

HTML tags: Codes that tell the Web browser how to format text—as a heading, as a list, or as body text—and whether images, sound, and other elements should be inserted.

browser display a sentence as a heading, you place the <h1> tag at the start of the sentence and an </h1> tag at the end of the sentence. When you view this page in your browser, the sentence is displayed as a heading. HTML also provides tags to import objects stored in files, such as photos, pictures, audio, and movies, into a Web page. In short, a Web page is made up of three components: text, tags, and references to files. The text is your Web page content, the tags are codes that mark the way words will be displayed, and the references to files insert photos and media into the Web page at specific locations. All HTML tags are enclosed in a set of angle brackets (< and >), such as <h2>. The closing tag has a forward slash in it, such as for closing bold. Consider the following text and tags:

```
<html>
<head>
<title>Table of Contents</title>
<link href="style.css" rel="stylesheet" type="text/css" />
</head>
<body style="background-color:#333333">
<div id="container">
<p><img src="header.png" width="602" height="78" /></p>
<h1 align=center>Principles of Information Systems</h1>
<ol>
<li>An Overview</li>
<li>Information Technology Concepts</li>
<li>Business Information Systems</li>
<li>Systems Development</li>
<li>Information Systems in Business and Society</li>
</ol>
</div>
</body>
</html>
```

The <html> tag identifies this as an HTML document. HTML documents are divided into two parts: the <head> and the <body>. The <body> contains everything that is viewable in the Web browser window, and the <head> contains related information such as a <title> to place on the browser's title bar. The background color of the page is specified in the <body> tag using a hexadecimal code. The heading "Principles of Information Systems" is identified as the largest level 1 heading with the <h1> tag, typically a 16–18 point font, centered on the page. The <ol> tag indicates an ordered list, and the <li> tags indicate list items. The resulting Web page is shown in Figure 4.18.

HTML works hand in hand with another markup language called CSS. **CSS**, which stands for **Cascading Style Sheets**, has become a popular tool for designing groups of Web pages. CSS uses special HTML tags to globally define font characteristics for a variety of page elements as well as how those elements are laid out on the Web page. Rather than having to specify a font for each occurrence of an element throughout a document, formatting can be specified once and applied to all occurrences. CSS styles are often defined in a separate file and then can be applied to many pages on a Web site. In the previous example code, you may have noticed the <link> tag that refers to an external style sheet file, style.css.

Extensible Markup Language (XML): The markup language designed to transport and store data on the Web.

Extensible Markup Language (XML) is a markup language for Web documents containing structured information, including words and pictures. XML does not have a predefined tag set. With HTML, for example, the <hl> tag always means

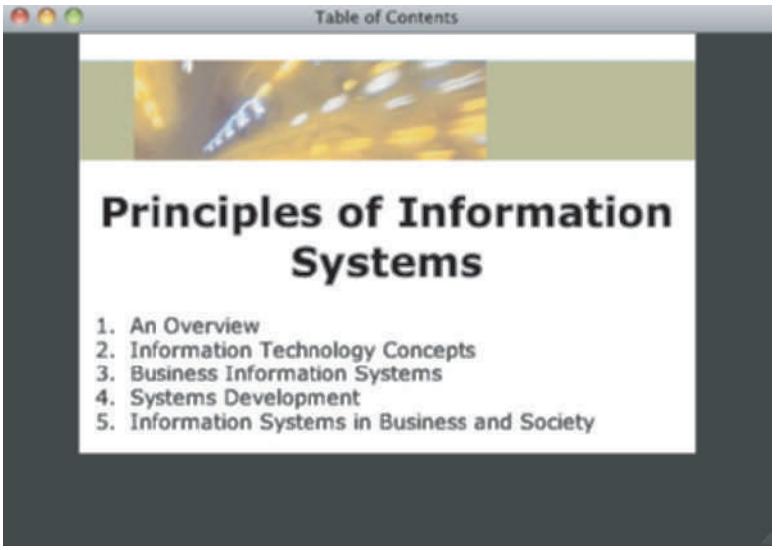


FIGURE **4.18**

HTML code interpreted by a browser

The example HTML code as interpreted by the Firefox Web browser on a Mac.

a first-level heading. The content and formatting are contained in the same HTML document. XML Web documents contain the content of a Web page. The formatting of the content is contained in a style sheet. A few typical instructions in XML follow:

```
<book>
<chapter>Hardware</chapter>
<topic>Input Devices</topic>
<topic>Processing and Storage Devices</topic>
<topic>Output Devices</topic>
</book>
```

Cascading Style Sheet (CSS): A markup language for defining the visual design of a Web page or group of pages.

A **Cascading Style Sheet (CSS)** is a file or portion of an HTML file that defines the visual appearance of content in a Web page. Using CSS is convenient because you only need to define the technical details of the page's appearance once, rather than in each HTML tag. For example, the visual appearance of the preceding XML content may be contained in the following style sheet. This style sheet specifies that the chapter title "Hardware" is displayed on the Web page in a large Arial font (18 points). "Hardware" will also appear in bold blue text. The "Input Devices" title will appear in a smaller Arial font (12 points) and italic red text.

```
chapter: (font-size: 18pt; color: blue; font-weight: bold;
display: block; font-family: Arial;
margin-top: 10pt; margin-left: 5pt)
topic: (font-size: 12pt; color: red; font-style: italic;
display: block; font-family: Arial;
margin-left: 12pt)
```

XML is extremely useful for organizing Web content and making data easy to find. Many Web sites use CSS to define the design and layout of Web pages, XML to define the content, and HTML to join the content (XML) with the design (CSS). See Figure 4.19. This modular approach to Web design allows you to change the visual design without affecting the content, or to change the content without affecting the visual design.

Web Programming Languages

Many of the services offered on the Web are delivered through the use of programs and scripts. A Web program may be something as simple as a menu

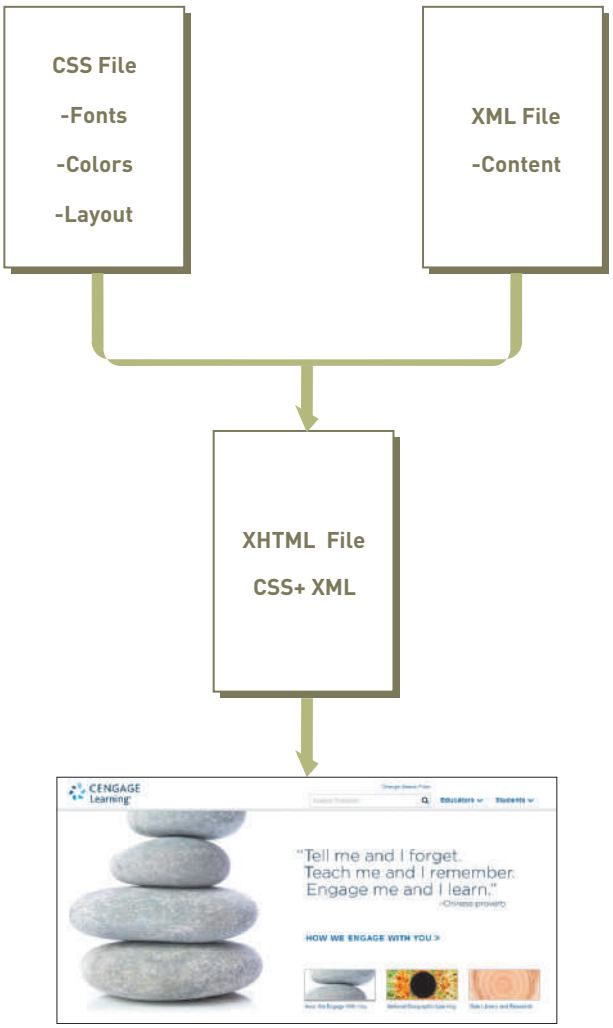


FIGURE **4.19**

XML, CSS, and HTML

Today's Web sites are created using XML to define content, CSS to define the visual style, and HTML to put it all together.

that expands when you click it or as complicated as a full-blown spreadsheet application. Web applications may run on the Web server, delivering the results of the processing to the user, or they may run directly on the client, the user's PC. These two categories are commonly referred to as server-side and client-side software.

JavaScript is a popular programming language for client-side applications. Using JavaScript, you can create interactive Web pages that respond to user actions. JavaScript can be used to validate data entry in a Web form, to display photos in a slideshow style, to embed simple computer games in a Web page, and to provide a currency conversion calculator. **Java** is an object-oriented programming language from Sun Microsystems based on the C++ programming language, which allows small programs, called *applets*, to be embedded within an HTML document. When the user clicks the appropriate part of an HTML page to retrieve an applet from a Web server, the applet is downloaded onto the client workstation where it begins executing. Unlike other programs, Java software can run on any type of computer. It can be used to develop client-side or server-side applications. Programmers use Java to make Web pages come alive, adding splashy graphics, animation, and real-time updates.

Java: An object-oriented programming language from Sun Microsystems based on the C++ programming language, which allows applets to be embedded within an HTML document.

Web Services

Web services consist of standards and tools that streamline and simplify communication among Web sites and that promise to revolutionize the way

we develop and use the Web for business and personal purposes. Internet companies, including Amazon, eBay, and Google, are now using Web services.

Amazon, for example, has developed Amazon Web Services (AWS) to make the contents of its huge online catalog available to other Web sites or software applications. Airbnb is an online marketplace that enables property owners and travelers to interact for the purpose of renting distinctive vacation spaces in nearly 25,000 cities in 192 countries. Shortly after Airbnb began operations, it migrated its cloud computing functions to AWS, which distributes incoming traffic to ensure high availability and fast response time. AWS also allows Airbnb to store backups and static files, including 10 TB of user pictures, and to monitor all of its server resources.[35]

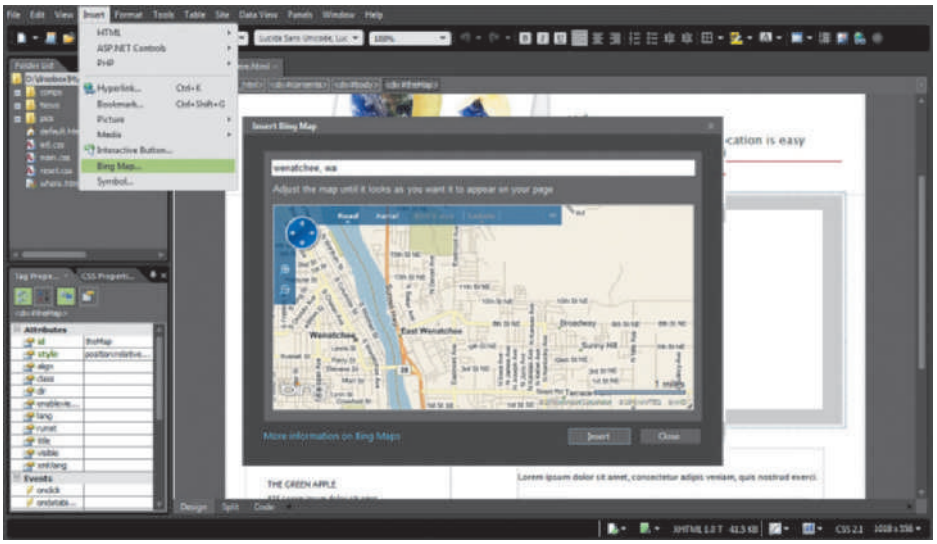
The key to Web services is XML. Just as HTML was developed as a standard for formatting Web content into Web pages, XML is used within a Web page to describe and transfer data between Web service applications.

Developing Web Content and Applications

If you need to create a Web site, you have lots of options. You can hire someone to design and build it, or you can do it yourself. If you do it yourself, you can use an online service to create the Web pages, use a Web page creation software tool, or use a plain text editor to create the site. Today's Web development applications allow developers to create Web sites using software that resembles a word processor. The software includes features that allow the developer to work directly with the HTML code or to use auto-generated code. Web development software also helps the designer keep track of all files in a Web site and the hyperlinks that connect them.

Popular tools for creating Web pages and managing Web sites include Adobe Dreamweaver, RapidWeaver (for Mac developers), Microsoft Expression Web, and Nvu. See Figure 4.20.

Many products make it easy to develop Web content and interconnect Web services, as discussed in the next section. Microsoft, for example, provides a development and Web services platform called .NET, which allows developers to use various programming languages to create and run programs, including those for the Web. The .NET platform also includes a rich library of programming code to help build XML Web applications. Other popular Web development platforms include JavaServer Pages, Microsoft ASP, and Adobe ColdFusion.



Microsoft product screenshots used with permission from Microsoft Corporation

FIGURE **4.20**

Creating Web pages

Microsoft Expression Web makes Web design nearly as easy as using a word processor.

After you create Web pages, your next step is to place, or publish, the content on a Web server. Popular publishing options include using ISPs, free sites, and Web hosting. Web hosting services provide space on their Web servers for people and businesses that don't have the financial resources, time, or skills to host their own Web sites. A Web host can charge $15 or more per month, depending on services. Some Web hosting sites include domain name registration, Web authoring software, and activity reporting and monitoring of the Web site. Some ISPs also provide limited Web space, typically 1 to 6 MB, as part of their monthly fee. If more disk space is needed, additional fees are charged. Free sites offer limited space for a Web site. In return, free sites often require the user to view advertising or agree to other terms and conditions.

Some Web developers are creating programs and procedures to combine two or more Web applications into a new service, called a *mashup*. A mashup is named for the process of mixing two or more hip-hop songs into one song. Map applications such as Google Maps provide tool kits that allow them to be combined with other Web applications. For example, Google Maps can be used with Twitter to display the location where various tweets were posted. Likewise, Google Maps combined with Flickr can overlay photos of specific geographic locations.

INTERNET AND WEB APPLICATIONS

The types of Internet and Web applications available are vast and ever expanding. Individuals and organizations around the world rely on Internet and Web applications. Using the Internet, entrepreneurs can start online companies and thrive. Joshua Opperman and Nell Garcia were voted Entrepreneur of 2013 award winners by *Entrepreneur* magazine. Opperman developed an online market for discarded wedding rings from the lovelorn; Garcia for taking her successful cake-baking skills to the masses via Internet workshops.[36] Altitude Digital, which matches online content publishers with advertisers using an eBay-like bidding platform, is on target to generate $20 million in revenue this year.[37]

The newspaper industry has had to deal with competition from Internet media, climbing newsprint prices, the loss of much classified advertising, and rapid declines in circulation. In an attempt to deal with these challenges, over one-third of the 1,380 daily newspapers in the United States and many newspapers in Canada and the United Kingdom have adopted digital pay plans. Under this strategy, frequent users of a newspaper's Web site eventually are requested to pay $10 to $20 per month for a digital subscription or lose access to the site. Less frequent users are allowed free access to a limited number of articles each month and articles found through search, links, and social media references.[38]

Internet advertising has been an important revenue source for many organizations. Internet companies, however, have to be careful about how they conduct their advertising. For example, Google, LinkedIn, and Yahoo have been accused in lawsuits of intercepting emails sent to users of their mail service and using those communications to tailor advertisements to them to increase their revenue.[39]

Social media Web sites, such as Facebook, represent a large percentage of all Internet advertising. Indeed, some 93 percent of marketers use social media for business.[40] Without question, social media Web sites like Facebook and newer Web approaches have exploded in popularity and importance.

Web 2.0 and the Social Web

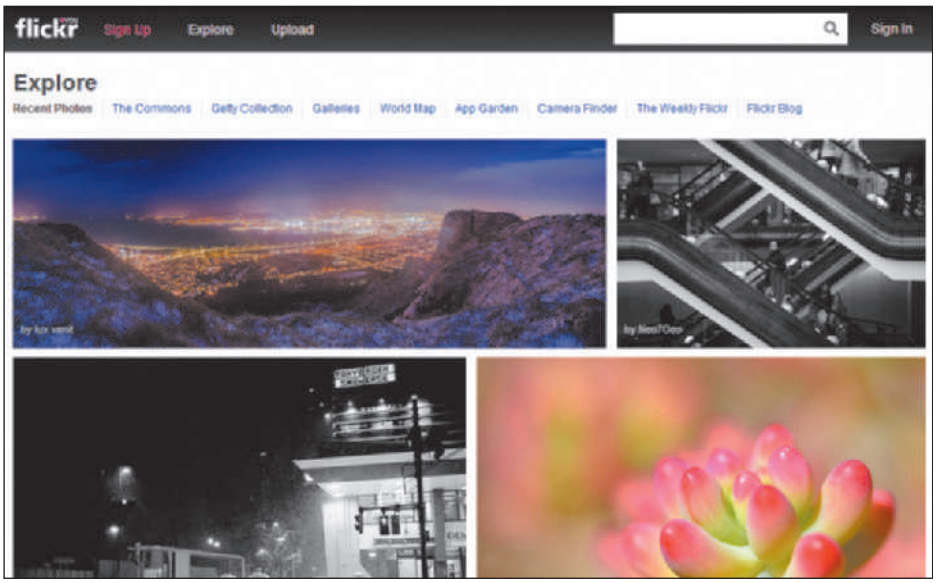
Over the years, the Web has evolved from a one-directional resource where users only obtain information to a two-directional resource where users obtain and contribute information. Consider Web sites such as YouTube, Wikipedia,

and Facebook as examples. The Web has also grown in power to support full-blown software applications such as Google Docs and is becoming a computing platform itself. These two major trends in how the Web is used and perceived have created dramatic changes in how people, businesses, and organizations use the Web, creating a paradigm shift to **Web 2.0**.

Web 2.0: The Web as a computing platform that supports software applications and the sharing of information among users.

The Social Web

The original Web—Web 1.0—provided a platform for technology-savvy developers and the businesses and organizations that hired them to publish information for the general public to view. Web sites such as YouTube and Flickr allow users to share video and photos with other people, groups, and the world. Microblogging sites such as Twitter allow people to post thoughts and ideas throughout the day for friends to read. See Figure 4.21.



www.flickr.com

FIGURE **4.21**

Flickr

Flickr allows users to share photos with other people around the world.

Social networking Web sites provide Web-based tools for users to share information about themselves with people on the Web and to find, meet, and converse with other members. Some of these characteristics can be seen in *The Social Network*, a popular movie about the start and growth of Facebook. Google is experimenting with Google+, a social networking site that could compete with social networks like Facebook. LinkedIn is designed for professional use to assist its members with creating and maintaining valuable professional connections. Ning provides tools for Web users to create their own social networks dedicated to a topic or interest.

Social networks have become very popular for finding old friends, staying in touch with current friends, and making new friends. Besides their personal value, these networks provide a wealth of consumer information and opportunity to businesses as well. Some businesses are including social networking features in their workplaces.

The use of social media in business is called Enterprise 2.0. Enterprise 2.0 applications, such as Salesforce's Chatter, Jive Software's Engage, and Yammer enable employees to create business wikis, support social networking, perform blogging, and create social bookmarks to quickly find information. Tyco is a dedicated fire protection and security company. The company recently went through a major restructuring, changing from a conglomerate of holding companies to a united global enterprise with more than 69,000 employees in 50 countries. Tyco relied on Yammer rather than email to educate its

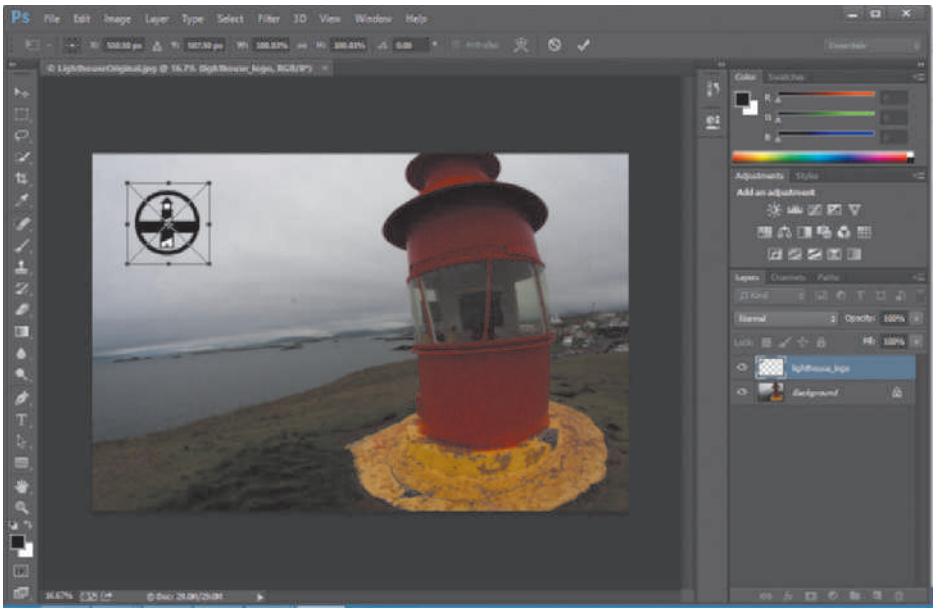
workforce on the difference between the old Tyco and the new Tyco and to increase employee engagement across the company.[41]

Not everyone is happy with social networking sites, however. Employers might use social networking sites to get personal information about you. Some people worry that their privacy will be invaded or their personal information used without their knowledge or consent.

Rich Internet Applications

The introduction of powerful Web-delivered applications, such as Google Docs, Adobe Photoshop Express, Xcerion Web-based OS, and Microsoft Office Web Apps, have elevated the Web from an online library to a platform for computing. Many of the computer activities traditionally provided through software installed on a PC can now be carried out using rich Internet applications (RIAs) in a Web browser without installing any software. A **rich Internet application** is software that has the functionality and complexity of traditional application software but that runs in a Web browser and does not require local installation. See Figure 4.22. RIAs are the result of continuously improving programming languages and platforms designed for the Web.

rich Internet application (RIA): Software that has the functionality and complexity of traditional application software but that does not require local installation and runs in a Web browser.



Adobe product screenshot reprinted with permission from Adobe Systems Incorporated.

FIGURE **4.22**

Rich Internet application

Adobe Photoshop Creative Cloud (CC) is a rich Internet application for graphic designers and other media professionals.

Most RIAs take advantage of being online by emphasizing their collaborative benefits. Microsoft and Google both support online document sharing and collaborative editing. 37signals provides online project management, contact management, calendar, and group chat applications. Microsoft SharePoint provides businesses with collaborative workspaces and social computing tools to allow people at different locations to work on projects together.

Online Information Sources

The Web has become the most popular source for daily news, surpassing newspapers and television. It has become the first place people look when they want news or are faced with a challenge or question.

News

The Web is a powerful tool for keeping informed about local, state, national, and global news. It has an abundance of special-interest coverage and provides the capacity to deliver deeper analysis of the subject matter. Text and photos are supported by the HTML standard. Video (sometimes called a

Webcast) and audio are provided in the browser through plug-in technology and in podcasts. See Figure 4.23.

FIGURE **4.23**

Online news

Online news is available in text, audio, and video formats providing the ability to drill down into stories.

As traditional news sources migrate to the Web, new sources are emerging from online companies. News Web sites from Google, Yahoo!, Digg, and Newsvine provide popular or interesting stories from a variety of news sources. In a trend some refer to as social journalism or citizen journalism, ordinary citizens are more involved in reporting the news than ever before. The online community is taking journalism into its hands and reporting the news from each person's perspective using an abundance of online tools. Although social journalism provides important news not available elsewhere, its sources may not be as reliable as mainstream media sources. It is sometimes difficult to discern news from opinion.

Education and Training

As a tool for sharing information and a primary repository of information on all subjects, the Web is ideally suited for education and training. Advances in interactive Web technologies further support important educational relationships between teacher and student and among students. See Figure 4.24.

Today, schools at all levels provide online education and training. Khan Academy, for example, provides free online training and learning in economics, math, banking and money, biology, chemistry, history, and many other subjects.[42] NPower helps nonprofit organizations, schools, and individuals to develop information system skills. The nonprofit organization gives training and hope to hundreds of disadvantaged young adults through a 22-week training program that can result in certification from companies such as Microsoft and Cisco.[43] Online training programs can be accessed via PCs, tablet computers, and smartphones. High school and college students are also starting to use these devices to read electronic textbooks instead of carrying heavy printed textbooks to class.

Educational support products, such as Blackboard, provide an integrated Web environment that includes virtual chat for class members; a discussion group for posting questions and comments; access to the class syllabus and agenda, student grades, and class announcements; and links to class-related material. Conducting classes over the Web with no physical class meetings is called *distance education.*

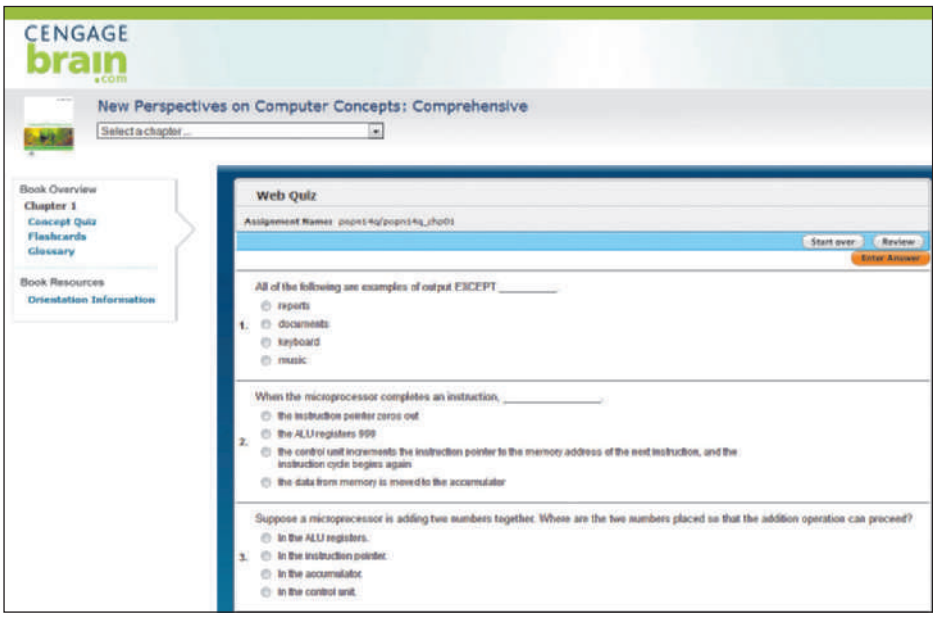


FIGURE **4.24**

Cengage Brain instruction resources

The Internet supports education from pre-K to lifelong learning.

Beyond traditional education, corporations such as Skillsoft offer professional job skills training over the Web. Job seekers often use these services to acquire specialized business or technical training. Museums, libraries, private businesses, government agencies, and many other types of organizations and individuals offer educational materials online for free or a fee. Consider eHow, the Web site that claims to teach you "How to do just about everything!" Certiport offers training and testing for technology certification, such as for Microsoft and Adobe products.

Business and Job Information

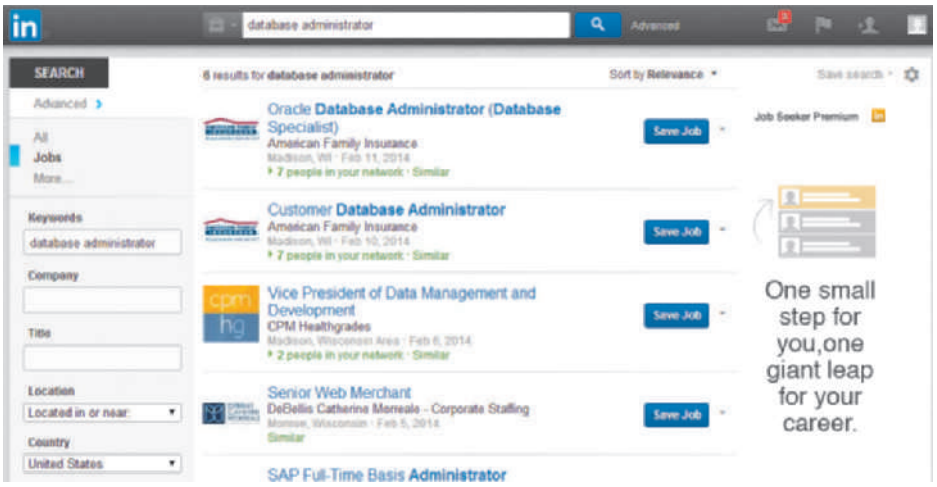
Providing news and information about a business and its products through the company's Web site and online social media can assist in increasing a company's exposure to the general public and improving its reputation. Providing answers to common product questions and customer support online can help keep customers coming back for more. For example, natural food company Kashi used its Web site to promote healthy living, with a blog about leading a natural lifestyle, recipes, and personal stories from Kashi employees. The Web site helps build a community around the Kashi brand and promotes awareness of Kashi's philosophy and products.[44]

The Web is also an excellent source of job-related information. People looking for their first jobs or seeking information about new job opportunities can find a wealth of information on the Web. Search engines, such as Google or Bing (discussed next), can be a good starting point for searching for specific companies or industries. You can use a directory on Yahoo's home page, for example, to explore industries and careers. Most medium and large companies have Web sites that list open positions, salaries, benefits, and people to contact for further information. The IBM Web site, *www.ibm.com*, provides information on jobs with IBM around the world. In addition, several sites specialize in helping you find job information and even apply for jobs online, including *www.linkedin.com* (see Figure 4.25), *www.monster.com*, *www.hotjobs.com*, and *www.careerbuilder.com*.

Search Engines and Web Research

search engine: A valuable tool that enables you to find information on the Web by specifying words that are key to a topic of interest, known as keywords.

A **search engine** is a valuable tool that enables you to find information on the Web by specifying words or phrases known as keywords, which are related to



Courtesy of LinkedIn

FIGURE **4.25**

LinkedIn jobs listing

LinkedIn and several other Web sites specialize in helping people get job information and even apply for jobs online.

a topic of interest. You can also use operators such as OR and NOT for more precise search results. Table 4.6 provides examples of the use of operators in Google searches as listed on Google's help page (*www.google.com/help/cheatsheet.html*).

TABLE 4.6 Using operators in Google Web searches

Keywords and Operator Entered	Search Engine Interpretation
vacation Hawaii	The words "vacation" and "Hawaii"
Maui OR Hawaii	Either the word "Maui" or the word "Hawaii"
"To each his own"	The exact phrase "To each his own"
virus -computer	The word virus, but not the word computer
Star Wars Episode +I	The movie title "Star Wars Episode", including the Roman numeral I
~auto loan	Loan information for both the word "auto" and its synonyms, such as "truck" and "car"
define:computer	Definitions of the word "computer" from around the Web
red * blue	The words "red" and "blue" separated by one or more words

The search engine market is dominated by Google. Other popular search engines include Yahoo!, Bing, Ask, Dogpile, and China's Baidu. Google has taken advantage of its market dominance to expand into other Web-based services, most notably email, scheduling, maps, social networking, Web-based applications, and mobile device software. Search engines such as Google often have to modify how they display search results, depending on pending litigation from other Internet companies and government scrutiny, such as antitrust investigations.

To help users get the information they want from the Web, most search engines use an automated approach that scours the Web with automated programs called spiders. These spiders follow all Web links in an attempt to catalog every Web page by topic; each Web page is analyzed and ranked using unique algorithms, and the resulting information is stored in a database. A keyword search at Yahoo!, Bing, or Google isn't a search of the Web but rather a search of a database that stores information about Web pages. The database is continuously checked and refreshed so that it is an accurate reflection of the current status of the Web.

INFORMATION SYSTEMS @ WORK

Improved Insight via Clickstream Analysis

When you visit a site, your clickstream is the sequence of pages you click as you spend time on the site. Clickstream analysis is the process of analyzing many clickstreams to understand visitors' collective behavior. The goal of clickstream analysis usually is to optimize a site for its users.

For example, clickstream analysis may find that many users want to see a list of a company's sales offices. Rather than making them reach that page by clicking "About Our Company," then "International Regions," then their local region, and finally, a list of its locations, the company might put a "Sales Offices" link on its home page. That would take the user directly to a page with a list of regions. Click a region, and it expands to show a list of its sales offices on the same page. Besides improving visitor satisfaction with the site, such a change to the site design also reduces the page-serving load on the site owner's Web servers. That, in turn, improves performance and may defer the need for an expensive upgrade.

Clickstream analysis is vital to organizations that depend on the Web for their existence. Greg Linden explains that "Google [search] and Microsoft [Bing] learn from people using Web search. When people find what they want, Google notices. When other people do that same search later, Google has learned from earlier searchers, and makes it easier for the new searchers to get where they want to go."

Learning from clickstreams could be useful in online education. Discussing algebra, Linden notes, "As millions of students try different exercises, we [that is, our computer] forget the paths that consistently led to continued struggles, remember the ones that lead to rapid mastery, and, as new students come in, we put them on the successful paths we have seen before." Therefore, students learn algebra more quickly and more easily. The improved experience may affect their overall attitude toward learning mathematics.

The benefits of clickstream analysis aren't just for online companies. In an interview with MIT's *Sloan Management Review*, David Kreutter, Pfizer's vice-president of U.S. commercial operations, described its value to Pfizer: "When physicians visit our Web site, we know what they're clicking on, we know what they're clicking through to.… We've got more data from which to try to discern patterns, which we can use in a predictive way. That's really what we're trying to focus on now: can we detect patterns early on, or at least much earlier than prescription writing, that will allow us to adapt more quickly to our customers' needs as well as to the competitive environment?"

Clickstream analysis helps Pfizer monitor what happens when its representatives visit physicians. Kreutter continues, "If our strategy is to deliver certain messages in a certain order, we can see if the message was delivered that way. For example, if we know that a certain segment of doctors in South Florida have a heavy proportion of elderly patients, they will often want to hear about drug-drug interactions first (since their patients are on many medications). We can track if we executed against that strategy, and we can track if that strategy had the impact, the literal prescribing behavior, that we anticipated. It … helps us to figure out, if we don't have the impact we hoped for, if our strategy was right but the execution was flawed, or if the strategy fundamentally needs to be rethought."

Discussion Questions

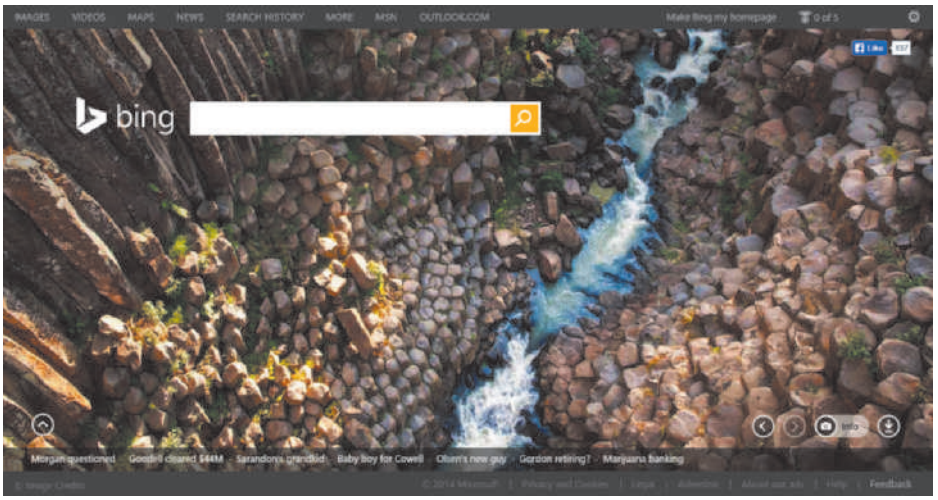
1. Consider Greg Linden's example of search engines learning from watching which search results users chose to click. What are the benefits to the search engine company (e.g., Google or Microsoft in Linden's examples) of having this information?
2. How could other companies benefit from clickstream analysis?

Critical Thinking Questions

1. Some people fear that clickstream analysis constitutes an invasion of privacy. Do you agree? Why or why not?
2. How does clickstream analysis benefit you as a user? Does clickstream analysis offer more advantages than disadvantages to individuals?

SOURCES: Kiron, D. and Shockley, R., "How Pfizer Uses Tablet PCs and Click-Stream Data to Track Its Strategy," Sloan Management Review, *sloanreview.mit.edu/the-magazine/2011-fall/53118/how-pfizer-uses-tablet-pcs-and-click-stream-data-to-track-its-strategy*, August 25, 2011; Linden, G., "Massive-Scale Data Mining for Education," Communications of the ACM, vol. 54, no. 11, November 2011, p. 13; Pfizer Web site, *www.pfizer.com*, accessed June 8, 2012.

The Bing search engine has attempted to innovate with its design. Bing refers to itself as a decision engine because it attempts to minimize the amount of information that it returns in its searches that is not useful or pertinent.[45] Bing also includes media—music, videos, and games—in its search results. See Figure 4.26.



Microsoft product screenshots used with permission from Microsoft Corporation

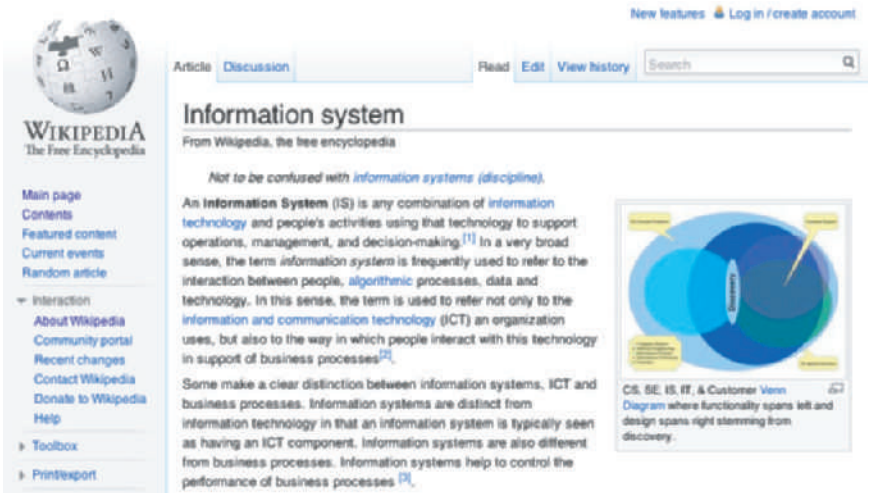
FIGURE **4.26**

Microsoft Bing decision engine

Microsoft calls its search engine a decision engine to distinguish it from other search software.

Savvy business owners know that the results gained from search engines are tools that draw visitors to the certain Web sites. Many businesses invest in search engine optimization (SEO)—a process for driving traffic to a Web site by using techniques that improve the site's ranking in search results. Normally, when a user gets a list of results from a Web search, the links listed highest on the first page of search results have a far greater chance of being clicked. SEO professionals, therefore, try to get the Web sites of their businesses to be listed with as many appropriate keywords as possible. They study the algorithms that search engines use, and then, they alter the contents of their Web pages to improve the page's chance of being ranked number one. SEO professionals use *Web analytics software* to study detailed statistics about visitors to their sites.

In addition to search engines, you can use other Web sites to research information. Wikipedia, an online encyclopedia with over 3 million English-language entries created and edited by millions of users, is another example of a Web site that can be used to research information. See Figure 4.27.



en.wikipedia.org

FIGURE **4.27**

Wikipedia

Wikipedia captures the knowledge of tens of thousands of experts.

In Hawaiian, *wiki* means quick, so a "wikipedia" provides quick access to information. The Web site is both open source and open editing, which means that people can add or edit entries in the encyclopedia at any time. More than 77,000 active contributors are working on more than 30 million articles written in some 285 languages. Besides being self-regulating, Wikipedia articles are vetted by around 1,400 administrators.[46] However, even with so many administrators, it is possible that some entries are inaccurate and biased.

The wiki approach to content development is referred to as *crowd sourcing*, which uses the combined effort of many individuals to accomplish some task. Another example of crowd sourcing is the OpenStreetMap.org project. OpenStreetMap uses a wiki and the power of the crowd to develop a detailed map of the world.

Besides online catalogs, libraries typically provide links to public and sometimes private research databases on the Web. Online research databases allow visitors to search for information in thousands of journal, magazine, and newspaper articles. Information database services are valuable because they offer the best in quality and convenience. They conveniently provide full-text articles from reputable sources over the Web. College and public libraries typically subscribe to many databases to support research. One of the most popular private databases is LexisNexis Academic Universe. See Figure 4.28.

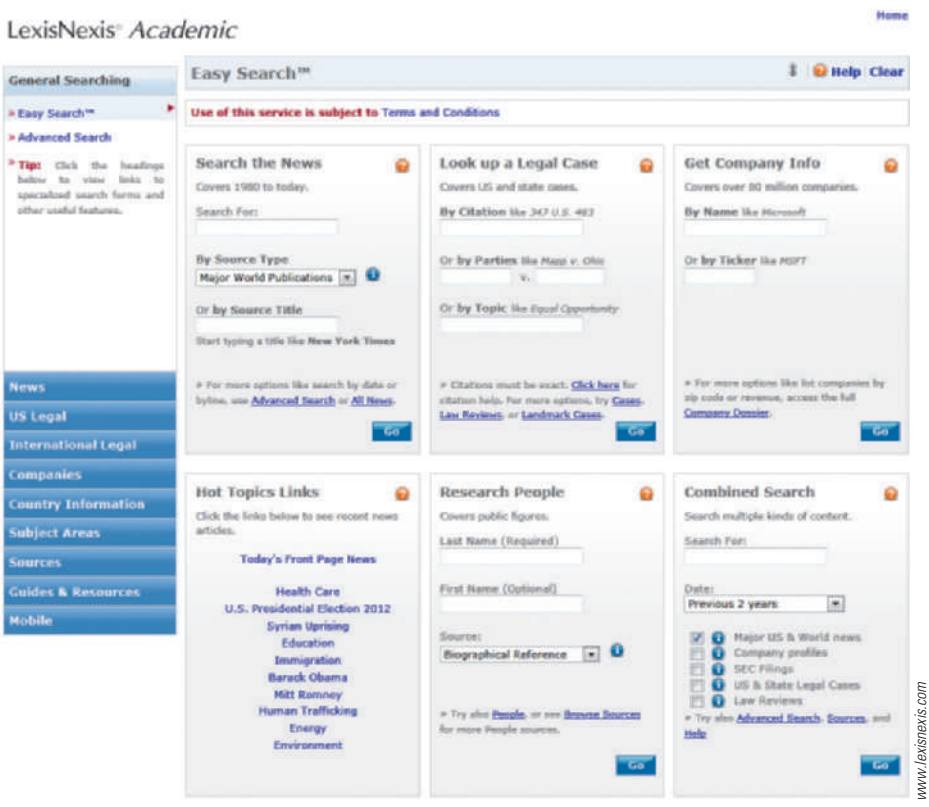


FIGURE **4.28**

LexisNexis

At LexisNexis Academic Universe, you can search the news, legal cases, company information, people, or a combination of categories.

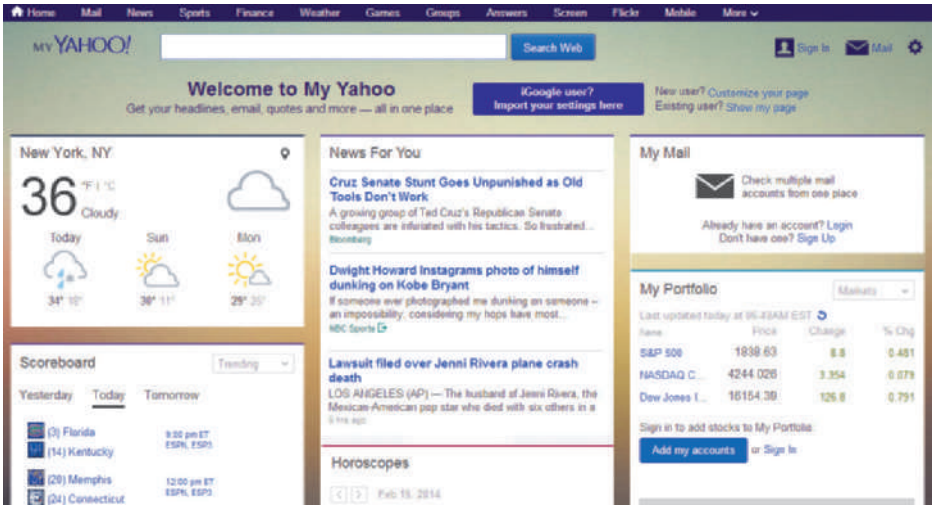
Web Portals

Web portal: A Web page that combines useful information and links and acts as an entry point to the Web; portals typically include a search engine, a subject directory, daily headlines, and other items of interest. Many people choose a Web portal as their browser's home page (the first page you open when you begin browsing the Web).

A **Web portal** is a Web page that combines useful information and links and acts as an entry point to the Web; portals typically include a search engine, a subject directory, daily headlines, and other items of interest. Because many people choose a Web portal as their browser's home page (the first page you open when you begin browsing the Web), the two terms are used interchangeably.

Many Web pages have been designed to serve as Web portals. Yahoo!, AOL, and MSN are examples of horizontal portals; "horizontal" refers to the

fact that these portals cover a wide range of topics. MyYahoo! allows users to custom design their pages, selecting from hundreds of widgets—small applications that deliver information and services. See Figure 4.29. Yahoo! also integrates with Facebook so that Facebook users can access their friends and news streams from the MyYahoo portal.



myahoo.com

FIGURE **4.29**

MyYahoo! personalized portal

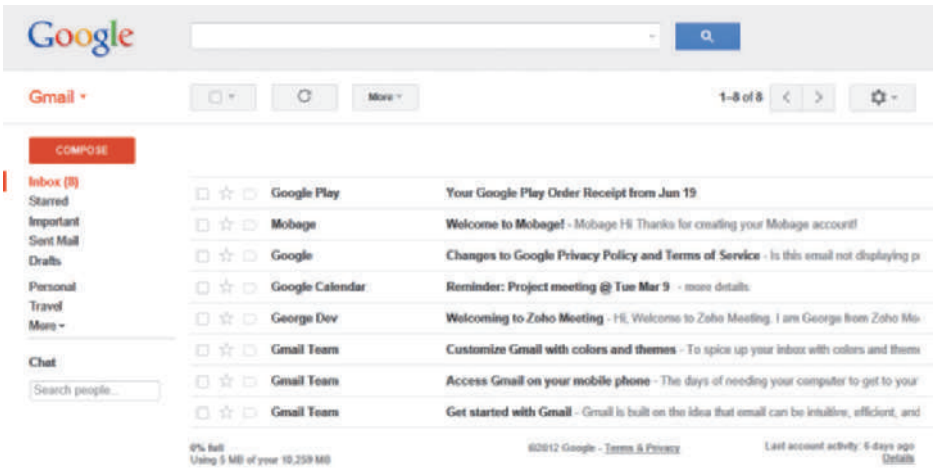
MyYahoo! and other personalized portals can contain custom designs and widgets.

Vertical portals are pages that provide information and links for special-interest groups. For example, the portal at *www.iVillage.com* focuses on items of interest to women, and *www.AskMen.com* is a vertical portal for men. Many businesses set up corporate portals for their employees to provide access to work-related resources, such as corporate news and information, along with access to business tools, databases, and communication tools to support collaboration.

Email

Email is a useful form of Internet communication that supports text communication, HTML content, and sharing documents as email attachments. Email is accessed through Web-based systems or through dedicated email applications, such as Microsoft Outlook and Mozilla Thunderbird. Email can also be distributed through enterprise systems to desktop computers, notebook computers, and smartphones.

Many people use online email services, such as Hotmail, MSN, and Gmail. See Figure 4.30. Online email services store messages on the server, not the



Courtesy of Google

FIGURE **4.30**

Gmail

Gmail is one of several free online email services.

user's computer, so that users need to be connected to the Internet to view, send, and manage email. Other people prefer to use software such as Outlook, Apple Mail, or Thunderbird, which retrieve email from the server and deliver it to the user's PC.

Business users who access email from smartphones, such as the BlackBerry, take advantage of a technology called push email. See Figure 4.31. Push email uses corporate server software that transfers, or pushes, email to the handset as soon as it arrives at the corporate email server. To the BlackBerry user, it appears as though email is delivered directly to the handset. Push email allows the user to view email from any mobile or desktop device connected to the corporate server. This arrangement allows users flexibility in where, when, and how they access and manage email.

© iStockphoto.com/ericrtham

FIGURE **4.31**

Blackberry email

BlackBerry users have instant access to email sent to their business accounts.

Instant Messaging

instant messaging: A method that allows two or more people to communicate online in real time using the Internet.

Instant messaging is online, real-time communication between two or more people who are connected to the Internet. See Figure 4.32. With instant messaging, participants build buddy lists, or contact lists, that let them see which contacts are currently logged on to the Internet and available to chat. If you send messages to one of your online buddies, a small dialog box opens on your buddy's computer and allows the two of you to chat via the keyboard. Although chat typically involves exchanging text messages with one other person, more advanced forms of chat exist. Today's instant messaging software supports not only text messages but also the sharing of images, sounds, files, and voice communications. Popular instant messaging services include America Online Instant Messenger (AIM), MSN Messenger, Google Talk, and Yahoo!.

Microblogging, Status Updates, and News Feeds

Twitter is a Web application that allows members to report on what they are doing throughout the day. Referred to as a microblogging service, Twitter allows users to send short text updates (up to 140 characters) from a cell phone or a Web account to their Twitter followers. While Twitter has been hugely successful for personal use, businesses are finding value in the service as well. Business people use Twitter to stay in close touch with associates by

FIGURE **4.32**

Instant messaging

Instant messaging lets you converse with another Internet user by exchanging messages instantaneously.

sharing their location and activities throughout the day. Businesses also find Twitter to be a rich source of consumer sentiment that can be tapped to improve marketing, customer relations, and product development. Many businesses have a presence on Twitter, dedicating personnel to communicate with customers by posting announcements and reaching out to individual users. Village Books, an independent bookstore, uses Twitter to build relationships with its customers and to make them feel part of their community.

The popularity of Twitter has caused social networks, such as Facebook, LinkedIn, and MySpace, to include Twitter-like news feeds. Previously referred to as Status Updates, Facebook users share their thoughts and activities with their friends by posting messages to Facebook's News Feed.

Conferencing

Some Internet technologies support real-time online conferencing. Participants dial into a common phone number to share a multiparty phone conversation. The Internet has made it possible for those involved in teleconferences to share computer desktops. Using services such as WebEx or GoToMeeting, conference participants log on to common software that allows them to broadcast their computer display to the group. This ability is quite useful for presenting with PowerPoint, demonstrating software, training, or collaborating on documents. Participants verbally communicate by phone or PC microphone. Some conferencing software uses Web cams to broadcast video of the presenter and group participants. The Addison Fire Protection District provides professional

fire protection and paramedic services to the 35,000 residents of Addison, Illinois. The district uses GoToMeeting to enable its employees to attend training and to support chief-to-chief meetings without requiring personnel to leave their assigned stations.[47]

Telepresence takes video conferencing to the ultimate level. Telepresence systems such as those from Cisco and Polycom use high-resolution video and audio with high-definition displays to make it appear that conference participants are actually sitting around a table. See Figure 4.33. You can see eyes blinking and people breathing. Participants enter a telepresence studio where they sit at a table facing display screens that show other participants in other locations. Cameras and microphones collect high-quality video and audio at all locations and transmit them over high-speed network connections to provide an environment that replicates actual physical presence. Document cameras and computer software are used to share views of computer screens and documents with all participants.

Courtesy of Polycom

FIGURE **4.33**

Halo Collaboration Meeting Room

The Halo telepresence system allows people at various locations to meet as though they were gathered around a table.

You don't need to be a big business to enjoy the benefits of video conversations. Free software is available to make video chat easy to use for anyone with a computer, a Webcam, and a high-speed Internet connection. Online applications such as Google Voice support video connections between Web users. For spontaneous, random video chat with strangers, you can use *www.Chatroulette.com* and Internet Conga Line. Software, such as Apple iChat and Skype, provide computer-to-computer video chat so users can speak to each other face-to-face. In addition to offering text, audio, and video chat on computers, Skype offers its video phone service over Internet-connected TVs. Recent Internet-connected sets from Panasonic and Samsung ship with the Skype software preloaded. You attach a Web cam to your TV to have a video chat from your sofa.

Blogging and Podcasting

Web log (blog): A Web site that people can create and use to write about their observations, experiences, and opinions on a wide range of topics.

A **Web log**, typically called a **blog**, is a Web site that people can create and use to write about their observations, experiences, and opinions on a wide range of topics. The community of blogs and bloggers is often called the blogosphere. A blogger is a person who creates a blog, while blogging refers to the process of placing entries on a blog site. A blog is like a journal. When people post information to a blog, it is placed at the top of the blog page.

Blogs can include links to external information and an area for comments submitted by visitors. Video content can also be placed on the Internet using the same approach as a blog. This is often called a *video log* or *vlog*.

A *podcast* is an audio broadcast over the Internet. The name podcast originated from Apple's *iPod* combined with the word *broadcast*. A podcast is like an audio blog. Using PCs, recording software, and microphones, you can record podcast programs and place them on the Internet. Apple's iTunes provides free access to tens of thousands of podcasts, which are sorted by topic and searchable by key word. See Figure 4.34. After you find a podcast, you can download it to your PC (Windows or Mac), to an MP3 player such as the iPod, or to any smartphone or tablet. You can also subscribe to podcasts using RSS software included in iTunes and other digital audio software.

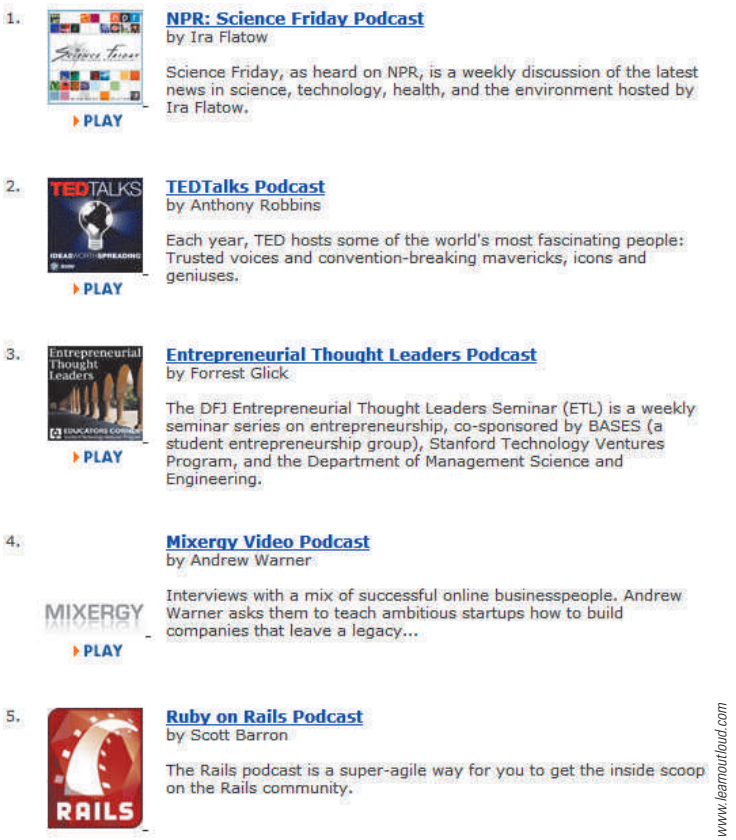


FIGURE **4.34**

Podcasts

iTunes and other sites provide free access to tens of thousands of podcasts.

Online Media and Entertainment

Like news and information, all forms of media and entertainment have followed their audiences online. Music, movies, television program episodes, user-generated videos, e-books, and audio books are all available online to download and purchase or stream.

content streaming: A method for transferring large media files over the Internet so that the data stream of voice and pictures plays more or less continuously as the file is being downloaded.

Content streaming is a method of transferring large media files over the Internet so that the data stream of voice and pictures plays more or less continuously as the file is being downloaded. For example, rather than wait for an entire 5 MB video clip to download before they can play it, users can begin viewing a streamed video as it is being received. Content streaming works best when the transmission of a file can keep up with the playback of the file.

Music

The Internet and the Web have made music more accessible than ever, with artists distributing their songs through online radio, subscription services, and

download services. Spotify, Pandora, Napster, and Grooveshark are just a few examples of free Internet music sites. Other Internet music sites charge a fee for music. Rhapsody has about 800,000 paid listeners and Slacker Radio has about 300,000 paid listeners. See Figure 4.35. Internet music has even helped sales of classical music by Mozart, Beethoven, and others. Internet companies, including Facebook, are starting to make music, movies, and other digital content available on their Web sites. Facebook, for example, allows online music companies, such as Spotify and Rdio, to post music activity on its Web site.

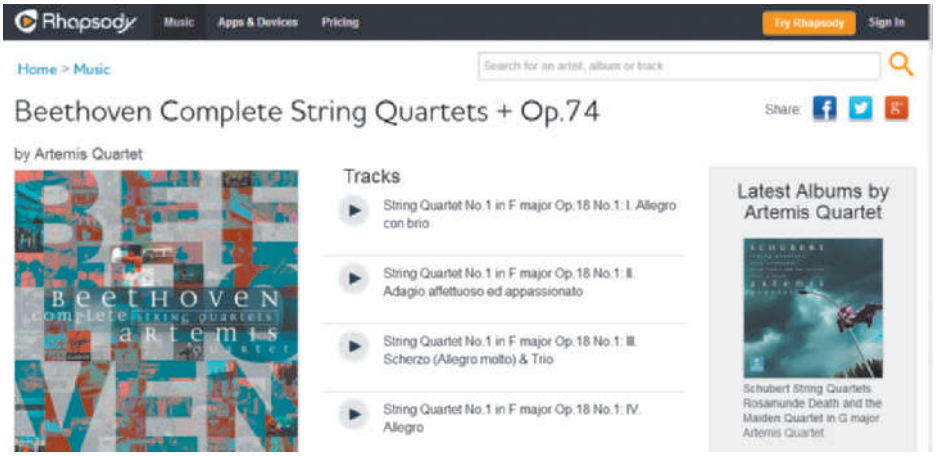


FIGURE **4.35**

Rhapsody

Rhapsody provides streaming music by subscription.

Apple's iTunes was one of the first online music services to find success. Microsoft, Amazon, Walmart, and other retailers also sell music online. The going rate for music downloads is $0.89 to $0.99 per song. Downloaded music may include digital rights management (DRM) technology that prevents or limits the user's ability to make copies or to play the music on multiple players.

Podcasts are yet another way to access music on the Web. Many independent artists provide samples of their music through podcasts. Podcast Alley includes podcasts from unsigned artists.

Movies, Video, and Television

Television and movies are expanding to the Web in leaps and bounds. Web sites such as Hulu and Internet-based television platforms such as Netflix and Joost provide television programming from hundreds of providers, including most mainstream television networks. See Figure 4.36. Walmart's acquisition of Vudu has allowed the big discount retailer to successfully get into the Internet movie business. Increasingly, TV networks have iPad and other mobile applications (apps) that stream TV content to tablet computers and other mobile devices. Other TV networks are starting to charge viewers to watch their episodes on the Internet. The Roku LT Streaming Media Box connects wirelessly to your TV and streams TV shows and movies from online sources such as Amazon Instant, Crackle, Disney, Hulu, Netflix, Pandora, and Xfinity TV.

No discussion of Internet video would be complete without mentioning YouTube. YouTube supports the online sharing of user-created videos. YouTube videos are relatively short and cover a wide range of categories from the nonsensical to college lectures. See Figure 4.37. It is estimated that 100 hours of video are uploaded to YouTube every minute and that over 6 billion hours of video are watched each month on YouTube. YouTube reaches more United States adults in the 18-34 age category than any cable network.[48] Other video-streaming sites include Google Video, Yahoo! Video, Metacafe, and AOL Video. As more companies create and post videos to Web sites like YouTube, some IS departments are creating a new position—video content manager.

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FIGURE **4.36**

Netflix

Netflix provides online access to thousands of movies and television shows.

youtube.com/edu

FIGURE **4.37**

YouTube EDU

YouTube EDU provides thousands of educational videos from hundreds of universities.

E-Books and Audio Books

An e-book is a book stored digitally rather than on paper and read on a display using e-book reader software. E-books have been available for quite a while, nearly as long as computers. However, it wasn't until the introduction of Amazon's e-book reading device, the Kindle, in 2007 that they became more widely accepted. Several features of the Kindle appeal to the general public. First, it features ePaper, a display that does not include backlighting like traditional displays. Some feel that ePaper is less harsh on your eyes than using a backlit display. Second, the Kindle is light and compact, similar in size and weight to a paperback book, although thinner than most books. Finally, Amazon created a vast library of e-books that could be purchased and downloaded to the Kindle over whispernet—a wireless network provided free of charge by Sprint. Today, dozens of electronics manufacturers are offering e-book readers.

The Apple iPad changed the e-book industry by providing a form factor that is similar to but larger than the Kindle. The iPad also includes a color backlit display. As an e-book reader, the iPad functions much like the Kindle; however, the iPad provides thousands of applications in addition to e-books. Besides using the Kindle, iPad, and other tablet devices, you can access e-books on the Web, download them as PDF files to view on your computer, or you can read them on your smartphone. While e-books are convenient, some have accused e-book publishers and distributors with conspiring to raise e-book prices.

There are dozens of e-book formats. Some are proprietary, such as Kindle's .azw format, which can be viewed only on a Kindle. Others formats are open, such as Open e-book's .opf format and the .epub format, both of which can be read on many different devices and software packages, including Samsung tablets and the iPad. See Figure 4.38.

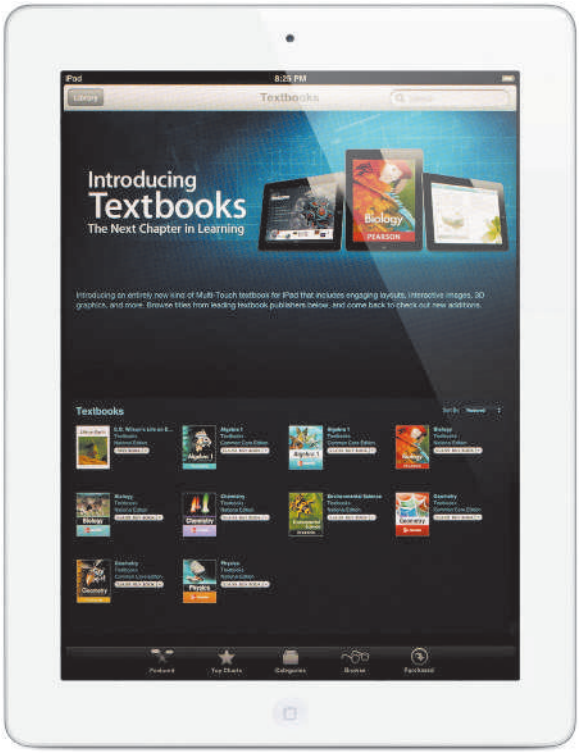


FIGURE **4.38**

iPad publishing

The iPad provides an interactive platform for magazines and books.

Audio books have become more popular due to the popularity of the iPod, the iPhone, and other mobile devices along with services such as Audible that allow you to download audio books. Audio books are either read by a narrator without much inflection or varying voices, or they can be performed by actors who add dramatic interpretations of the book to the reading. Audio books may be abridged (consolidated and edited for audio format) or unabridged (read word for word from the book). Audio book services may allow you to purchase books individually or sign up for a membership and receive a new book each month.

Online Games and Entertainment

Video games have become a huge industry with worldwide annual revenue projected to exceed $100 billion by 2017.[49] Zynga, a fast-growing Internet company, sells virtual animals and other virtual items for games, such as FarmVille. The company, for example, sells a clown pony with colorful clothes for about $5. Zynga has a VIP club for people that spend a lot on

virtual items it offers for sale. Some Internet companies also sell food for virtual animals. People can feed and breed virtual animals and sell their offspring. With all the money being made with virtual animals and their pet food, lawsuits are likely. The market for Internet gaming is very competitive and constantly changing. After Google included online games on its Web site, Facebook updated its online gaming offerings. Many video games are available online. They include single-user, multiuser, and massively multiuser games. The Web offers a multitude of games for all ages.

Game consoles such as the Wii, Xbox, and PlayStation provide multiplayer options for online gaming over the Internet. Subscribers can play with or against other subscribers in 3D virtual environments. They can even talk to each other using a microphone headset. Microsoft's Xbox LIVE provides features that allow users to keep track of their buddies online and match up with other players who are of the same skill level.

Shopping Online

Shopping on the Web can be convenient, easy, and cost effective. You can buy almost anything via the Web, from books and clothing to cars and sports equipment. Groupon, for example, offers discounts at restaurants, spas, auto repair shops, music performances, and almost any other product or service offered in your area or city. See Figure 4.39. Revenues for Groupon were expected to exceed $2 billion in 2013.[50]

© iStockphoto.com/Lee Rogers

FIGURE **4.39**

Groupon

Groupon offers discounts at restaurants, spas, auto repair shops, music performances, and almost any other product or service offered in your area or city.

Other online companies offer different services. Dell.com and many other computer retailers provide tools that allow shoppers to specify every aspect and component of a computer system to purchase. ResumePlanet.com would be happy to create your professional résumé. Peapod or Amazon Grocery would be happy to deliver groceries to your doorstep. Products and services abound online.

Many online shopping options are available to Web users. E-tail stores—online versions of retail stores—provide access to many products that may be unavailable in local stores. JCPenney, Target, Walmart, and many others carry only a percentage of their inventory in their retail stores; the other inventory is available online. To add to their other conveniences, many Web sites offer free shipping and pickup for returned items that don't fit or otherwise meet a customer's needs.

Like your local shopping mall, cybermalls provide access to a collection of stores that aim to meet your every need. Cybermalls are typically aligned with popular Web portals such as Yahoo!, AOL, and MSN.

Web sites such as *www.mySimon.com*, *www.DealTime.com*, *www.PriceSCAN.com*, *www.PriceGrabber.com*, and *www.NexTag.com* provide product price quotations from numerous e-tailers to help you to find the best deal. An application for Android smartphones and tablets called Compare Everywhere allows users to compare the price of an item offered by many retailers. Even if the best price is offered at your local warehouse store, shopping online provides the assurance that you are getting the best deal.

Online clearinghouses, Web auctions, and marketplaces offer a platform for businesses and individuals to sell their products and belongings. Online clearinghouses, such as *www.uBid.com*, provide a method for manufacturers to liquidate stock and for consumers to find a good deal. Outdated or overstocked items are put on the virtual auction block and users bid on the items. The highest bidder when the auction closes gets the merchandise—often for less than 50 percent of the advertised retail price. Credit card numbers are collected at the time that bids are placed. A good rule to keep in mind is not to place a bid on an item unless you are prepared to buy it at that price.

The most popular online auction or marketplace is *www.eBay.com*. See Figure 4.40. eBay provides a public platform for global trading where anyone can buy, sell, or trade practically anything. It offers a wide variety of features and services that enable members to buy and sell on the site quickly and conveniently. Buyers have the option to purchase items at a fixed price or in auction-style format, where the highest bid wins the product.

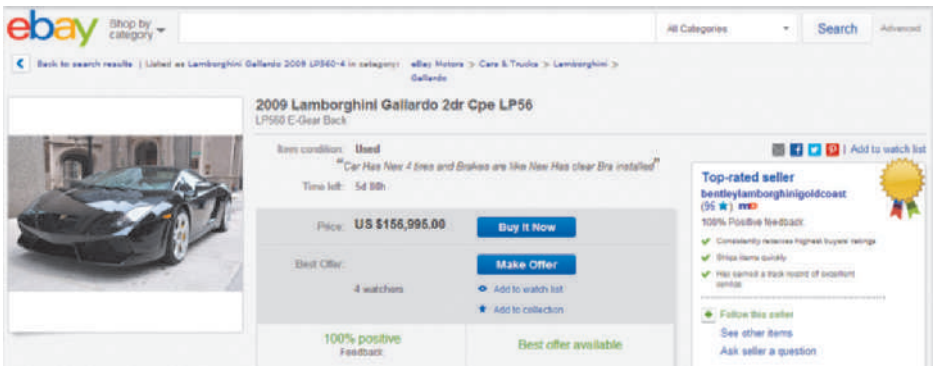


FIGURE **4.40**

eBay

eBay provides an online marketplace where anyone can buy, sell, or trade practically anything.

Auction houses such as eBay accept limited liability for problems that buyers or sellers may experience in their transactions. Transactions that make use of eBay's PayPal service are protected. Others, however, may be risky. Participants should be aware that auction fraud is the most prevalent type of fraud on the Internet.

Craigslist is a network of online communities that provides free online classified advertisements. It is a popular online marketplace for purchasing items from local individuals. Many shoppers turn to Craigslist rather than going to the classifieds in the local paper.

Businesses benefit from shopping online as well. *Global supply management* (*GSM*) online services provide methods for businesses to find the best deals on the global market for raw materials and supplies needed to manufacture their products. *Electronic exchanges* provide an industry-specific Web resource created to deliver a convenient centralized platform for B2B e-commerce among manufacturers, suppliers, and customers. You can read more about this topic in Chapter 5.

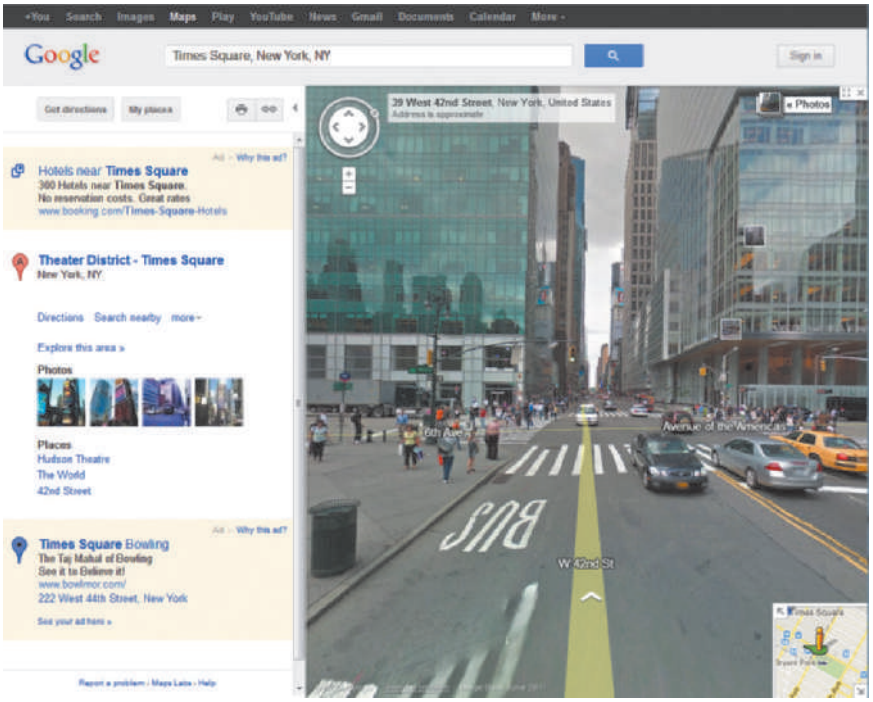
Travel, Geolocation, and Navigation

The Web has had a profound effect on the travel industry and the way people plan and prepare for trips. From getting assistance with short trips across

town to planning long holidays abroad, travelers are turning to the Web to save time and money and overcome much of the risk involved in visiting unknown places.

Travel Web sites, such as *www.travelocity.com*, *www.expedia.com*, *www.kayak.com*, and *www.priceline.com*, help travelers find the best deals on flights, hotels, car rentals, vacation packages, and cruises. Priceline offers a slightly different approach from the other Web sites. It allows shoppers to name a price they're willing to pay for a ticket and then works to find an airline that can meet that price. After flights have been reserved, travelers can use these Web sites to book hotels and rental cars, often at discounted prices.

Mapping and geolocation tools are among the most popular and successful Web applications. MapQuest, Google Maps, and Bing Maps are examples. See Figure 4.41. By offering free street maps for cities around the world, these tools help travelers find their way. Provide your departure location and destination, and these online applications produce a map that displays the fastest route. Now with GPS technologies, these tools can detect your current location and provide directions from where you are.



Courtesy of Google

FIGURE **4.41**

Google Maps

Mapping software, such as Google Maps, provide streetside views of Times Square.

Google Maps also provides extensive location-specific business information, satellite imagery, up-to-the-minute traffic reports, and Street View. The latter is the result of Google employees driving the streets of the world's cities in vehicles with high-tech camera gear, taking 360-degree images. These images are integrated into Google Maps to allow users to get a "street view" of an area that can be manipulated as if they were actually walking down the street looking around. Bing Maps takes it a step further with high-resolution aerial photos and street-level 3D photographs.

Geographic information systems (GIS) provide geographic information layered over a map. For example, Google Earth provides options for viewing traffic, weather, local photos and videos, underwater features such as shipwrecks and marine life, local attractions, businesses, and places of interest.

Software such as Google+ Location and Loopt allow you to find your friends on a map—with their permission—and will automatically notify you if a friend is near.

Geo-tagging is technology that allows for tagging information with an associated location. For example, Flickr and other photo software and services allow photos to be tagged with the location they were taken. Once tagged, it becomes easy to search for photos taken, for example, in Florida. Geo-tagging also makes it easy to overlay photos on a map, as Google Maps and Bing Maps have done. Twitter, Facebook, and other social networks have made it possible for users to geo-tag photos, comments, tweets, and posts.

Geolocation information does pose a risk to privacy and security. Many people prefer that their location remain unknown, at least to strangers and often to acquaintances and even friends. Recently, criminals have made use of location information to determine when people are away from their residences so that they can burglarize without fear of interruption.

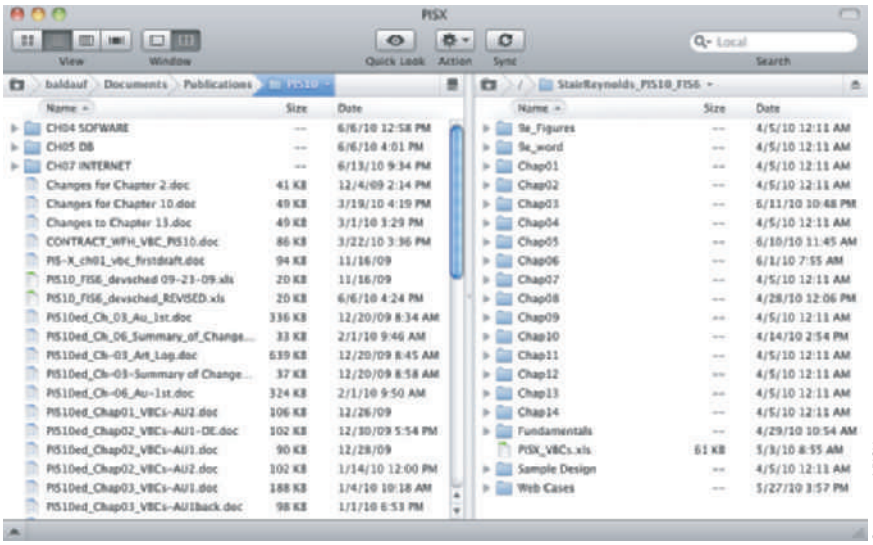
Internet Utilities

Just as the Web is an application that runs on the Internet to provide a framework for delivering information and services, other applications have been designed to run on the Internet for other purposes. Many of these applications serve as utilities for accessing and maintaining resources on the Internet. A few such utilities that predate the Web and http, and still remain useful, are telnet, SSH, and FTP.

Telnet is a network protocol that enables users to log on to networks remotely over the Internet. Telnet software uses a command-line interface that allows the user to work on a remote server directly. Because Telnet is not secured with encryption, most users are switching to *secure shell* (*SSH*), which provides Telnet functionality through a more secure connection.

File Transfer Protocol (FTP): A protocol that provides a file transfer process between a host and a remote computer and allows users to copy files from one computer to another.

File Transfer Protocol (FTP) is a protocol that supports file transfers between a host and a remote computer. See Figure 4.42. Using FTP, users can copy files from one computer to another. For example, the authors and editors of this book used an FTP site provided by the publisher, Cengage Learning, to share and transfer important files during the publication process. Chapter files and artwork, for example, were uploaded to a Cengage Learning FTP site and downloaded by authors and editors to review. Like Telnet, FTP connections are not encrypted, and are, therefore, not secure. Many users are switching to secure FTP (SFTP) for more protected file transfers.



Courtesy of PISX

FIGURE **4.42**

FTP applications

FTP applications allow you to transfer files between computers by clicking and dragging them from one window to another.

INTRANETS AND EXTRANETS

An intranet is an internal corporate network built using Internet and World Wide Web standards and products. Employees of an organization use it to gain access to corporate information. After getting their feet wet with public Web sites that promote company products and services, corporations are seizing the Web as a swift way to streamline—even transform—their organizations. These private networks use the infrastructure and standards of the Internet and the World Wide Web. Using an intranet offers one considerable advantage: Many people are already familiar with Internet technology, so they need little training to make effective use of their corporate intranet.

An intranet is an inexpensive yet powerful alternative to other forms of internal communication, including conventional computer setups. One of an intranet's most obvious virtues is its ability to reduce the need for paper. Because Web browsers run on any type of computer, the same electronic information can be viewed by any employee. That means that all sorts of documents (such as internal phone books, procedure manuals, training manuals, and requisition forms) can be inexpensively converted to electronic form on the Web and be constantly updated. An intranet provides employees with an easy and intuitive approach to accessing information that was previously difficult to obtain. For example, it is an ideal solution to providing information to a mobile salesforce that needs access to rapidly changing information.

A growing number of companies offer limited network access to selected customers and suppliers. Such networks are referred to as extranets, which connect people who are external to the company. An **extranet** is a network that links selected resources of the intranet of a company with its customers, suppliers, or other business partners. Again, an extranet is built around Web technologies.

extranet: A network based on Web technologies that links selected resources of a company's intranet with its customers, suppliers, or other business partners.

Security and performance concerns are different for an extranet than for a Web site or network-based intranet. User authentication and privacy are critical on an extranet so that information is protected. Obviously, the network must perform well to provide quick response to customers and suppliers. Table 4.7 summarizes the differences between users of the Internet, intranets, and extranets.

TABLE 4.7 Summary of Internet, intranet, and extranet users

Type	User	Need User ID and Password?
Internet	Anyone	No
Intranet	Employees	Yes
Extranet	Business partners	Yes

Secure intranet and extranet access applications usually require the use of a *virtual private network* (*VPN*), a secure connection between two points on the Internet. VPNs transfer information by encapsulating traffic in IP packets and sending the packets over the Internet, a practice called **tunneling**. Most VPNs are built and run by ISPs. Companies that use a VPN from an ISP have essentially outsourced their networks to save money on wide area network equipment and personnel.

tunneling: The process by which VPNs transfer information by encapsulating traffic in IP packets over the Internet.

SUMMARY

Principle:

A telecommunications system has many fundamental components that must be carefully selected and work together effectively to enable people to meet personal and organization objectives.

Telecommunications refers to the electronic transmission of signals for communications, including telephone, radio, and television. Telecommunications is

creating profound changes in business because it removes the barriers of time and distance.

The elements of a telecommunications system include the sending and receiving devices, modems, the transmission media, and the message. The sending unit transmits a signal to a modem, which performs a number of functions such as converting the signal into a different form or from one type to another. The modem then sends the signal through a medium, which is anything that carries an electronic signal and serves as an interface between a sending device and a receiving device. The signal is received by another modem that is connected to the receiving computer. The process can then be reversed, and another message can pass from the receiving unit to the original sending unit. The transmission medium physically connects data communications devices and carries the message from the source to its receivers.

Telecommunications media can be divided into two broad categories: guided transmission media, in which a communications signal travels along a solid medium, and wireless media, in which the communications signal is sent over airwaves. Guided transmission media include twisted-pair wire cable, coaxial cable, and fiber-optic cable. Wireless telecommunications involves the broadcast of communications in one of three frequency ranges: microwave, radio, and infrared.

Wireless communications options include near field communications, Bluetooth, ultra wideband, Wi-Fi, and a variety of 3G and 4G communications options.

Telecommunications uses various devices, including smartphones, modems, multiplexers, PBXs, front-end processors, switches, bridge, routers, and gateways.

The effective use of networks can turn a company into an agile, powerful, and creative organization, giving it a long-term competitive advantage. Networks let users share hardware, programs, and databases across the organization. They can transmit and receive information to improve organizational effectiveness and efficiency. They enable geographically separated workgroups to share documents and opinions, which fosters teamwork, innovative ideas, and new business strategies.

Network topology indicates how the communications links and hardware devices of the network are arranged. The three most common network topologies in use today are the star, bus, and mesh.

The physical distance between nodes on the network and the communications and services provided by the network determines whether it is called a personal area network (PAN), local area network (LAN), metropolitan area network (MAN), or a wide area network (WAN).

The electronic flow of data across international and global boundaries is often called transborder data flow.

When an organization needs to connect two or more computer systems, it can follow one of three basic data processing strategies: centralized, decentralized, or distributed.

A client/server system is a network that connects a user's computer (a client) to one or more server computers (servers). A client is often a PC that requests services from the server, shares processing tasks with the server, and displays the results.

A network operating system controls the computer systems and devices on a network, allowing them to communicate with one another. Network-management software enables a manager to monitor the use of individual computers and shared hardware, scan for viruses, and ensure compliance with software licenses.

Principle:

The Internet provides a critical infrastructure for delivering and accessing information and services.

The Internet is truly international in scope, with users on every continent. It is the world's largest computer network. Actually, it is a collection of interconnected networks, all freely exchanging information. The Internet transmits data from one computer (called a host) to another. The set of conventions used to pass packets from one host to another is known as the Internet Protocol (IP). Many other protocols are used with IP. The best known is the Transmission Control Protocol (TCP). TCP is so widely used that many people refer to the Internet protocol as TCP/IP, the combination of TCP and IP used by most Internet applications. Each computer on the Internet has an assigned IP address for easy identification. A Uniform Resource Locator (URL) is a Web address that specifies the exact location of a Web page using letters and words that map to an IP address, and a location on the host.

People can connect to the Internet backbone in several ways: via a LAN whose server is an Internet host, or via a dial-up connection, high-speed service, or wireless service. An Internet service provider is any company that provides access to the Internet. To use this type of connection, you must have an account with the service provider and software that allows a direct link via TCP/IP.

Cloud computing refers to a computing environment where software and storage are provided as an Internet service and accessed with a Web browser. Computing activities are increasingly being delivered over the Internet rather than from installed software on PCs. Cloud computing offers many advantages to businesses. By outsourcing business information systems to the cloud, a business saves on system design, installation, and maintenance. Employees can also access corporate systems from any Internet-connected computer using a standard Web browser.

Principle:

Originally developed as a document-management system, the World Wide Web has grown to become a primary source of news and information, an indispensable conduit for commerce, and a popular hub for social interaction, entertainment, and communication.

The Web is a collection of tens of millions of servers that work together as one in an Internet service providing information via hyperlink technology to billions of users worldwide. Thanks to the high-speed Internet circuits connecting them and hyperlink technology, users can jump between Web pages and servers effortlessly—creating the illusion of using one big computer. Because of its ability to handle multimedia objects and hypertext links between distributed objects, the Web is emerging as the most popular means of information access on the Internet today.

As a hyperlink-based system that uses the client/server model, the Web organizes Internet resources throughout the world into a series of linked files, called pages, accessed and viewed using Web client software, called a Web browser. Internet Explorer, Firefox, Chrome, Opera, and Safari are popular Web browsers. A collection of pages on one particular topic, accessed under one Web domain, is called a Web site.

Hypertext Markup Language (HTML) is the standard page description language for Web pages. The HTML tags let the browser know how to format the text. HTML also indicates where images, sound, and other elements should be inserted. Some newer Web standards are gaining in popularity, including Extensible Markup Language (XML), and Cascading Style Sheets (CSS).

Many of the services offered on the Web are delivered through the use of programs and scripts. JavaScript is a popular programming language for developing Web applications that run on the user's PC. The Java object-oriented programming language allows small programs to be embedded within an HTML document to be downloaded onto a client workstation and run.

Web services consist of standards and tools that streamline and simplify communications among Web sites. XML is used within a Web page to describe and transfer data between Web service applications.

Adobe Dreamweaver, Microsoft Expressions Web, and Nvu are popular tools for creating Web pages and managing Web sites.

The .NET platform allows developers to use various programming languages to create and run programs.

Web 2.0 refers to the Web as a computing platform that supports software applications and the sharing of information between users. The Web is changing from a one-directional resource where users find information to a two-directional resource where users find and share information. The Web has also grown in power to support complete software applications and is becoming a computing platform in and of itself.

A rich Internet application (RIA) is software that has the functionality and complexity of traditional application software, but runs in a Web browser and does not require local installation.

Principle:

The Internet and Web provide numerous resources for finding information, communicating and collaborating, socializing, conducting business and shopping, and being entertained.

The most common and popular uses for the Internet and Web can be categorized as publishing information, assisting users in finding information, supporting communication and collaboration, building online community, providing software applications, providing a platform for expressing ideas and opinions, delivering media of all types, providing a platform for commerce, and supporting travel and navigation.

The Web has become the most popular medium for distributing and accessing information. It is a powerful tool for keeping informed about local, state, national, and global news. As a tool for sharing information and a primary repository of information on all subjects, the Web is ideally suited for education and training. Museums, libraries, private businesses, government agencies, and many other types of organizations and individuals offer educational materials online for free or a fee. Many businesses use the Web browser as an interface to corporate information systems. Web sites have sprung up to support every subject and activity of importance.

A search engine is a valuable tool that enables you to find information on the Web by specifying words that are key to a topic of interest—known as keywords. In addition to search engines, you can use other Internet sites to research information. Wikipedia, an encyclopedia with more than 3 million English-language entries created and edited by millions of users, is another example of a Web site that can be used to research information. There are other wikis are designed for special purposes. Online research is also greatly assisted by traditional resources that have migrated from libraries to Web sites such as online databases.

A Web portal is a Web page that combines useful information and links and acts as an entry point to the Web—the first page you open when you begin browsing the Web. A Web portal typically includes a search engine, a subject directory, daily headlines, and other items of interest. They can be general or specific in nature.

The Internet and Web provide many applications for communication and collaboration. Email is an incredibly useful form of Internet communication that not only supports text communication but also supports HTML content, and sharing documents as email attachments. Instant messaging is online, real-time communication between two or more people who are connected to the Internet. Referred to as a microblogging service, Twitter allows users to

send short text updates (up to 140 characters long) from a cell phone or the Web to their Twitter followers. There are a number of Internet technologies that support real-time online conferencing. The Internet has made it possible for those involved in teleconferences to share computer desktops. Using services such as WebEx or GoToMeeting, conference participants log on to common software that allows them to broadcast their computer display to the group. Telepresence systems such as those from Cisco and HP use high-resolution video and audio with high-definition displays to make it appear that conference participants are actually sitting around a table.

Web sites such as YouTube and Flickr allow users to share video and photos with other people, groups, and the world. Microblogging sites such as Twitter allow people to post thoughts and ideas throughout the day for friends to read. Social bookmarking sites such as *www.digg.com* and *www.delicious.com* allow users to pool their votes to determine what online news stories and Web pages are most interesting at any given time of the day. Similarly, Epinions and many retail Web sites allow consumers to voice their opinions about products. Social networking Web sites provide Web-based tools for users to share information about themselves with people on the Web and to find, meet, and converse with other members.

A Web log, or blog, is a Web site that people can create and use to write about their observations, experiences, and opinions on a wide range of topics. Internet users may subscribe to blogs using a technology called Really Simple Syndication (RSS). RSS is a collection of Web technologies that allow users to subscribe to Web content that is frequently updated. With RSS, you can receive a blog update without actually visiting the blog Web site. A *podcast* is an audio broadcast over the Internet.

Like news and information, all forms of media and entertainment have followed their audiences online. The Internet and the Web have made music more accessible than ever, with artists distributing their songs through online radio, subscription services, and download services. With increasing amounts of Internet bandwidth going to more homes, streaming video and television are becoming commonplace. E-books have been available for quite a while, nearly as long as computers. eBook reading devices are gaining in user acceptance. Online games include the many different types of single-user, multiuser, and massively multiuser games played on the Internet and the Web.

Many online shopping options are available to Web users. E-tail stores—online versions retail stores—provide access to many products that may be unavailable in local stores. Like your local shopping mall, cybermalls provide access to a collection of stores that aim to meet your every need. Online clearinghouses, Web auctions, and marketplaces provide a platform for businesses and individuals to sell their products and belongings.

The Web has had a profound effect on the travel industry and the way people plan and prepare for trips. From getting assistance with short trips across town to planning long holidays abroad, travelers are turning to the Web to save time and money and overcome much of the risk involved in visiting unknown places. Mapping and geolocation tools are among the most popular and successful Web applications. MapQuest, Google Maps, and Bing Maps are examples. Geo-tagging is technology that allows for tagging information with an associated location.

Principle:

Popular Internet and Web technologies have been applied to business networks in the form of intranets and extranets.

An intranet is an internal corporate network built using Internet and World Wide Web standards and products. Because Web browsers run on any type of computer, the same electronic information can be viewed by any

employee. That means that all sorts of documents can be converted to electronic form on the Web and can constantly be updated.

An extranet is a network that links selected resources of the intranet of a company with its customers, suppliers, or other business partners. It is also built around Web technologies. Security and performance concerns are different for an extranet than for a Web site or network-based intranet. User authentication and privacy are critical on an extranet. Obviously, the network must perform well to provide quick response to customers and suppliers.

KEY TERMS

ARPANET
Bluetooth
broadband communications
bus network
Cascading Style Sheet (CSS)
centralized processing
channel bandwidth
client/server architecture
cloud computing
computer network
content streaming
decentralized processing
distributed processing
Extensible Markup Language (XML)
extranet
File Transfer Protocol (FTP)
HTML tags
hyperlink
Hypertext Markup Language (HTML)
instant messaging
Internet backbone
Internet censorship
Internet Protocol (IP)
Internet service provider (ISP)
IP address
Java
local area network (LAN)
Long Term Evolution (LTE)
mesh network
metropolitan area network (MAN)
near field communication (NFC)
network operating system (NOS)
network topology
network-management software
personal area network (PAN)
rich Internet application (RIA)
search engine
software defined networking
star network
telecommunications medium
tunneling
ultra wideband (UWB)
Uniform Resource Locator (URL)
Web
Web 2.0
Web browser
Web log (blog)
Web portal
Wi-Fi
wide area network (WAN)
Worldwide Interoperability for Microwave Access (WiMAX)

CHAPTER 4: SELF-ASSESSMENT TEST

A telecommunications system has many fundamental components that must be carefully selected and work together effectively to enable people to meet personal and organization objectives.

1. The basic components of a telecommunications system are sending and receiving devices, modems, the transmission media, and the _____.
2. Telecommunications media can be divided into two broad categories: _____.
   a. infrared and microwave
   b. fiber optic and cable
   c. guided and wireless
   d. packet switching and circuit switching
3. Microwave communications involves the broadcast of communications in one of three frequency ranges: microwave, radio, or _____.

4. _____ indicates how the communications links and hardware devices of the network are arranged.
   a. Communications protocol
   b. Transmission media
   c. Network topology
   d. None of the above

The Internet provides a critical infrastructure for delivering and accessing information and services.

5. Each computer on the Internet has a URL for easy identification. True or False?
6. On the Internet, what enables traffic to flow from one network to another?
   a. Internet Protocol
   b. ARPANET
   c. Uniform Resource Locator
   d. MILNET
7. Cloud computing is a computing environment where software and storage are provided as an Internet service and accessed with a(n) _____.
   a. Web browser
   b. mobile computing device such as a smartphone or tablet computer
   c. search engine
   d. Virtual Private Network (VPN)
8. A(n) _____ is a company that provides people and organizations with access to the Internet.

Originally developed as a document-management system, the World Wide Web has grown to become a primary source of news and information, an indispensable conduit for commerce, and a popular hub for social interaction, entertainment, and communication.

9. The Web is a collection of _____ of servers that work together as one in an Internet service providing information via hyperlink technology to billions of users worldwide.
   a. hundreds of thousands
   b. millions
   c. tens of millions
   d. over 100 million
10. The World Wide Web is a hyperlink-based system that uses the _____ model.
    a. file/server
    b. circuit-switching
    c. cloud computing
    d. client/server
11. Which technology was developed to assist in easily specifying the visual appearance of Web pages in a Web site?
    a. HTML
    b. XHTML
    c. XML
    d. CSS
12. What is the standard page description language for Web pages?
    a. Home Page Language
    b. Hypermedia Language
    c. Java
    d. Hypertext Markup Language (HTML)

The Internet and Web provide numerous resources for finding information, communicating and collaborating, socializing, conducting business and shopping, and being entertained.

13. Web sites such as Facebook and LinkedIn are examples of _____ Web sites.
    a. media sharing
    b. social network
    c. social bookmarking
    d. content streaming
14. A(n) _____ is a Web page that combines useful information and links and acts as an entry point to the Web—the first page you open when you begin browsing the Web.

Popular Internet and Web technologies have been applied to business networks in the form of intranets and extranets.

15. A(n) _____ is a network based on Web technology that links customers, suppliers, and others to the company.
16. An intranet is an internal corporate network built using Internet and World Wide Web standards and products. True or False?

CHAPTER 4: SELF-ASSESSMENT TEST ANSWERS

1. message or signal
2. c.
3. infrared
4. c.
5. False
6. a.
7. a.
8. Internet Service Provider (ISP)
9. c.
10. d.
11. d.
12. d.
13. b.
14. Web portal
15. extranet
16. True

REVIEW QUESTIONS

1. Define the term telecommunications medium. Name three media types.
2. What is meant by network topology? Identify and briefly describe different network topologies.
3. What is a telecommunications protocol?
4. What are the names of the three primary frequency ranges used in wireless communications?
5. Briefly describe the differences between a circuit-switching and packet-switching network.
6. Identify two organizations that lead in the setting of communications standards.
7. What roles do the bridge, router, gateway, and switch play in a network?
8. Distinguish between a PAN, LAN, MAN, and WAN.
9. What is the Web? Is it another network like the Internet or a service that runs on the Internet?
10. What is MILNET?
11. What is HTML? How does it work?
12. Explain the naming conventions used to identify Internet host computers.
13. What is a Web browser? Identify four popular Web browsers.
14. What is cloud computing? How is it used?
15. Briefly describe three ways to connect to the Internet. What are the advantages and disadvantages of each approach?
16. What is an Internet censorship?
17. What is clickstream data analysis? How is it used?
18. What is a podcast?
19. Identify four popular Web browsers.
20. What is content streaming?
21. What is ICANN and what role does it play?
22. What is a URL, and how is it used?
23. What is an intranet? Provide three examples of the use of an intranet.
24. What is an extranet? How is it different from an intranet?

DISCUSSION QUESTIONS

1. Briefly discuss the differences between centralized and decentralized processing.
2. Distinguish between client/server and file server architecture.
3. What is the issue associated with transborder data flow? How might this issue limit the use of an organization's WAN?
4. Distinguish between centralized and distributed data processing.
5. Social networks are being widely used today. Describe how this technology could be used in a business setting. Are there any drawbacks or limitations to using social networks in a business setting?
6. Why is it important to have an organization that manages IP addresses and domain names?
7. What are the benefits and risks involved in using cloud computing?
8. Describe how a company could use a blog and podcasting.
9. Identify three companies with which you are familiar that are using the Web to conduct business. Describe their use of the Web.
10. What are the defining characteristics of a Web 2.0 site?
11. Discuss the advantages and disadvantages of a virtual private network.
12. What social concerns surround geolocation technologies?
13. One of the key issues associated with the development of a Web site is getting people to visit it. If you were developing a Web site, how would you inform others about it and make it interesting enough that they would return and tell others about it?
14. Keep track of the amount of time you spend on social networking sites for one week. Do you think that this is time well spent? Why or why not?
15. Briefly summarize the differences in how the Internet, a company intranet, and an extranet are accessed and used.

PROBLEM-SOLVING EXERCISES

1. You have been hired as a telecommunications consultant to help a software firm identify new ideas for GPS applications. Use PowerPoint or similar software to produce a presentation of your top three ideas.
2. Do research on the Web to identify the three most frequently visited non-U.S.-based social networking sites. Use a word processor to write a report that identifies and then compares and contrasts their services. Also discuss the advantages and potential problems of sharing personal information online. What information collected by social networking sites do you think should be kept private from the general public

3. Think of a business that you might like to establish. Use a word processor to define the business in terms of what product(s) or service(s) it provides, where it is located, and its name. Go to *www.godaddy.com* and find an appropriate domain name for your business that is not yet taken. Shop around online for the best deal on Web site hosting. Write a paragraph about your experience finding a name, why you chose the name that you did, and how much it will cost you to register the name and host a site.

TEAM ACTIVITIES

1. Form a team to identify the public locations (such as an airport, public library, or café) in your area where wireless LAN connections are available. Visit two locations and write a brief paragraph discussing your experience at each location trying to connect to the Internet.
2. Plan, set up, and execute a meeting with another team wherein you do not meet physically but via use of a Web service such as GoToMeeting or WebEx. What are some of the problems you encounter in setting up and executing the meeting? How would you evaluate the effectiveness of the meeting? What could have been done to make the meeting even more effective?
3. Try using the search engine Baidu to find information on several topics. Write a brief summary of your experience.

WEB EXERCISES

1. Do research on the Web to identify the latest revelations about the NSA from Edward Snowden. In your opinion, should he be considered a patriot or a traitor? Defend your position.
2. Using the Internet, identify three organizations that make extensive use of extranets to collaborate with their business partners. Write a report summarizing the advantages and disadvantages of using extranets.
3. Using the Internet, research three universities that extensively use online or distance learning. Write a report of what you found.

CAREER EXERCISES

1. Identify three telecommunications organizations that appear to have excellent growth opportunities. Do research to identify current job openings and the qualifications needed to fill these positions. Do any of these positions appeal to you? Why or why not?
2. Explore LinkedIn, a social media network for professional networking. Use some of its features to find former students of your school or coworkers at your place of employment. What are some of the advantages of using such a Web site? What are some of the potential problems?

CASE STUDIES

Case One

Rural Africa Reaches to the Sky for Internet Access

In Africa, only about 16 percent of the population has access to the Internet. By comparison, about 63 percent of the population in Europe has Internet access. Furthermore, Internet connectivity is plagued by the low bandwidth, unreliability, and high cost. Overcoming this digital divide is not an easy task, as the continent lacks terrestrial connectivity between the submarine cables, the Internet exchange points—the infrastructure Internet service providers (ISP) need to exchange traffic between their different networks—and 'last mile' delivery systems. As a result, individuals, organizations, and businesses rely heavily on mobile telephony and satellite technology.

SkyVision has stepped into the African market and other emerging markets with customized satellite-based virtual private networks that are supporting economic development. The VPN allows companies to connect their WAN sites to share data and support significantly more efficient collaboration. Through its satellite systems, SkyVision is able to offer reliable broadband and high-speed data services to the most remote locations.

For example, only 12 percent of the rural population in Zimbabwe have access to banking services. Banks simply cannot provide connectivity to rural areas where 65 percent of the population lives. SkyVision VPN connected the

Harare headquarters to the rural branches so that they could offer the wide range of banking services that rely on core banking systems, email, Internet, and point of sale (POS) services. SkyVision satellite and fiber optic VPN technology allowed one Nigerian bank to install and connect 90 ATM sites to never-before-served rural locations. Within the developing oil and gas industries, SkyVision has also established reliable connectivity between companies' headquarters and remote depots—as well as between onshore and off-shore operations.

SkyVision technology has also promoted the development of economic ties between Europe and Africa. The Agro-Industrial Group, for example, need to connect several private African agro-industrial companies to each other and to their European headquarters. SkyVision established reliable and secure data sharing system.

Despite these advances, analysts point out that the prices of more reliable connectivity solutions are prohibitive for many companies, organizations, and businesses. So many organizations and corporations are continuing to take initiatives. In late 2013, Google announced Project Link, a plan to build fiber optic networks that would allow for high-speed Internet connectivity. The project is headquartered in Kamala, the capital of Uganda, a dense urban center that lacks broadband access. Google is hoping to fund the project by charging the mobile telephony providers who will link into the network.

These efforts, however, will focus on major cities and support development in urban Africa. Yet a number of barriers exist to high-speed terrestrial networks. African governments sometimes charge high licensing fees and tax technology equipment heavily. Policy-makers also need to cooperate to facilitate cross-border terrestrial connectivity and encourage private investment. Until governments take these steps, it will be left to initiatives, like those of SkyVision, to reach out to those in remote rural areas.

Discussion Questions

1. Where does Africa stand in relation to Europe and other developed nations with regard to Internet connectivity and use?
2. What technological barriers do companies face when trying to link networks that are located in different locations and how do companies like SkyVision help these companies?

Critical Thinking Questions

1. Do you think that innovators like SkyVision or Google will have more success?
2. What role do you think governments and international organizations should take in overcoming the digital divide in urban and rural Africa?

SOURCES: Donnelly, Caroline, "Google to Improve Internet Access in Africa via Project Link," ITPRO, November 21, 2013; "Lifting Barriers to Internet Connectivity in Africa," AnalysisMason, October 2013; Internet Work Statistics, *http://www.internetworldstats.com/*, accessed December 26, 2013; SkyVision Case Studies: Agro-Industrial Group; Banking & Finance Solution, Nigeria; Bank in Zimbabwe; Oil & Gas Corporation.

Case Two

War Games: Now More Real Than Ever

Earth is under invasion. Our only hope lies with the team of soldiers who are being trained on massive multiplayer virtual simulators. Sound familiar? It's the plot line of the wildly popular futuristic novel entitled "Ender's Game."

But just how futuristic is the scenario? True, we have yet to be invaded by an alien race. But the U.S. military is already developing massive multiplayer virtual online gaming systems for training purposes. Since 2009, the United States Army Simulation and Training Technology Center (STTC) has been working with the Department of Defense (DOD), the Department of Homeland Security (DHS), and private contractors to create a virtual online gaming platform to train soldiers to master strategic skills needed under fire.

Currently, the U.S. army uses numerous simulation tools and online apps. For example, soldiers about to be deployed to Afghanistan might watch detailed videos of a recent skirmish to learn techniques they will require to clear a building where enemy forces are hiding.

But in 2014, the army tested its first avatar-based multiplayer online training game that simulates conditions on the ground in Afghanistan. The project called MOSES, military open simulator enterprise strategy, simulates a 25-by-25 kilometer Afghan terrain into which 700 trainees can project their avatars. Soldiers will interact with each other as well as with simulated Afghan civilians and enemy combatants. They will have to cooperate as they carry out maneuvers and make good choices, such as which village elders to trust as they collect information they need to carry out a maneuver.

Unlike other gaming environments in which bullets fly in a straight line, ignoring the physics that would determine the course of a real-life bullet, MOSES and its predecessor EDGE (Enhanced Dynamic Geosocial Environment) have created a life-like simulation in which objects and people behave as they would in the real world. STTC Director Douglas Maxwell and his team of government and private engineers have developed a flexible virtual environment using artificial intelligence and advanced computational steering of objects. For example, as soldiers' avatars work to disarm improvised explosive devices (IEDs), MOSES' flexible environment even captures real-time terrain warping in response to an exploding IED.

As teams are working to develop MOSES, EDGE technology has already been adapted to develop another project that will service federal, state, and local emergency agencies and private sector partners across the nation in the event of a terrorist threat. The project, called Virtual Training Active Shooter Response, is an online gaming system that trains first responders for active shooter incidents.

Sacramento police and fire departments were the first to pilot the program in 2013. Trainees were placed in a scenario in which a bomb planted in a hotel sets off a fire. Terrorists are in position picking off people as they try to make it to safety. The game featured a realistic replica of a popular Sacramento hotel with a lobby, restaurant and bar, ballrooms, 27 guest room floors, a basement, and two main entrances. Teams from the different Sacramento city departments, police, fire, and emergency medical services, had to work together to neutralize the threat. Unlike simulations in which individuals work through a computer-generated simulation, this product

improves collaboration between different groups of first responders—a valuable skill that is difficult to develop without actually being in the field.

Researchers have found that massive multiplayer online fantasy games tend to encourage addiction and lead to depression, allowing individuals to avoid solving real-world problems. EDGE indicates, however, that developers might be able to produce games that allow people to develop skills necessary to succeed in the real world.

Discussion Questions

1. What purposes do massive multiplayer games serve today? What purposes could they serve in the future?
2. What advantage do projects developed with EDGE have over other training software?

Critical Thinking Questions

1. Do massive multiplayer games serve a useful function in today's society? Why or why not?
2. What types of technologies are used by massive multiplayer games that could be used in other ways?

SOURCES: Hugh, Lessig, "The New Army: A Newport News tech center uses gaming and apps to train soldiers," *Daily Press*, January 28, 2012, *http://articles.dailypress.com/2012-01-28/news/dp-nws-high-tech-training-20120128_1_training-exercises-army-s-training-latest-training-tool*; Korolov, Maria, "Army takes a flier on OpenSim," *Network World*, March 25, 2013, *www.networkworld.com/news/2013/032513-army-opensim-267405.html?page=3*; Montalbano, Elizabeth, "DOD Explores Virtual Worlds For Military Training," InformationWeek, May 12, 2011, *www.informationweek.com/security/risk-management/dod-explores-virtual-worlds-for-military-training/d/d-id/1097729?*; Pellerin, Cheryl, "Fighting Bombs in Cyberspace Gives Army an 'EDGE,'" American Forces Press Service, U.S. Department of Defense, May 12, 2011, *www.defense.gov/News/NewsArticle.aspx?ID=63924*; Barrie, Allison, Army, "DHS join forces for virtual training tech for first responders," *Fox News*, November 21, 2013, *www.foxnews.com/tech/2013/11/21/army-dhs-join-forces-for-virtual-training-tech-for-first-responders/*; "DHS is training first responders to respond to an active shooter," *Government Security News*, November 20, 2013, *www.gsnmagazine.com/node/39069*.

Questions for Web Case

See the Web site for this book to read about the Altitude Online case for this chapter. Following are questions concerning this Web case.

Altitude Online: Telecommunications and Networks

Discussion Questions

1. What telecommunications equipment is needed to fulfill Altitude Online's vision?
2. Why is it necessary to lease a line from a telecommunication company?

Critical Thinking Questions

1. What types of services will be provided over Altitude Online's network?
2. What considerations should Jon and his team take into account as they select telecommunications equipment?

Altitude Online: The Internet, Web, Intranets, and Extranets

Discussion Questions

1. What impact will the new ERP system have on Altitude Online's public-facing Web site? How will it affect its intranet?
2. What types of applications will be available from the employee dashboard?

Critical Thinking Questions

1. Altitude Online employees have various needs, depending on their position within the enterprise. How might the dashboard and intranet provide custom support for individual employee needs?
2. What Web 2.0 applications should Altitude Online consider for its dashboard? Remember that the applications must be available only on the secure intranet.

NOTES

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Business Information Systems

CHAPTERS

5 Electronic and Mobile Commerce and Enterprise Systems

Principles	Learning Objectives
• Electronic and mobile commerce are evolving, providing new ways of conducting business that present both potential benefits and problems.	• Describe the current status of various forms of e-commerce, including B2B, B2C, C2C, and m-commerce. • Identify several e-commerce and m-commerce applications. • Identify several advantages associated with the use of e-commerce and m-commerce.
• E-commerce and m-commerce require the careful planning and integration of a number of technology infrastructure components.	• Identify the key components of technology infrastructure that must be in place for e-commerce and m-commerce to work. • Discuss the key features of the electronic payment systems needed to support e-commerce and m-commerce.
• An organization must have information systems that support the routine, day-to-day activities and that help a company add value to its products and services.	• Identify the basic activities and business objectives common to all transaction processing systems.
• An organization that implements an enterprise system is creating a highly integrated set of systems, which can lead to many business benefits.	• Define the terms enterprise resource management, customer relationship management, and product lifecycle management systems and identify their functions and benefits.

Information Systems in the Global Economy
BHARTI AIRTEL, INDIA

Airtel Money Boosts M-Commerce in Asia and Africa

Source: Bharti Enterprises

Feeling a bit peckish in Mumbai at about 8 pm local time, but too tired to cook or go out to eat? Pick up your cell phone and order Domino's pizza. It's no problem. You don't even need cash. You don't need a credit or debit card. You just need your mobile phone and an Airtel Money account.

Bharti Airtel (Airtel) is one of the top four mobile service providers globally. Based in New Delhi, India, the company services over 370 million subscribers in 20 countries across Africa, Asia, and the Channel Islands (in the English Channel, off the French coast of Normandy). It offers 2G and 3G wireless service, m-commerce, and Airtel Money. Within India, the company also provides fixed-line services, Internet access and satellite television, high-speed DSL broadband connections, and enterprise services linking Africa and South Asia to international long-distance carriers.

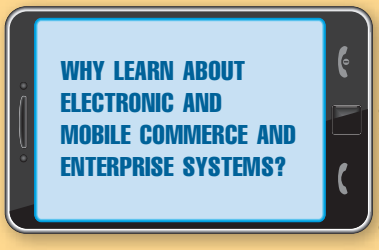
Recently, however, Airtel has experienced intense growth in the mobile industry. Its consumers, especially in India, are flocking toward m-commerce—for some very good reasons. First, mobile devices, such as cell phones and tablets, are significantly cheaper than computers. As m-commerce develops, consumers don't even need expensive smartphones to navigate these sites, compare prices, and make purchases. So, access to m-commerce has become affordable to a growing consumer base with lower incomes. In fact, because these devices are cheaper, the Indian government has invested in and distributed cell phones and tablets as part of its programs to overcome the digital divide between urban and rural areas. Other developing countries may follow this lead. Moreover, Bharti Airtel pioneered the strategy of lowering its mobile rates to increase affordability and traffic.

Unlike personal computers and laptops, mobile phones are always connected. So, you don't have to be at home, at work, or at an Internet café to make your purchases. Furthermore, mobile devices are relatively secure because they are not yet subject to the onslaught of virus and pernicious attacks that PC users must constantly fend off. Moreover, owners keep their mobile devices on-hand, decreasing the risk that others will access their personal electronic information.

Finally, the increasing prevalence of Airtel Money is fueling the growth in the mobile industry. In 2011, Airtel launched its mobile money service, allowing customers to make cash payments at service centers or transfer money directly from their banks or credit card companies. Customers can shop online, pay utility bills, book train or movie tickets, and transfer money from wherever they happen to be. Airtel also has deals with online vendors to offer special Airtel Money discounts. The good news is that even if you do lose your phone or laptop, your Airtel Money is protected by a PIN number, so at least that personal information is secure.

As you read this chapter, consider the following:

- What are the advantages of e-commerce and m-commerce?
- How do innovations in technology and infrastructure affect regions across the globe?



Electronic and mobile commerce and enterprise systems have transformed many areas of our lives and careers. One fundamental change has been the manner in which companies interact with their suppliers, customers, government agencies, and other business partners. As a result, most organizations today have or are considering setting up business on the Internet and implementing integrated enterprise systems. To be successful, all members of the organization need to participate in that effort. As a sales or marketing manager, you will be expected to help define your firm's e-commerce business model. Customer service employees can expect to use enterprise systems to provide improved customer service. As a human resource or public relations manager, you will likely be asked to provide content for a Web site directed to potential employees and investors. Analysts in finance need to know how to use enterprise systems to capture and report the data needed to manage and control the firm's operations. Clearly, as an employee in today's organization, you must understand the potential role of e-commerce and enterprise systems, how to capitalize on their many opportunities, and how to avoid their pitfalls. The emergence of m-commerce adds an exciting new dimension to these opportunities and challenges. This chapter begins by providing a brief overview of the dynamic world of e-commerce and defines its various components.

AN INTRODUCTION TO ELECTRONIC COMMERCE

electronic commerce (e-commerce): Conducting business activities (e.g., distribution, buying, selling, marketing, and servicing of products or services) electronically over computer networks.

Electronic commerce (e-commerce) is the conducting of business activities (e.g., distribution, buying, selling, marketing, and servicing of products or services) electronically over computer networks. It includes any business transaction executed electronically between companies (business-to-business), companies and consumers (business-to-consumer), consumers and other consumers (consumer-to-consumer), public sector and business (government-to-business), the public sector to citizens (government-to-citizen), and public sector to public sector (government-to-government). Business activities that are strong candidates for conversion to e-commerce are ones that are paper based, time consuming, and inconvenient for customers.

Business-to-Business E-Commerce

business-to-business (B2B) e-commerce: A subset of e-commerce in which all the participants are organizations.

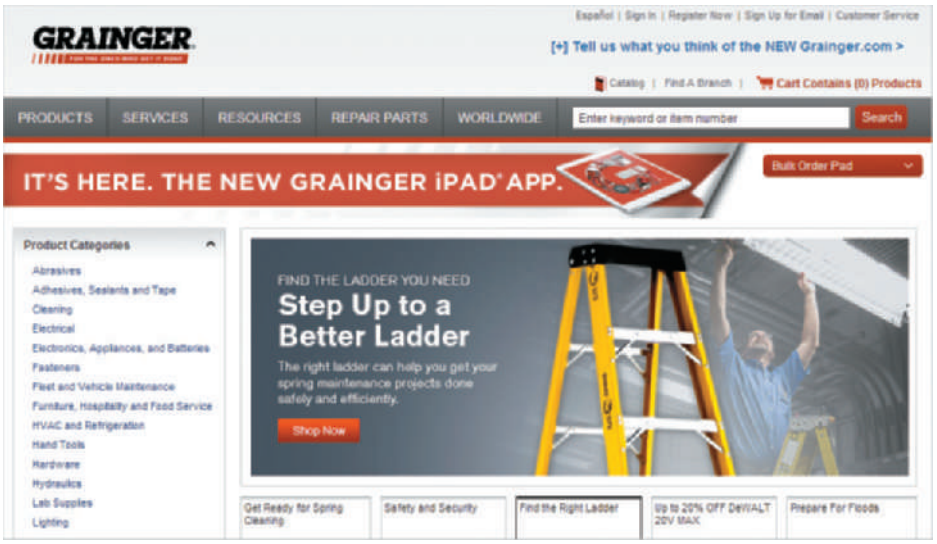
Business-to-business (B2B) e-commerce is a subset of e-commerce in which all the participants are organizations. B2B e-commerce is a useful tool for connecting business partners in a virtual supply chain to cut resupply times and reduce costs. Although the business-to-consumer market grabs more of the news headlines, the B2B market is considerably larger and is growing more rapidly. B2B sales within the United States (excluding EDI transactions) was estimated to be $559 billion in 2013, twice the size of B2C commerce.[1] Moving more customers online is key to B2B commerce success. Indeed, in a recent survey by Oracle, 57 percent of respondents said customer acquisition is a top metric used to measure e-commerce success and 42 percent said customer retention.[2]

Grainger is a B2B distributor of products for facilities maintenance, repair, and operations (a category called MRO) with more than 1.2 million different items offered online. See Figure 5.1. The company exceeded $3 billion in online sales in 2013, which represented one-third of total sales.[3] The firm provides a suite of mobile apps that makes it possible to access products online and quickly find and order products via your smartphone or mobile device.[4]

Business-to-Consumer E-Commerce

business-to-consumer (B2C) e-commerce: A form of e-commerce in which customers deal directly with an organization and avoid intermediaries.

Business-to-consumer (B2C) e-commerce is a form of e-commerce in which customers deal directly with an organization and avoid intermediaries.



Source: grainger.com

FIGURE **5.1**

Grainger e-commerce

Grainger offers more than 1.2 million items online.

Early B2C pioneers competed with the traditional "brick-and-mortar" retailers in an industry selling their products directly to consumers. For example, in 1995, upstart Amazon.com challenged well-established booksellers Waldenbooks and Barnes & Noble. A recent Forrester Research Inc. and Internet Retailer survey found that the average order value was $491 for B2B versus $147 for B2C.[5]

Table 5.1 shows the estimated B2C sales by world region in 2016. Roughly 5 percent of total retail sales is spent by online shoppers.[6]

TABLE 5.1 Forecasted global B2C e-commerce spending (USD billions)

Region/Selected Countries	2014	2016	Increase
North America	**$469**	**$580**	**24%**
United States	$442	$546	24%
Canada	$28	$34	21%
Asia/Pacific	**$502**	**$708**	**41%**
China	$275	$440	60%
Australia	$28	$31	11%
India	$21	$30	43%
Western Europe	**$326**	**$388**	**19%**
UK	$111	$133	20%
Germany	$58	$66	12%
Spain	$25	$30	25%
Central and Eastern Europe	**$58**	**$69**	**19%**
Russia	$21	$25	19%
Latin America	**$56**	**$70**	**25%**
Brazil	$24	$27	12%
Mexico	$10	$13	30%
Middle East and Africa	**$34**	**$45**	**32%**
Worldwide	**$1,445**	**$1,860**	**29%**

Source: Indvik, Lauren, "Study: Global E-Commerce to Hit $1.2 Trillion Led by Asia," Mashable, June 27, 2013, *http://mashable.com/2013/06/27/ecommerce-study-china-asia/.*

One reason for the steady growth in B2C e-commerce is shoppers find that many goods and services are cheaper when purchased via the Web, including stocks, books, newspapers, airline tickets, and hotel rooms.

Another reason for the growth in B2C e-commerce is that online B2C shoppers have the ability to design a personalized product. Brooks Brothers provides an example of this personalization. Suits have what is called a "drop," which is the difference between the number given in the suit size and your pant size. American suits typically have a six-inch drop; an American suit in size 38R would have pants in size 32. On their newly designed Web site, Brooks Brothers allows men to pair any size pant with any size jacket, an offer especially attractive to men who do not fit into the traditional jacket and pants size combinations.[7]

Yet a third reason for the continued growth is the use of social media networks to promote products and reach consumers. Vera Bradley is a luggage design company that produces a variety of products and has more than 1 million Facebook followers. The firm has been extremely conscientious in cross-posting items from Facebook, Flickr, and YouTube to Pinterest. When you visit the Vera Bradley Web site, Pinterest and other social buttons appear on the product pages so that shoppers can share their likes with friends. Vera Bradley is an example of a B2C retailer that makes social media channels work together effectively to reach more potential customers.[8]

By using B2C e-commerce to sell directly to consumers, producers or providers of consumer products can eliminate the middlemen, or intermediaries, between them and the consumer. In many cases, this squeezes costs and inefficiencies out of the supply chain and can lead to higher profits for businesses and lower prices for consumers. The elimination of intermediate organizations between the producer and the consumer is called *disintermediation*.

More than just a tool for placing orders, the Internet enables shoppers to compare prices, features, and value, and to check other customers' opinions. Internet shoppers also can unleash shopping bots or access sites such as eBay Shopping.com, Google Shopping, Shopzilla, PriceGrabber, Yahoo! Shopping, or Excite to browse the Internet and obtain lists of items, prices, and merchants. Many B2C merchants have added what is called "social commerce" to their Web sites by creating a section where shoppers can go to see only those products that have been reviewed and listed by other shoppers. Walmart implemented its Shopycat application that refers to information from a shopper's friends on Facebook to make gift recommendations for the shopper. He or she can then purchase these items from Walmart or other stores online or via a personal visit.[9]

As a result of a 1992 Supreme Court ruling that says online retailers don't have to collect sales taxes in states where they lack a physical presence, millions of online shoppers do not pay state or local tax on their online purchases. This avoidance of sales tax creates a price advantage for online retailers over brick-and-mortar stores where sales taxes must be collected. It also results in the annual loss of about $23 billion in tax revenue that could go to state and local governments to provide services for their citizens.[10]

Consumer-to-Consumer E-Commerce

consumer-to-consumer (C2C) e-commerce: A subset of e-commerce that involves electronic transactions between consumers using a third party to facilitate the process.

Consumer-to-consumer (C2C) e-commerce is a subset of e-commerce that involves electronic transactions between consumers using a third party to facilitate the process. eBay is an example of a C2C e-commerce site; customers buy and sell items to each other through the site. Founded in 1995, eBay has become one of the most popular Web sites in the world. Other popular C2C sites include Bidz.com, Craigslist, eBid, ePier, Ibidfree, Kijiji, Ubid, and Tradus. C2C has created an opportunity for many people to make a living out of selling items on auction Web sites.

Companies and individuals engaging in e-commerce must be careful that their sales do not violate the rules of various county, state, or country legal jurisdictions. Extending background checks to the flourishing world of online gun sales has become a highly controversial issue in the United States. Under current law, the question of when a background check must occur depends on who is selling the gun. Federal regulations require licensed dealers to perform checks, but the legal definition of who must be licensed is unclear. With no requirements for background checks on most private transactions, the anonymity of the Internet enables unlicensed sellers to advertise weapons and people legally barred from gun ownership (such as convicted felons) to buy them.[11]

Table 5.2 summarizes the key factors that differentiate among B2B, B2C, and C2C e-commerce.

TABLE 5.2 Differences among B2B, B2C, and C2C

Factors	B2B	B2C	C2C
Value of sale	Thousands or millions of dollars	Tens or hundreds of dollars	Tens of dollars
Length of sales process	Days to months	Days to weeks	Hours to days
Number of decision makers involved	Several people to a dozen or more	One or two	One or two
Uniformity of offer	Typically a uniform product offering	More customized product offering	Single product offering, one of a kind
Complexity of buying process	Extremely complex, much room for negotiation on price, payment and delivery options, quantity, quality, and options and features	Relatively simple, limited discussion over price and payment and delivery options	Relatively simple, limited discussion over payment and delivery options; negotiation over price
Motivation for sale	Driven by a business decision or need	Driven by an individual consumer's need or emotion	Driven by an individual consumer's need or emotion

E-Government

e-government: The use of information and communications technology to simplify the sharing of information, speed formerly paper-based processes, and improve the relationship between citizens and government.

E-government is the use of information and communications technology to simplify the sharing of information, speed formerly paper-based processes, and improve the relationship between citizens and government. Government-to-citizen (G2C), government-to-business (G2B), and government-to-government (G2G) are all forms of e-government, each with different applications.

Citizens can use G2C applications to submit their state and federal tax returns online, renew auto licenses, purchase postage, apply for student loans, and make campaign contributions. Citizens can purchase items from the U.S. government through its GSA Auctions Web site, which offers the general public the opportunity to bid electronically on a wide range of government assets. Healthcare.gov is a healthcare exchange Web site created by and operated under the United States federal government as specified in the Patient Protection and Affordable Care Act. It is designed for use by residents in the 36 U.S. states that opted not to create their own state exchanges.[12]

G2B applications support the purchase of materials and services from private industry by government procurement offices, enable firms to bid on government contracts, and help businesses identify government contracts on which they may bid. Business.gov allows businesses to access information about laws and regulations and to download relevant forms needed to comply with federal requirements for their businesses. FedBizOpps is a Web site

where government agencies post procurement notices to provide an easy point of contact for businesses that want to bid on government contracts.

G2G applications support transactions between the federal government and state or local governments. Government to Government Services online is a suite of Web applications that enables government organizations to report information, such as birth and death data, arrest warrant information, and information about the amount of state aid being received, to the Social Security Administration. Oregon e-government provides e-commerce services to various state agencies. For example, the Oregon transaction payment engine option enables agencies to use an efficient Internet payment solution while adhering to statewide policies and procedures.[13]

MOBILE COMMERCE

Mobile commerce (m-commerce) relies on the use of mobile, wireless devices, such as cell phones and smartphones, to place orders and conduct business. Handset manufacturers such as Samsung, Ericsson, Motorola, Nokia, and Qualcomm are working with communications carriers such as AT&T, T-Mobile, Sprint/Nextel, and Verizon to develop such wireless devices, related technology, and services. The Internet Corporation for Assigned Names and Numbers (ICANN) created a .mobi domain to help attract mobile users to the Web. mTLD Top Level Domain Ltd of Dublin, Ireland, administers this domain and helps to ensure that the .mobi destinations work quickly, efficiently, and effectively with user handsets.

Mobile Commerce in Perspective

The market for m-commerce in North America is maturing much later than in Western Europe and Japan because in North America, responsibility for network infrastructure is fragmented among many providers, consumer payments are usually made by credit card, and many Americans are unfamiliar with mobile data services. In most Western European countries, communicating via wireless devices is common, and consumers are much more willing to use m-commerce. Japanese consumers are generally enthusiastic about new technology and are therefore much more likely to use mobile technologies for making purchases.

Worldwide m-commerce is expected to grow to more than one-half billion customers shopping by mobile devices by 2016.[14] In the United States, it is estimated that m-commerce generated about $42 billion in revenue for 2013. By 2017 m-commerce sales are estimated to reach over $113 billion—representing a compound annual growth rate (CAGR) of 28 percent.[15] Clearly mobile commerce is a rapidly growing segment of e-commerce. However, experts point out that the relative clumsiness of mobile browsers and security concerns must be overcome to ensure rapid m-commerce growth.

ELECTRONIC AND MOBILE COMMERCE APPLICATIONS

E-commerce and m-commerce are being used in innovative and exciting ways. This section examines a few of the many B2B, B2C, C2C, and m-commerce applications. As with any new technology, e-commerce and m-commerce will succeed only if it provides users with real benefits. Companies involved in e-commerce and m-commerce must think through their strategies carefully and ensure that they provide services that truly meet customers' needs.

electronic retailing (e-tailing): The direct sale of products or services by businesses to consumers through electronic storefronts, typically designed around the familiar electronic catalog and shopping cart model.

Retail and Wholesale

E-commerce is being used extensively in retailing and wholesaling. **Electronic retailing**, sometimes called *e-tailing*, is the direct sale of products or services by businesses to consumers through electronic storefronts, which are typically

designed around the familiar electronic catalog and shopping cart model. Companies such as Office Depot, Walmart, and many others have used the same model to sell wholesale goods to employees of corporations. Tens of thousands of electronic retail Web sites sell everything from soup to nuts.

cybermall: A single Web site that offers many products and services at one Internet location.

A **cybermall** is a single Web site that offers many products and services at one Internet location—similar to a regular shopping mall. An Internet cybermall pulls multiple buyers and sellers into one virtual place, easily reachable through a Web browser. For example, the Intl Super Cyber Mall (*www.applaudwomen.com/IntlSuperCyberMallatApplaudWomen.html*) provides direct links to over 150 stores representing 34 different categories of products from businesses such as Auto Zone, Best Buy, Foot Locker, Old Navy, Pandora, Dr. Wayne Dyer, The Great Courses, and dozens of other online shopping sites.[16]

A key sector of wholesale e-commerce is spending on manufacturing, repair, and operations (MRO) goods and services—from simple office supplies to mission-critical equipment needed to keep manufacturing facilities running smoothly. MRO purchases often approach 40 percent of a manufacturing company's total revenues and companies face significant internal costs resulting from outdated and cumbersome MRO management processes. For example, studies show that a high percentage of manufacturing downtime is often caused by not having the right part at the right time in the right place. The result is lost productivity and capacity. E-commerce software for plant operations provides powerful comparative searching capabilities to enable managers to identify functionally equivalent items, helping them spot opportunities to combine purchases for cost savings. Comparing various suppliers, coupled with consolidating more spending with fewer suppliers, leads to decreased costs. In addition, automated workflows are typically based on industry best practices, which can streamline processes.

Industrial Parts House provides access to more than 1 million MRO parts and supplies with a 99 percent fill rate on all customer orders. It provides 24 hour shipping with each order received by 3 pm being shipped out the same day.[17]

Manufacturing

One approach taken by many manufacturers to raise profitability and improve customer service is to move their supply chain operations onto the Internet. Here, they can form an **electronic exchange**, an electronic forum where manufacturers, suppliers, and competitors buy and sell goods, trade market information, and run back-office operations, as shown in Figure 5.2. This approach has greatly speeded up the movement of raw materials and finished products among all members of the business community and has reduced the amount of inventory that must be maintained. It has also led to a much more competitive marketplace and lower prices.

electronic exchange: An electronic forum where manufacturers, suppliers, and competitors buy and sell goods, trade market information, and run back-office operations.

Companies can join one of three types of exchanges based on who operates the exchange. Private exchanges are owned and operated by a single company. The owner uses the exchange to trade exclusively with established business partners. Walmart's Retail Link is such an exchange. Consortium-operated exchanges are run by a group of traditionally competing companies with common procurement needs. For example, Covisint was developed to serve the needs of the big three auto makers. Independent exchanges are open to any set of buyers and sellers within a given market. They provide services and a common technology platform to their members and are open, usually for a fee, to any company that wants to use them. For example, Tinypass is a flexible e-commerce platform that enables content publishers to choose from a variety of payment models to sell access to their digital media be it an article, a movie, a blog post, a PDF, access to a forum, or access to an entire Web site.[18]

Several issues are associated with the use of exchanges. One is that companies distrust their corporate rivals and fear they might lose trade secrets

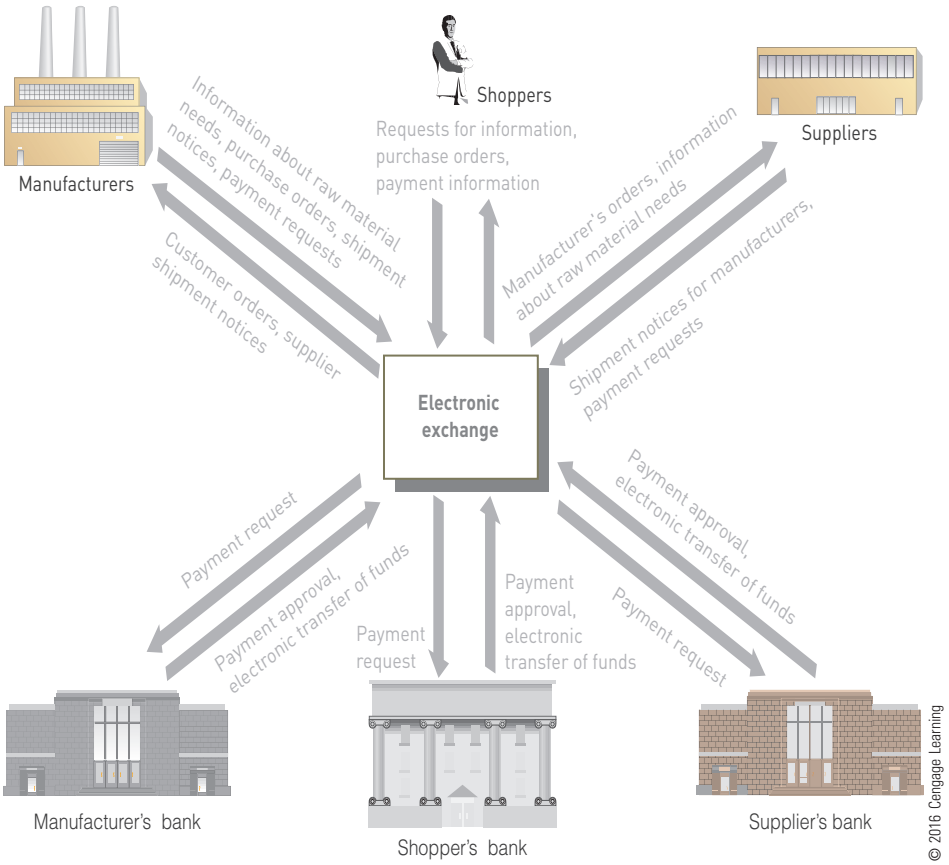


FIGURE **5.2**

Model of an electronic exchange

An electronic exchange is an electronic forum where manufacturers, suppliers, and competitors buy and sell goods, trade market information, and run back-office operations.

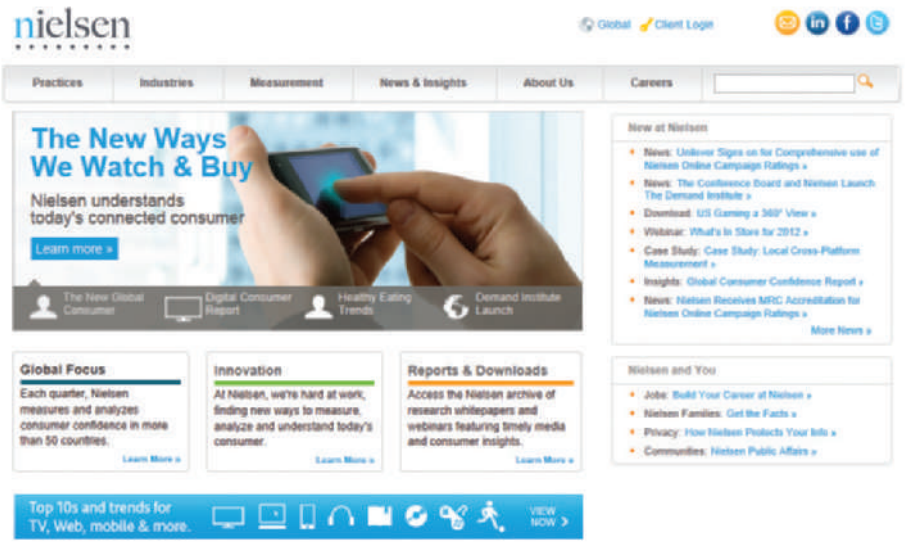
through participation in such exchanges. Suppliers worry that online marketplaces will drive down the prices of goods and favor buyers. Suppliers also can spend a great deal of money setting up to participate in multiple exchanges. For example, more than a dozen new exchanges have appeared in the oil industry, and the printing industry has more than 20 online marketplaces. Until a clear winner emerges in particular industries, suppliers are more or less forced to sign on to several or all of them. Yet another issue is potential government scrutiny of exchange participants: When competitors get together to share information, it raises questions of collusion or antitrust behavior.

Marketing

The nature of the Web enables firms to gather more information about customer behavior and preferences as customers and potential customers gather their own information and make their purchase decisions. Analysis of this data is complicated because of the Web's interactivity and because each visitor voluntarily provides or refuses to provide personal data such as name, address, email address, telephone number, and demographic data. Internet advertisers use the data to identify specific markets and target them with tailored advertising messages. This practice, called **market segmentation**, divides the pool of potential customers into subgroups usually defined in terms of demographic characteristics, such as age, gender, marital status, income level, and geographic location.

market segmentation: The identification of specific markets to target them with tailored advertising messages.

In the past, market segmentation has been difficult for B2B marketers because firmographic data (addresses, financials, number of employees, and industry classification code) was difficult to obtain. However, Nielsen, the marketing and media information company, recently developed its Business-Facts database, which includes critical information such as contact names, locations, addresses, number of employees, annual sales, and SIC and NAICS industry classification codes for more than 14 million U.S. businesses. See Figure 5.3.



Source: www.nielsen.com

FIGURE **5.3**

Nielsen marketing company

Nielsen is a major marketing company that measures and analyzes how consumers acquire information, consume media, and buy goods and services.

Using this data, analysts can estimate potential sales for each business and rank the business against all other prospects and customers.[19]

Advertising

Mobile ad networks distribute mobile ads to publishers such as mobile Web sites, application developers, and mobile operators. Mobile ad impressions are generally bought at a cost per thousand (CPM), cost per click (CPC), or cost per action (CPA), in which the advertiser pays only if the customer clicks through and then buys the product or service. The main measures of success are the number of users reached, click through rate (CTR), and the number of actions users take, such as the number of downloads prompted by the ad. The advertiser is keenly interested in this data to measure the effectiveness of its advertising spending and may pay extra to purchase the data from the mobile ad network or a third party.

AdMob is a mobile advertising provider that serves up ads for display on mobile devices and in applications like those that run on the Android and iPhone. With AdMob (part of Google), smartphone application developers can connect with more than a million Google advertisers and show relevant ads in their app. As users engage with the ads, the app developer earns money. App developers can also advertise their app in other apps to increase downloads. In this manner, app developers can distribute their apps for free and recover their costs over time through payments from advertisers.[20]

Because m-commerce devices usually have a single user, they are ideal for accessing personal information and receiving targeted messages for a particular consumer. Through m-commerce, companies can reach individual consumers to establish one-to-one marketing relationships and communicate whenever it is convenient—in short, anytime and anywhere. See Figure 5.4.

Bartering

During the recent economic downturn, many people and businesses turned to bartering as a means of gaining goods and services. A number of Web sites have been created to support this activity, as shown in Table 5.3. Businesses are willing to barter to reduce excess inventory, gain new customers, or avoid paying cash for necessary raw materials or services. Cash-strapped customers find bartering to be an attractive alternative to paying scarce dollars. Generally,

FIGURE **5.4**

M-commerce is convenient and personal

Consumers are increasingly using mobile phones to purchase goods and perform other transactions online.

TABLE 5.3 Popular bartering Web sites

Web Site	Purpose
Craiglist.org	Includes a section where users can request an item in exchange for services or exchange services for services.
Goozez.com	Allows users to exchange video games and movies.
Swapagift.com	Enables users to buy, sell, or swap merchant gift cards.
SwapHog.com	Bartering site that offers a third-party service that first receives all items and inspects them before finalizing the transaction to eliminate fraud and ensure a successful transaction.
Swapstyle.com	Users can swap, sell, or buy women's accessories, clothes, cosmetics, and shoes.
Swaptree.com	Users trade books, CDs, DVDs, and video games on a one-for-one basis.
TradeAway.com	Enables users to exchange a wide variety of new or used item, service, or real estate.

bartering transactions have tax-reporting, accounting, and other record-keeping responsibilities associated with them. Indeed, the IRS hosts a Bartering Tax Center Web site that provides details about the tax laws and responsibilities for bartering transactions.

Retargeting

An average of 67.75 percent of all online shopping carts are abandoned, amounting to over $9 billion in lost sales for 2011.[21] Retargeting is a technique used by advertisers to recapture these shoppers by using targeted and personalized ads to direct shoppers back to a retailer's site. For example, a visitor who viewed the men's clothing portion of a retailer's Web site and then abandoned the Web site would be targeted with banner ads showing various men's clothing items from that retailer. The banner ads might even display the exact items the visitor viewed, such as men's casual slacks. The retargeting could be even further enhanced to include comments and recommendations from other consumers who purchased the same items. Thus, retargeting ensures that potential consumers see relevant, targeted ads for products they've already expressed interest in.

Price Comparison

An increasing number of companies provide mobile phone apps that enable shoppers to compare prices and products on the Web. Amazon's Price Check and Google's Shopper enable shoppers to do a quick price comparison by simply scanning the product's barcode or by taking a picture of a book, DVD, CD, or video game cover. Barcode Scanner allows shoppers to scan UPC or Quick Response codes to perform a price comparison and read the latest reviews.[22]

Couponing

During 2013, more than 287 billion free-standing insert coupons were distributed in North America with a total value of $467 billion, or an average of $1.67 per coupon.[23] Surprisingly, only 0.95 percent of those coupons were redeemed even during tough economic times for many people.[24]

Many manufacturers and retailers now send mobile coupons directly to consumers' smartphones. Unfortunately, the standard red laser scanners used at checkout stands have difficulty reading information displayed on a smartphone without special smartphone apps. Therefore, for many shoppers, current technology requires that the consumer print out the coupon, have it scanned, and present it to the clerk to enter the numbers from the coupon manually.

Procter and Gamble, the world's largest consumer products company, and mobeam piloted a new approach to enable mobile coupons to be read directly by the standard bar code scanners at the checkout counter. This will enable consumers to receive electronic coupons, sort and organize them on their smartphone, and bring them to the store where they can be scanned directly. The mobeam approach converts the barcode into a beam of light that can be read by the typical barcode scanner. The mobeam application must be loaded onto the smartphone before scanning.[25] The estimated number of mobile coupon redeemers is expected to increase due to the integration of couponing into social networks, along with an increase in smartphone and tablet users, new mobile apps, and location-based deals.[26] See Figure 5.5.

Investment and Finance

The Internet has revolutionized the world of investment and finance. Perhaps the changes have been so significant because this industry had so many built-in inefficiencies and so much opportunity for improvement. The brokerage business adapted to the Internet faster than any other arm of finance. See Figure 5.6. The allure of online trading that enables investors to do quick, thorough research and then buy shares in any company in a few seconds and at a fraction of the cost of a full-commission firm has brought many investors to the Web. TD Ameritrade offers a mobile trading app for investors to monitor their investments, view streaming quotes, access multiple chat rooms and data feeds to communicate live with other traders, interact with over 300 charts and indicators, access streaming news from CNBC, generate investment

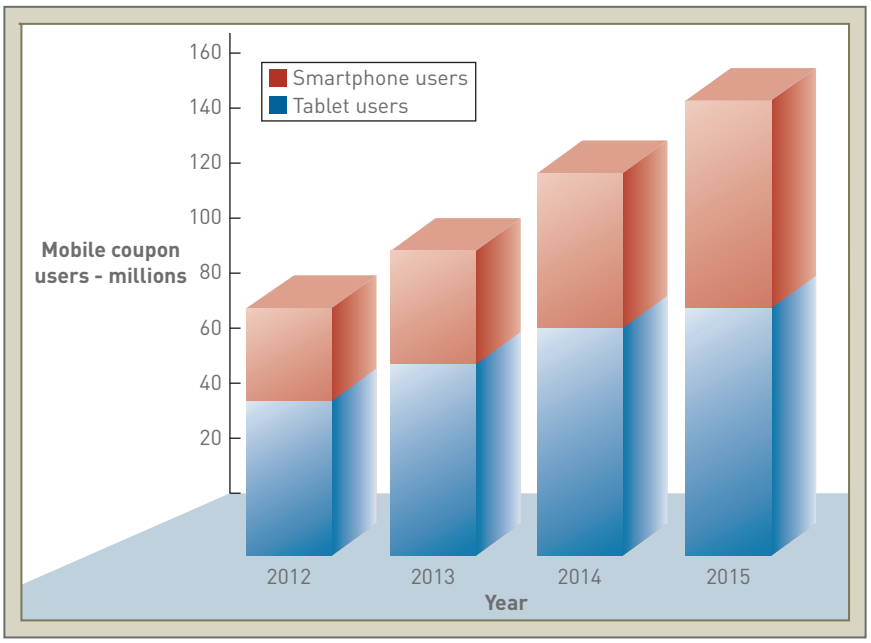


FIGURE **5.5**

Growth in U.S. mobile coupon users

The number of mobile coupon redeemers is increasing significantly.

FIGURE **5.6**

Mobile investment and finance

Investment firms provide mobile trading apps to support clients on the go.

ideas from research and analysts' opinions, and execute trades from their Apple, BlackBerry, or Android mobile devices.[27]

Banking

Online banking customers can check balances of their savings, checking, and loan accounts; transfer money among accounts; and pay their bills. These customers enjoy the convenience of not writing checks by hand, of tracking their current balances, and of reducing expenditures on envelopes and stamps. In addition, paying bills online is good for the environment because it reduces the amount of paper used, thus saving trees and reducing greenhouse gases.

All of the major banks and many smaller ones in the United States enable their customers to pay bills online; many support bill payment via cell phone or other wireless device. Banks are eager to gain more customers who pay

bills online because such customers tend to stay with the bank longer, have higher cash balances, and use more of the bank's products and services. To encourage the use of this service, many banks have eliminated all fees associated with online bill payment.

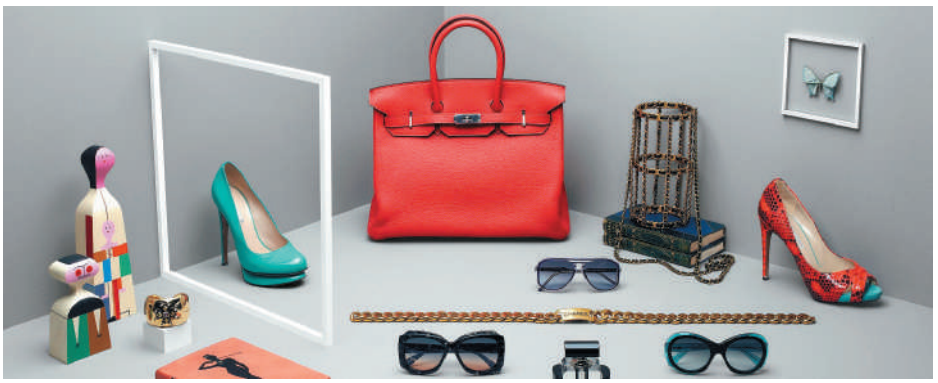
Consumers who have enrolled in mobile banking and downloaded the mobile application to their cell phones can check their credit card balances before making major purchases and can avoid credit rejections. They can also transfer funds from savings to checking accounts to avoid an overdraft.

M-Pesa (M for mobile, Pesa for money in Swahili) with some 20 million users worldwide is considered by many to be the most developed mobile payment system in the world. The service is operated by Safaricom and Vodacom, the largest mobile network operators in Kenya and Tanzania. M-Pesa enables users with a national ID card or passport to deposit, withdraw, and transfer money easily with a mobile device. Its services have expanded from a basic mobile money transfer scheme to include loans and savings products, bill pay, and salary disbursements.[28]

E-Boutiques

An increasing number of Web sites offer personalized shopping consultations for shoppers interested in upscale, contemporary clothing—dresses, sportswear, denim apparel, handbags, jewelry, shoes, and gifts. Key to the success of Web sites such as Charm Boutique and ShopLaTiDa is a philosophy of high customer service and strong, personal client relationships. Online boutique shoppers complete a personal shopping profile by answering questions about body measurements, profession, interests, preferred designers, and areas of shopping where they would welcome assistance. Shoppers are then given suggestions on what styles and designers might work best and where they can be found—online or in brick-and-mortar shops.

Quintessentially Gifts is a luxury gifts and shopping service whose researchers and editorial stylists can find the rarest and most exquisite gifts for the affluent shopper. See Figure 5.7. From a McQueen Luxury Dive Toy's underwater scooter to a Hermes Birkin handbag sans the usual two-year wait, the gift team can get it for you.[29]



Source: www.quintessentiallygifts.com

FIGURE **5.7**

Luxury gifts online

Quintessentially Gifts is an online shopping service that features unusual luxury gifts.

Advantages of Electronic and Mobile Commerce

Conversion to an e-commerce or m-commerce system enables organizations to reduce the cost of doing business, speed the flow of goods and information, increase the accuracy of order processing and order fulfillment, and improve the level of customer service. These advantages are summarized in Table 5.4.

Now that we've examined several e-commerce and m-commerce applications, let's look at the key components of technology infrastructure that must be in place to make this all work.

TABLE 5.4 Advantages of electronic and mobile commerce

Advantages	Explanation
Provides global reach	Allows manufacturers to buy at a low cost worldwide and offers enterprises the chance to sell to a global market right from the very start-up of their business.
Reduces costs	Eliminates time-consuming and labor-intensive steps throughout the order and delivery process so that more sales can be completed in the same period and with increased accuracy.
Speeds flow of goods and information	The flow of information is accelerated because of the established electronic connections and communications processes.
Increases accuracy	Enables buyers to enter their own product specifications and order information directly so that human data-entry error is eliminated.
Improves customer service	Increased and more detailed information about delivery dates and current status increases customer loyalty.

E-COMMERCE AND M-COMMERCE TECHNOLOGY INFRASTRUCTURE

Successful implementation of e-business requires significant changes to existing business processes and substantial investment in IS technology. These technology components must be chosen carefully and be integrated to support a large volume of transactions with customers, suppliers, and other business partners worldwide. Online consumers complain that poor Web site performance (e.g., slow response time, inadequate customer support, and lost orders) drives them to abandon some e-commerce sites in favor of those with better, more reliable performance. This section provides a brief overview of the key technology infrastructure components. See Figure 5.8.

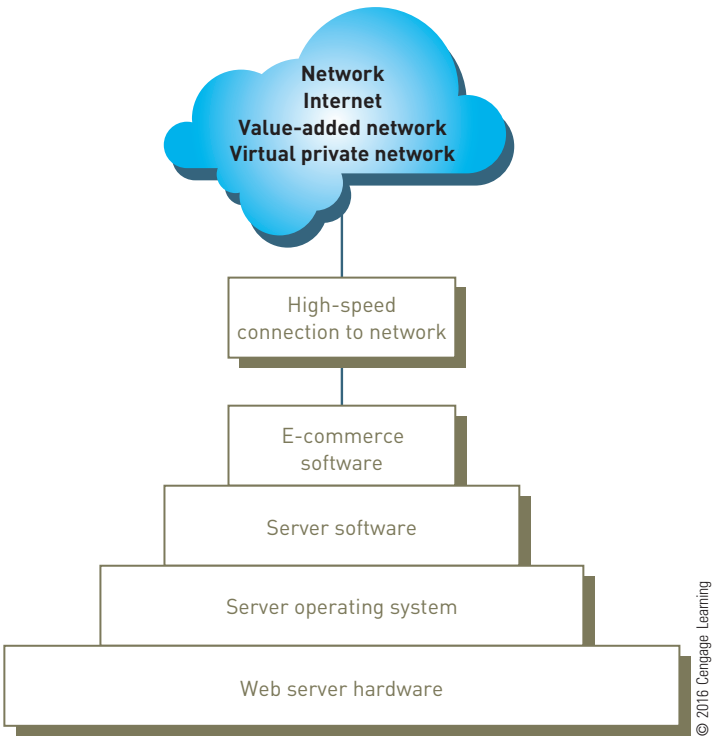


FIGURE **5.8**

Key technology infrastructure components

E-commerce systems require specific kinds of hardware and software to be successful.

Hardware

A Web server hardware platform complete with the appropriate software is a key ingredient to e-commerce infrastructure. The amount of storage capacity and computing power required of the Web server depends primarily on two things: the software that must run on the server and the volume of e-commerce transactions that must be processed. The most successful e-commerce solutions are designed to be highly scalable so that they can be upgraded to meet unexpected user traffic.

Key Web site performance measures include response time, transaction success rate, and system availability. Table 5.5 shows the values for the key measures for four popular online retailers for one week.

TABLE 5.5 Key performance measures for popular retail Web sites

Retail Apparel Firm	Response Time (seconds)	Success Rate	Outage Time During One Week
Abercrombie	4.64	98.6%	1 hour
Macy's	6.81	99.5%	0 hours
Sears	12.90	99.1%	1 hour
J Crew	7.89	97.7%	1 hour
Saks Fifth Avenue	10.59	95.7%	2 hours

Source: "Keynote Online Retail Transaction Indices," *e-Commerce Times*, *www.ecommercetimes.com/web-performance*, February 15, 2014.

A key decision facing a new e-commerce company is whether to host its own Web site or to let someone else do it. Many companies decide that using a third-party Web service provider is the best way to meet initial e-commerce needs. The third-party company rents space on its computer system and provides a high-speed connection to the Internet, thus minimizing the initial out-of-pocket costs for e-commerce start-up. The third party can also provide personnel trained to operate, troubleshoot, and manage the Web server.

Web Server Software

In addition to the Web server operating system, each e-commerce Web site must have Web server software to perform fundamental services, including security and identification, retrieval and sending of Web pages, Web site tracking, Web site development, and Web page development. The two most widely used Web server software packages are Apache HTTP Server and Microsoft Internet Information Services.

E-Commerce Software

After you have located or built a host server, including the hardware, operating system, and Web server software, you can begin to investigate and install e-commerce software to support five core tasks: catalog management to create and update the product catalog, product configuration to help customers select the necessary components and options, shopping cart facilities to track the items selected for purchase (see Figure 5.9), e-commerce transaction processing, and Web traffic data analysis to provide details to adjust the operations of the Web site.

Mobile Commerce Hardware and Software

For m-commerce to work effectively, the interface between the wireless, handheld device and its user must improve to the point that it is nearly as easy to purchase an item on a wireless device as it is to purchase it on a PC.

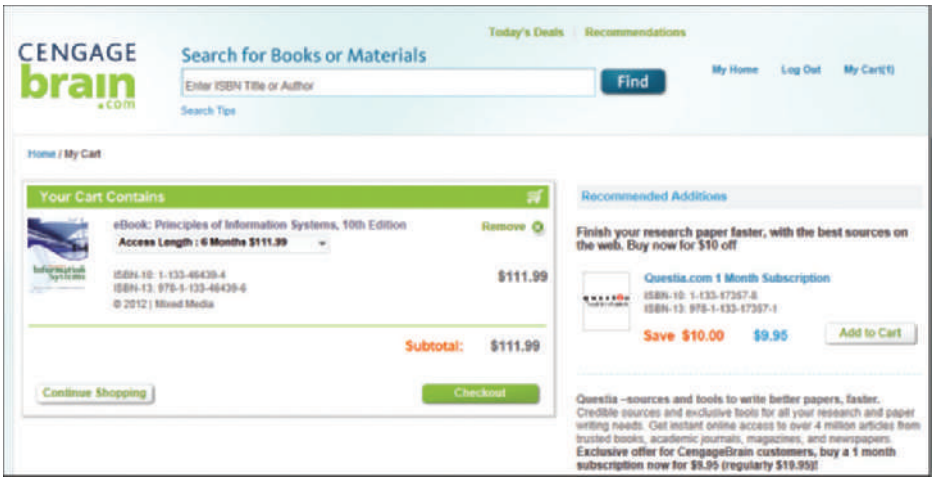


FIGURE **5.9**

Electronic shopping cart

An electronic shopping cart allows online shoppers to view their selections and add or remove items.

In addition, network speed must improve so that users do not become frustrated. Security is also a major concern, particularly in two areas: the security of the transmission itself and the trust that the transaction is being made with the intended party. Encryption can provide secure transmission. Digital certificates, discussed later in this chapter, can ensure that transactions are made between the intended parties.

The handheld devices used for m-commerce have several limitations that complicate their use. Their screens are small, perhaps no more than a few square inches, and might be able to display only a few lines of text. Their input capabilities are limited to a few buttons, so entering data can be tedious and error prone. They also have less processing power and less bandwidth than desktop or laptop computers, which are usually connected to a high-speed LAN. They also operate on limited-life batteries. For these reasons, it is currently impossible to directly access many Web sites with a handheld device. Web developers must rewrite Web applications so that users with handheld devices can access them.

To address the limitations of wireless devices, the industry has undertaken a standardization effort for their Internet communications. The Wireless Application Protocol (WAP) is a standard set of specifications for Internet applications that run on handheld, wireless devices. It effectively serves as a Web browser for such devices.

Electronic Payment Systems

Electronic payment systems are a key component of the e-commerce infrastructure. Current e-commerce technology relies on user identification and encryption to safeguard business transactions. Actual payments are made in a variety of ways, including electronic cash, electronic wallets, and smart, credit, charge, and debit cards. Web sites that accept multiple payment types convert more visitors to purchasing customers than merchants who offer only a single payment method.

Authentication technologies are used by many organizations to confirm the identity of a user requesting access to information or assets. A **digital certificate** is an attachment to an e-mail message or data embedded in a Web site that verifies the identity of a sender or Web site. A **certificate authority (CA)** is a trusted third-party organization or company that issues digital certificates. The CA is responsible for guaranteeing that the people or organizations granted these unique certificates are in fact who they claim to be. Digital certificates thus create a trust chain throughout the transaction, verifying both purchaser and supplier identities.

digital certificate: An attachment to an e-mail message or data embedded in a Web site that verifies the identity of a sender or Web site.

certificate authority (CA): A trusted third-party organization or company that issues digital certificates.

Secure Sockets Layer

Secure Sockets Layer (SSL): A communications protocol used to secure sensitive data during e-commerce.

All online shoppers fear the theft of credit card numbers and banking information. To help prevent this type of identity theft, the **Secure Sockets Layer (SSL)** communications protocol is used to secure sensitive data. The SSL communications protocol includes a handshake stage, which authenticates the server (and the client, if needed), determines the encryption and hashing algorithms to be used, and exchanges encryption keys. Following the handshake stage, data might be transferred. The data is always encrypted, ensuring that your transactions are not subject to interception or "sniffing" by a third party. Although SSL handles the encryption part of a secure e-commerce transaction, a digital certificate is necessary to provide server identification. The e-commerce world was shaken when it was discovered that the Heartbleed bug in OpenSSL (an open source implementation of SSL) may have left almost two-thirds of all active Web sites susceptible to attacks to read sensitive data on the Web server.[30]

Electronic Cash

electronic cash: An amount of money that is computerized, stored, and used as cash for e-commerce transactions.

Electronic cash is an amount of money that is computerized, stored, and used as cash for e-commerce transactions. Typically, consumers must open an account with an electronic cash service provider by providing identification information. When the consumers want to withdraw electronic cash to make a purchase, they access the service provider via the Internet and present proof of identity—a digital certificate issued by a certification authority or a username and password. After verifying a consumer's identity, the system debits the consumer's account and credits the seller's account with the amount of the purchase. PayPal, BillMeLater, MoneyZap, and TeleCheck are four popular forms of electronic cash.

PayPal enables any person or business with an email address to securely, easily, and quickly send and receive payments online. To send money, you enter the recipient's email address and the amount you want to send. You can pay with a credit card, debit card, or funds from a checking account. The recipient gets an email message that says, "You've Got Cash!" Recipients can then collect their money by clicking a link in the email message that takes them to *www.paypal.com*. To receive the money, the user also must have a credit card or checking account to accept fund transfers. To request money for an auction, invoice a customer, or send a personal bill, you enter the recipient's email address and the amount you are requesting. The recipient gets an email message and instructions on how to pay you using PayPal. Today over 140 million Internet users use PayPal to send money and some 90 percent of eBay purchases go through PayPal.[31]

Credit, Charge, Debit, and Smart Cards

Many online shoppers use credit and charge cards for most of their Internet purchases. A credit card, such as Visa or MasterCard, has a preset spending limit based on the user's credit history, and each month the user can pay all or part of the amount owed. Interest is charged on the unpaid amount. A charge card, such as American Express, carries no preset spending limit, and the entire amount charged to the card is due at the end of the billing period. Charge cards do not involve lines of credit and do not accumulate interest charges. American Express became the first company to offer disposable credit card numbers in 2000. Other banks, such as Citibank, protect the consumer by providing a unique number for each transaction. Debit cards look like credit cards, but they operate like cash or a personal check. Credit, charge, and debit cards currently store limited information about you on a magnetic strip. This information is read each time the card is swiped to make a purchase. All credit card customers are protected by law from paying more than $50 for fraudulent transactions.

smart card: A credit card–sized device with an embedded microchip to provide electronic memory and processing capability.

The **smart card** is a credit card–sized device with an embedded microchip to provide electronic memory and processing capability. Smart cards can be used for a variety of purposes, including storing a user's financial facts, health insurance data, credit card numbers, and network identification codes and passwords. They can also store monetary values for spending.

Smart cards are better protected from misuse than conventional credit, charge, and debit cards because the smart-card information is encrypted. Conventional credit, charge, and debit cards clearly show your account number on the face of the card. The card number, along with a forged signature, is all that a thief needs to purchase items and charge them against your card. A smart card makes credit theft practically impossible because a key to unlock the encrypted information is required, and there is no external number that a thief can identify and no physical signature a thief can forge. Table 5.6 compares various types of payment systems.

TABLE 5.6 Comparison of payment systems

Payment System	Description	Advantages	Disadvantages
Credit card	Carries preset spending limit based on the user's credit history	Each month the user can pay all or part of the amount owed	Unpaid balance accumulates interest charges—often at a high rate of interest
Charge card	Looks like a credit card but carries no preset spending limit	Does not involve lines of credit and does not accumulate interest charges	The entire amount charged to the card is due at the end of the billing period
Debit card	Looks like a credit card or automated teller machine (ATM) card	Operates like cash or a personal check	Money is immediately deducted from user's account balance
Smart card	Is a credit card device with embedded microchip capable of storing facts about card holder	Better protected from misuse than conventional credit, charge, and debit cards because the smart card information is encrypted	Not widely used in the United States

p-card (procurement card or purchasing card): A credit card used to streamline the traditional purchase order and invoice payment processes.

P-Cards

A **p-card (procurement card or purchasing card)** is a credit card used to streamline the traditional purchase order and invoice payment processes. The p-card is typically issued to selected employees who must follow company rules and guidelines that may include a single purchase limit, a monthly spending limit, or merchant category code restrictions. Due to an increased risk of unauthorized purchases, each p-card holder's spending activity is reviewed periodically by someone independent of the cardholder to ensure adherence to the guidelines. Spending on p-cards has increased from $196 billion in 2012 to $229 billion in 2013.[32]

Payments Using Cell Phones

The use of cell phones has become commonplace to make purchases and transfer funds between consumers. Two options are available: payments linked to your bank account and payments added to your phone bill. The goals are to make the payment process as simple and secure as possible and for it to work on many different phones and through many different cell phone service providers—not simple tasks. Fortunately, the intelligence built into the iPhone and other smartphones can make this all possible.

You can use several services (e.g., Phone Transact iMerchant Pro, Square, RoamPay, and PayWare Mobile) to plug a credit card reader device into the

headphone jack on a cell phone to accept credit card payments. Intuit's GoPayment service does not require a credit card reader but provides software that lets you enter the credit card number.

With Xipwire, consumers can text someone with a special code to place a purchase on their monthly phone bill and bypass any credit card system altogether. A free Starbucks Card Mobile app that runs on iPhones, iPod Touches, and some BlackBerry smartphones enables customers to pay for their java by holding their mobile device in front of a scanner that reads the app's on-screen barcode. Registered customers link their credit card information to their Starbucks.com account.

AN OVERVIEW OF TRANSACTION PROCESSING SYSTEMS

Every organization has many *transaction processing systems (TPSs)*, which capture and process the detailed data necessary to update records about the fundamental business operations of the organization. These systems include order entry, inventory control, payroll, accounts payable, accounts receivable, and the general ledger, to name just a few. The input to these systems includes basic business transactions, such as customer orders, purchase orders, receipts, time cards, invoices, and customer payments. The processing activities include data collection, data editing, data correction, data manipulation, data storage, and document production. The result of processing business transactions is that the organization's records are updated to reflect the status of the operation at the time of the last processed transaction.

A TPS also provides employees involved in other business processes—via management information system/decision support system (MIS/DSS) and the special-purpose information systems—with data to help them achieve their goals. (MIS/DSS systems are discussed in Chapter 6.) A transaction processing system serves as the foundation for these other systems. See Figure 5.10.

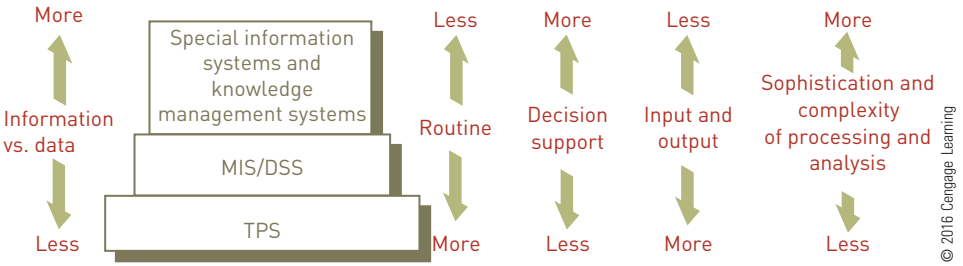


FIGURE **5.10**

TPS, MIS/DSS, and special information systems in perspective

A TPS provides valuable input to MIS, DSS, and KM systems.

TPSs support routine operations associated with customer ordering and billing, employee payroll, purchasing, and accounts payable. The amount of support for decision making that a TPS directly provides managers and workers is low.

TPSs work with a large amount of input and output data and use this data to update the official records of the company about such things as orders, sales, and customers. As systems move from transaction processing to management information/decision support and special-purpose information systems, they involve less routine, more decision support, less input and output, and more sophisticated and complex analysis. These higher-level systems require the basic business transaction data captured by the TPS.

For example, Policy Bazaar is an Indian organization that provides online life insurance comparisons. The firm employs 800 workers and is growing rapidly. Policy Bazaar moved from an Excel and paper-based payroll to a fully automated payroll transaction processing system. As a result, the

accuracy of payroll processing has been improved, the total cost has been reduced, and the firm is able to provide an employee self-service portal to support special reimbursements and tax return filings.[33]

Traditional Transaction Processing Methods and Objectives

batch processing system: A form of data processing whereby business transactions are accumulated over a period of time and prepared for processing as a single unit or batch.

With **batch processing systems**, business transactions are accumulated over a period of time and prepared for processing as a single unit or batch. See Figure 5.11a. Transactions are accumulated for as long as necessary to meet the needs of the users of that system. For example, it might be important to process invoices and customer payments for the accounts receivable system daily. On the other hand, the payroll system might receive time cards and process them biweekly to create checks, update employee earnings records, and distribute labor costs. The essential characteristic of a batch processing system is that there is some delay between an event and the eventual processing of the related transaction to update the organization's records.

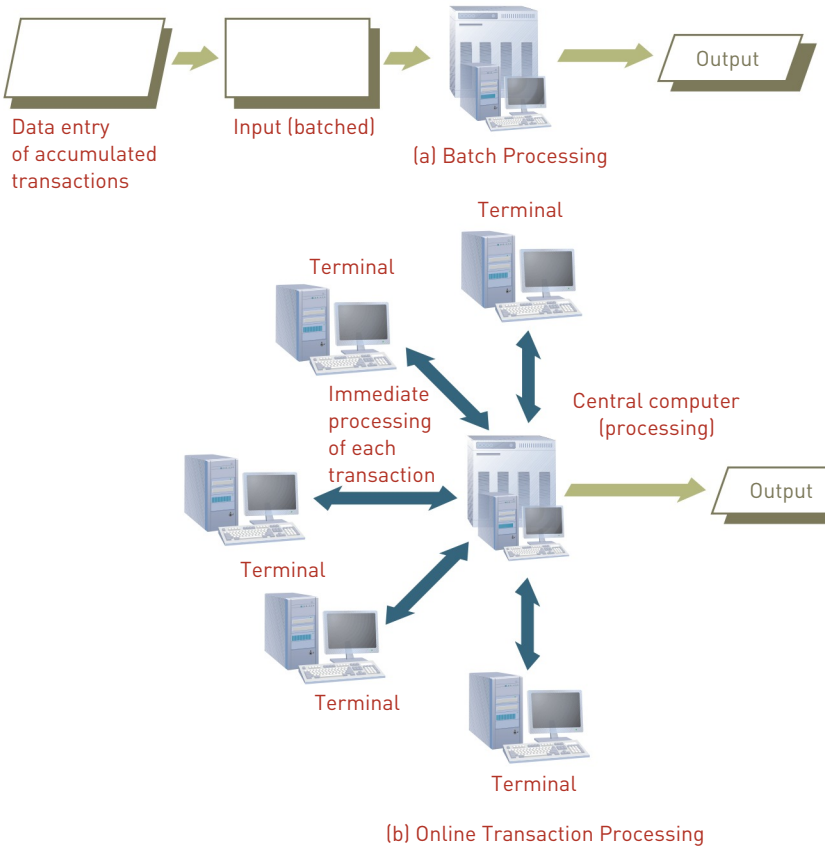


FIGURE **5.11**

Batch versus online transaction processing

(a) Batch processing inputs and processes data in groups. (b) In online processing, transactions are completed as they occur.

Spectrum Family Medical is a five-provider practice in Maryland that employs a batch processing billing system. The practice averages 1,200 patient visits per month, but sends claims to medical insurance companies within two days and sends bills to patients within one day.[34]

online transaction processing (OLTP): A form of data processing where each transaction is processed immediately, without the delay of accumulating transactions into a batch.

With **online transaction processing (OLTP)**, each transaction is processed immediately, without the delay of accumulating transactions into a batch. See Figure 5.11b. Consequently, at any time, the data in an online system reflects the current status. This type of processing is essential for businesses that require access to current data such as airlines, ticket agencies, and stock investment firms. Many companies find that OLTP helps them provide faster, more efficient service—one way to add value to their activities in the eyes of the customer. More and more companies are using the Internet to capture and process

transaction data such as customer orders and shipping information from e-commerce applications. With over 143 million active accounts around the world, PayPal employs a massive OLTP system to process some 9 million payments every day (over 100 payment transactions per second).[35]

The specific business needs and goals of the organization define the method of transaction processing best suited for the various applications of the company. Increasingly, the need for current data for decision making is driving many organizations to move from batch processing systems to online transaction processing systems when it is economically feasible. For example, the State of Wisconsin Department of Health Services (DHS) runs the Women, Infants, and Children (WIC) program. WIC's goal is to support and sustain the health and well-being of nutritionally at-risk pregnant, breastfeeding, and postpartum women, as well as their infants and children. DHS employed a batch processing system to manage this program, and processed the WIC data in a batch at the end of the day. This practice created a built-in delay in obtaining information needed for decision-making and government-reporting requirements. However, DHS needs up-to-date data to avoid dual participation incidents, such as a client or caregiver receiving more WIC checks than allowed for one month, or receiving WIC checks and the Commodity Supplemental Food Program (CSFP) payments at the same time. DHS moved to an online transaction processing system to ensure that all data is now available on a current basis. The system is Web-based and WIC staff needs only a Web browser and secure Internet access to work with the data.[36]

Figure 5.12 shows the flow of key pieces of information from one TPS to another for a typical manufacturing organization. TPSs can be designed so that the flow of information from one system to another is automatic and requires no manual intervention or reentering of data. Such a set of systems is called an *integrated information system*. Many organizations have limited or no integration among their TPSs. In this case, data input to one TPS must be printed out and manually reentered into other systems. Of course, this increases the amount of effort required and introduces the likelihood of processing delays and errors.

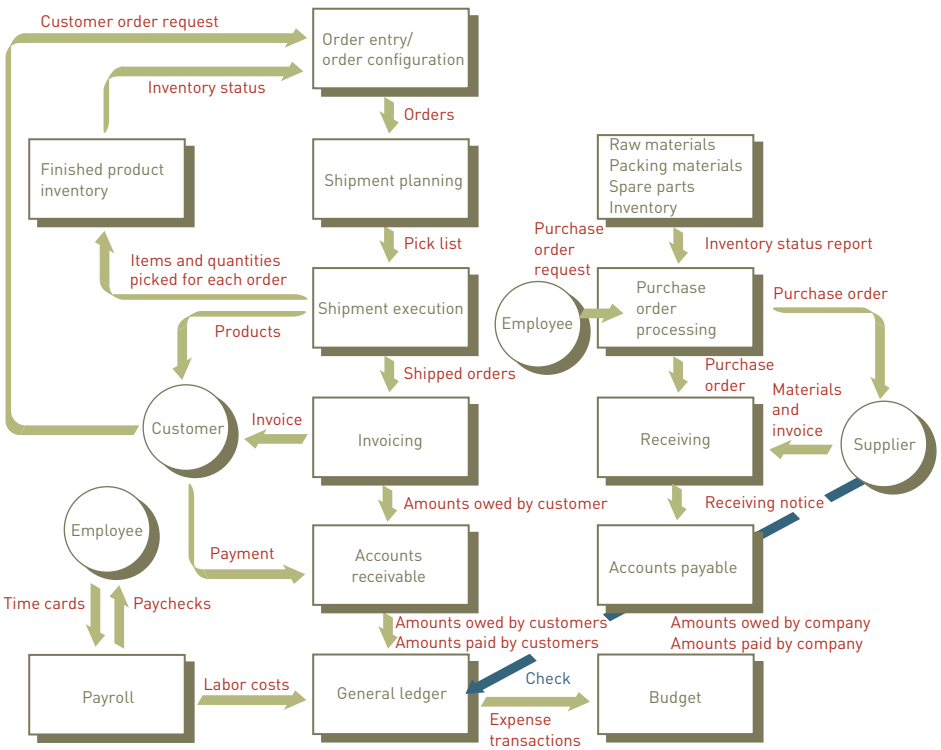


FIGURE **5.12**

Integration of a firm's TPS

When transactions entered into one system are processed, they create new transactions that flow into another system.

Because of the importance of transaction processing, organizations expect their TPSs to accomplish a number of specific objectives including:

- Process data generated by and about transactions
- Maintain a high degree of accuracy and integrity
- Avoid processing fraudulent transactions
- Produce timely user responses and reports
- Increase labor efficiency
- Help improve customer service and/or loyalty

Depending on the specific nature and goals of the organization, any of these objectives might be more important than others. By meeting these objectives, TPSs can support corporate goals such as reducing costs; increasing productivity, quality, and customer satisfaction; and running more efficient and effective operations. For example, overnight delivery companies such as FedEx expect their TPSs to increase customer service. These systems can locate a client's package at any time—from initial pickup to final delivery. This improved customer information allows companies to produce timely information and be more responsive to customer needs and queries.

A TPS typically includes the following types of systems:

- **Order processing systems.** Running these systems efficiently and reliably is so critical that the order processing system is sometimes referred to as the lifeblood of the organization. The processing flow begins with the receipt of a customer order. The finished product inventory is checked to see if sufficient inventory is on hand to fill the order. If sufficient inventory is available, the customer shipment is planned to meet the customer's desired receipt date. A product pick list is printed at the warehouse from which the order is to be filled on the day the order is planned to be shipped. At the warehouse, workers gather the items needed to fill the order and enter the item identifier and quantity for each item to update the finished product inventory. When the order is complete and sent on its way, a customer invoice is created with a copy included in the customer shipment.
- **Purchasing systems.** The traditional transaction processing systems that support the purchasing business function include inventory control, purchase order processing, receiving, and accounts payable. Employees place purchase order requests in response to shortages identified in inventory control reports. Purchase order information flows to the receiving system and accounts payable systems. A record is created upon receipt of the items ordered. When the invoice arrives from the supplier, it is matched to the original order and the receiving report, and a check is generated if all data is complete and consistent.
- **Accounting systems.** The accounting systems must track the flow of data related to all the cash flows that affect the organization. As mentioned earlier, the order processing system generates an invoice for customer orders to include with the shipment. This information is also sent to the accounts receivable system to update the customer's account. When the customer pays the invoice, the payment information is also used to update the customer's account. The necessary accounting transactions are sent to the general ledger system to keep track of amounts owed and amounts paid. Similarly, as the purchasing systems generate purchase orders and those items are received, information is sent to the accounts payable system to manage the amounts owed by the company. Data about amounts owed and paid by customers to the company and from the company to vendors and others are sent to the general ledger system, which records and reports all financial transactions for the company.

In the past, organizations knitted together a hodgepodge of systems to accomplish the transaction processing activities shown in Figure 5.12. Some of

the systems might have been applications developed using in-house resources, some may have been developed by outside contractors, and others may have been off-the-shelf software packages. Much customization and modification of this diverse software was necessary for all the applications to work together efficiently. In some cases, it was necessary to print data from one system and then manually reenter it into other systems. Of course, this increased the amount of effort required and increased the likelihood of processing delays and errors.

The approach taken today by many organizations is to implement an integrated set of transaction processing systems from a single or limited number of software vendors that handle most or all of the transaction processing activities shown in Figure 5.12. The data flows automatically from one application to another with no delay or need to reenter data. For example, Zoës Kitchen is a chain of Mediterranean-influenced casual food restaurants with 16 locations in Alabama and neighboring states. The firm implemented a set of integrated systems across its multiple locations to manage food and labor costs, improve cash management, perform weekly reconciliation of cash and credit cards, and simplify the weekly bank reconciliation.[37]

Transaction Processing Systems for Entrepreneurs and Small and Medium-Sized Enterprises

Many software packages provide integrated TPS solutions for small and medium-sized enterprises (SMEs), wherein the SME is a legally independent enterprise with no more than 500 employees. Integrated transaction processing systems for SMEs are typically easy to install and operate and usually have a low total cost of ownership, with an initial cost of a few hundred to a few thousand dollars. Such solutions are highly attractive to firms that have outgrown their current software but cannot afford a complex, high-end integrated system solution. Table 5.7 presents some of the dozens of such software solutions available.

TABLE 5.7 Sample of integrated TPS solutions for SMEs

Vendor	Software	Type of TPS Offered	Target Customers
AccuFund	AccuFund	Financial reporting and accounting	Nonprofit, municipal, and government organizations
OpenPro	OpenPro	Complete ERP solution, including financials, supply chain management, e-commerce, customer relationship management, and retail POS system	Manufacturers, distributors, and retailers
Intuit	QuickBooks	Financial reporting and accounting	Manufacturers, professional services, contractors, nonprofits, and retailers
Sage	Timberline	Financial reporting, accounting, and operations	Contractors, real estate developers, and residential builders
Redwing	TurningPoint	Financial reporting and accounting	Professional services, banks, and retailers

QuickBooks is accounting software from Intuit that SMEs use to easily maintain their accounting records. In India, hundreds of companies are subsidiaries of much larger foreign companies. Quite often, these subsidiaries adopt QuickBooks to maintain all their accounts in an accurate and consistent manner. Users can maintain a customer database and record customer payments as well as keep track of current balances. The software makes it easy to create a supplier database and write checks to pay for goods and services.[38]

Qvinci.web allows companies to collect QuickBooks data from many locations and format that data into the company's standardized chart of accounts.

Financial managers at various SMEs, such as Anytime Fitness, Christian Brothers Automotive, Dairy Queen, Sunoco Oil & Gas, The UPS Store, and Wellness Center, use QuickBooks to create predefined financial reports.[39]

TRANSACTION PROCESSING ACTIVITIES

Along with having common characteristics, all TPSs perform a common set of basic data-processing activities. TPSs capture and process data that describes fundamental business transactions. This data is used to update databases and to produce a variety of reports for people both within and outside the enterprise. The business data goes through a **transaction processing cycle** that includes data collection, data editing, data correction, data processing, data storage, and document production. See Figure 5.13.

transaction processing cycle: The process of data collection, data editing, data correction, data processing, data storage, and document production.

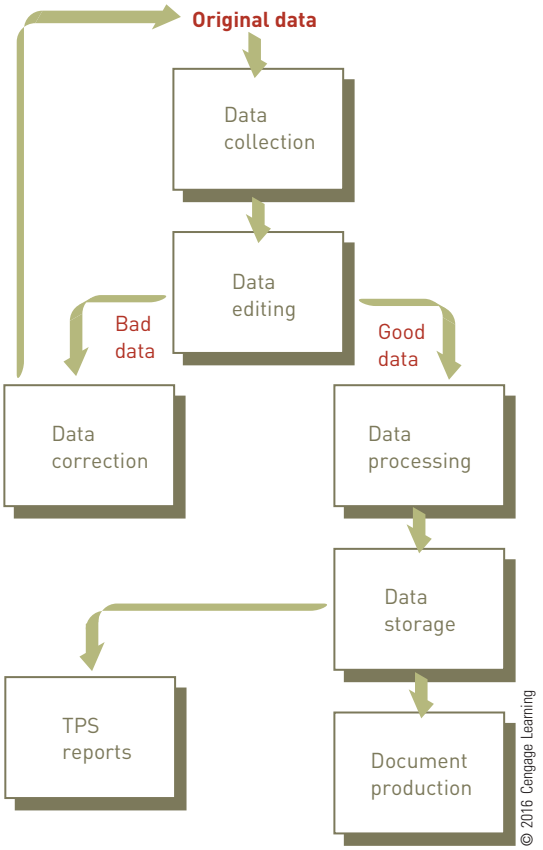


FIGURE **5.13**

Transaction processing activities

A transaction processing cycle includes data collection, data editing, data correction, data processing, data storage, and document production.

Data Collection

Capturing and gathering all data necessary to complete the processing of transactions is called **data collection**. In some cases, it can be done manually, such as by collecting handwritten sales orders or changes to inventory. In other cases, data collection is automated via special input devices such as scanners, point-of-sale (POS) devices, and terminals.

data collection: Capturing and gathering all data necessary to complete the processing of transactions.

Data collection begins with a transaction (e.g., taking a customer order) and results in data that serves as input to the TPS. Data should be captured at its source and recorded accurately in a timely fashion with minimal manual effort and in an electronic or digital form that can be directly entered into the computer. This approach is called **source data automation**. An example of source data automation is an automated device at a retail store that speeds the checkout process—either UPC codes read by a scanner or RFID signals picked up when the items approach the checkout stand. Using UPC bar

source data automation: Capturing data at its source and recording it accurately in a timely fashion with minimal manual effort and in an electronic or digital form that it can be directly entered into the computer.

codes or RFID tags is quicker and more accurate than having a clerk enter codes manually at the cash register. The product ID for each item is determined automatically, and its price retrieved from the item database. The point-of-sale TPS uses the price data to determine the customer's bill. The store's inventory and purchase databases record the number of units of an item purchased, along with the price and the date and time of the purchase. The inventory database generates a management report notifying the store manager to reorder items that have fallen below the reorder quantity. The detailed purchases database can be used by the store or sold to marketing research firms or manufacturers for detailed sales analysis. See Figure 5.14.

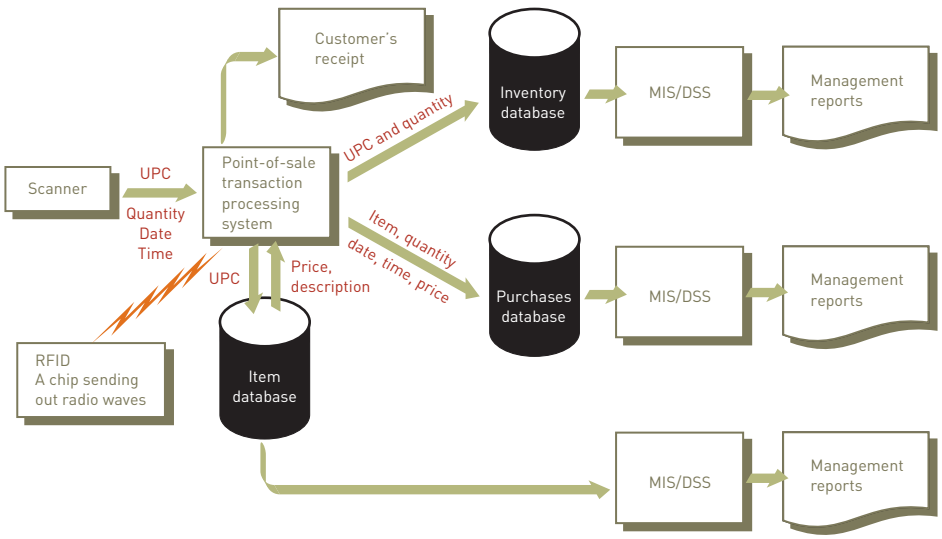


FIGURE **5.14**

Point-of-sale transaction processing system

The purchase of items at the checkout stand updates a store's inventory database and its database of purchases.

Many grocery stores combine point-of-sale scanners and coupon printers. The systems are programmed so that each time a specific product—for example, a box of cereal—crosses a checkout scanner, an appropriate coupon, perhaps a milk coupon, is printed. Companies can pay to be promoted through the system, which is then reprogrammed to print those companies' coupons if the customer buys a competitive brand. These TPSs help grocery stores increase profits by improving their repeat sales and bringing in revenue from other businesses.

Many mobile POS systems operate on mobile devices such as iPads, iPhones, and iPod Touches. Some mobile POS systems include marketing tools that SMEs can use to thank first-time customers and send automated emails to longtime customers that have not visited recently. The owner of the China Baroque jewelry store implemented a mobile POS that provides a reporting feature to enable her to see exactly what jewelry is selling the most and in which store location the sales were made. This enables her to make better production and buying decisions.[40]

Cloud-based POS systems provide a range of capabilities including advanced integration with digital loyalty programs, various accounting tools, and the ability to generate gift cards and coupons. An SME can implement such a system for a few thousand dollars compared to more traditional cash register-based POS systems that can cost tens of thousands.[41]

Data Editing

data editing: The process of checking data for validity and completeness.

An important step in processing transaction data is to check data for validity and completeness to detect any problems, a task called **data editing**. For example, quantity and cost data must be numeric, and names must be alphabetic; otherwise, the data is not valid. Often, the codes associated with an individual transaction are edited against a database containing valid codes. If

any code entered (or scanned) is not present in the database, the transaction is rejected.

Data Correction

It is not enough simply to reject invalid data. The system should also provide error messages that alert those responsible for editing the data. Error messages must specify the problem so proper corrections can be made. A **data correction** involves reentering data that was not typed or scanned properly. For example, a scanned UPC code must match a code in a master table of valid UPCs. If the code is misread or does not exist in the table, the checkout clerk is given an instruction to rescan the item or type the information manually.

data correction: The process of reentering data that was not typed or scanned properly.

Data Processing

Another major activity of a TPS is **data processing**, the process of performing calculations and other data transformations related to business transactions. Data manipulation can include classifying data, sorting data into categories, performing calculations, summarizing results, and storing data in the organization's database for further processing. In a payroll TPS, for example, data processing includes multiplying an employee's hours worked by the hourly pay rate. Overtime pay, federal and state tax withholdings, and deductions are also calculated.

data processing: The process of performing calculations and other data transformations related to business transactions.

Data Storage

Data storage involves updating one or more databases with new transactions. After being updated, this data can be further processed by other systems so that it is available for management reporting and decision making. Thus, although transaction databases can be considered a by-product of transaction processing, they have a pronounced effect on nearly all other information systems and decision-making processes in an organization.

data storage: The process of updating one or more databases with new transactions.

Document Production

Document production involves generating output records, documents, and reports. These can be hard-copy paper reports or displays on computer screens (sometimes referred to as soft copy). Printed paychecks, for example, are hard-copy documents produced by a payroll TPS, whereas an outstanding balance report for invoices might be a soft-copy report displayed by an accounts receivable TPS. Often, as shown earlier in Figure 5.14, results from one TPS flow downstream to become input to other systems, which might use the results of updating the inventory database to create the stock exception report, a type of management report showing items with inventory levels below the reorder point.

In addition to major documents such as checks and invoices, most TPSs provide other useful management information, such as printed or on-screen reports that help managers and employees perform various activities. A report showing current inventory is one example; another might be a document listing items ordered from a supplier to help a receiving clerk check the order for completeness when it arrives. A TPS can also produce reports required by local, state, and federal agencies, such as statements of tax withholding and quarterly income statements.

document production: The process of generating output records, documents, and reports.

ENTERPRISE RESOURCE PLANNING

An **enterprise system** is central to an organization and ensures information can be shared across all business functions and all levels of management to support the running and managing of a business. Enterprise systems employ a database of key operational and planning data that can be shared by all. See Figure 5.15. This eliminates the problems of lack of information and

enterprise system: A system central to the organization that ensures information can be shared across all business functions and all levels of management to support the running and managing of a business.

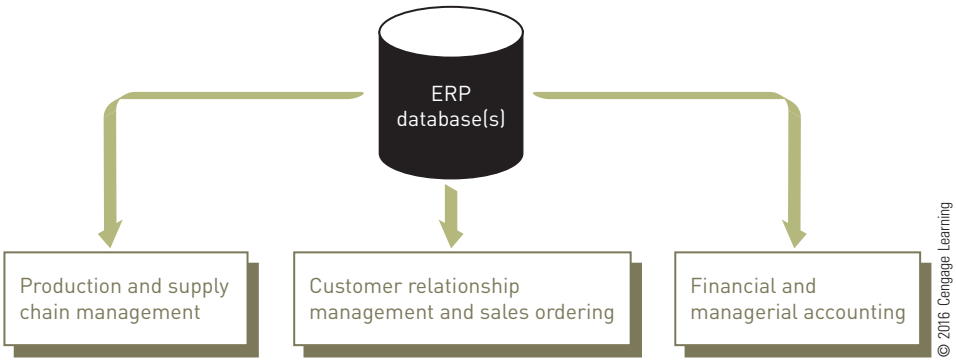


FIGURE **5.15**

Enterprise resource planning system

An ERP integrates business processes and the ERP database.

inconsistent information caused by multiple transaction processing systems that support only one business function or one department in an organization. Examples of enterprise systems include enterprise resource planning systems that support supply-chain processes, such as order processing, inventory management, and purchasing, and customer relationship management systems that support sales, marketing, and customer service-related processes.

Businesses rely on such systems to perform many of their daily activities in areas such as product supply, distribution, sales, marketing, human resources, manufacturing, accounting, and taxation so that work is performed quickly, while avoiding waste and mistakes. Without such systems, recording and processing business transactions would consume huge amounts of an organization's resources. This collection of processed transactions also forms a storehouse of data invaluable to decision making. The ultimate goal is to satisfy customers and provide a competitive advantage by reducing costs and improving service.

An Overview of Enterprise Resource Planning

ERP systems evolved from materials requirement planning systems (MRP) that tied together the production planning, inventory control, and purchasing business functions for manufacturing organizations. Many organizations recognized that their legacy transaction processing systems lacked the integration needed to coordinate activities and share valuable information across all the business functions of the firm. As a result, costs were higher and customer service poorer than desired. Firms are now scrapping large parts of their existing information systems and converting to new ERP systems. Large organizations, specifically members of the *Fortune* 1000, were the first to take on the challenge of implementing ERP. As they did, they uncovered many advantages as well as some disadvantages summarized in the following sections.

Advantages of ERP

Increased global competition, new needs of executives for control over the total cost and product flow through their enterprises, and ever-more-numerous customer interactions drive the demand for enterprise-wide access to real-time information. ERP offers integrated software from a single vendor to help meet those needs. The primary benefits of implementing ERP include improved access to data for operational decision making, elimination of inefficient or outdated systems, improvement of work processes, and technology standardization. ERP vendors have also developed specialized systems for specific applications and market segments.

Improved Access to Data for Operational Decision Making

ERP systems operate via an integrated database, using one set of data to support all business functions. The systems can support decisions on optimal sourcing or cost accounting, for instance, for the entire enterprise or business

units from the start, rather than gathering data from multiple business functions and then trying to coordinate that information manually or reconciling data with another application. The result is an organization that looks seamless, not only to the outside world but also to the decision makers who are deploying resources within the organization. The data is integrated to facilitate operational decision making and allows companies to provide greater customer service and support, strengthen customer and supplier relationships, and generate new business opportunities.

Amrit Feeds is one of India's largest producers of chicken feed, poultry, and dairy products with annual revenue of 25,000 million rupees (around $409 million). Until recently, the firm deployed separate sales teams with disparate order entry methods across India, making it difficult to capture current customer demand data. Amrit recognized that using nonstandard methods and multiple, poorly integrated systems was causing problems in production planning with frequent stockouts and unfilled sales orders. Over a period of time, Amrit implemented an ERP system whose scope includes sales ordering, demand forecasting, and production planning. The successful implementation of the system has provided the firm with access to quality data to improve key decision making. As a result, the firm has increased production output by 2.5 percent, cut stockout of finished products by 16 percent, and increased its order fulfillment rate by 9 percent.[42]

Elimination of Costly, Inflexible Legacy Systems

Adoption of an ERP system enables an organization to eliminate dozens or even hundreds of separate systems and replace them with a single, integrated set of applications for the entire enterprise. In many cases, these systems are decades old, the original developers are long gone, and the systems are poorly documented. As a result, the systems are extremely difficult to fix when they break, and adapting them to meet new business needs takes too long. They become an anchor around the organization that keeps it from moving ahead and remaining competitive. An ERP system helps match the capabilities of an organization's information systems to its business needs—even as these needs evolve.

Network Rail runs, maintains, and develops Britain's rail tracks, signaling, bridges, tunnels, and 17 key stations. It also ensures all current or potential future train operators are treated fairly when they use or seek to use the railway. It employs an ERP system to support order management, logistics planning, and customer interactions. At one time, the system ran on a few powerful servers, an arrangement that made it difficult to add computing capacity as business demands increased. Network Rail migrated to a new setup with the ERP system running on more and smaller servers. This increased the organization's ability to expand the capacity of the system in small, relatively inexpensive increments to meet evolving business needs. It also improved system reliability in the event of a disaster—if one server should fail, many others can take up the workload.[43]

Improvement of Work Processes

Competition requires companies to structure their business processes to be as effective and customer oriented as possible. ERP vendors do considerable research to define the best business processes. They gather requirements of leading companies within the same industry and combine them with research findings from research institutions and consultants. The individual application modules included in the ERP system are then designed to support these best practices, the most efficient and effective ways to complete a business process. Thus, implementation of an ERP system ensures good work processes based on best practices. For example, for managing customer payments, the ERP system's finance module can be configured to reflect the most efficient

practices of leading companies in an industry. This increased efficiency ensures that everyday business operations follow the optimal chain of activities, with all users supplied the information and tools they need to complete each step.

The chemical division of an integrated petroleum company built on the successful implementation of its ERP system to capture best practices and support a program of continuous improvement with a goal of optimizing its supply chain. In the first wave of continuous improvement changes, project teams worked across business functions to reduce the number of suppliers and improve purchase pricing and services. In the next phase, the continuous improvement teams worked to increase cross functional collaboration and significantly advance internal processes. In the third wave of changes, project teams redesigned and redefined organizational roles, job skills, management systems, and company culture and behaviors to increase efficiency and improve customer interactions and order fulfillment. The net effect of all these changes was to reduce overall supply chain costs by 12 percent and increase order satisfaction from 76 percent to 91 percent.[44]

Upgrade of Technology Infrastructure

When implementing an ERP system, an organization has an opportunity to upgrade the information technology (including hardware, operating systems, and databases) that it uses. While centralizing and formalizing these decisions, the organization can eliminate the hodgepodge of multiple hardware platforms, operating systems, and databases it is currently using—most likely from a variety of vendors. Standardizing on fewer technologies and vendors reduces ongoing maintenance and support costs as well as the training load for those who must support the infrastructure.

DuPont with headquarters in Geneva, Switzerland, is recognized as one of the world's most innovative companies. It employs over 60,000 workers in 70 countries to provide a variety of products and services for customers in the agriculture, electronics, transportation, and apparel industries. Each DuPont strategic business unit had its own information systems operations group and strategy, creating a hodgepodge of applications, technology, and vendors. The support of all this diverse technology was costly and time consuming. The DuPont management team initiated the Legacy Application Migration Programme (LAMP) with a goal of migrating the business units to a single, integrated ERP environment. The scope of this effort included legal, corporate, and business reporting, inter-company processes, and price management. The project was successful and has resulted in elimination of costly-to-maintain legacy applications, a simpler infrastructure that is easier and less expensive to manage, and improved productivity.[45]

Leading ERP Systems

ERP systems are commonly used in manufacturing companies, colleges and universities, professional service organizations, retailers, and healthcare organizations. The business needs for each of these types of organizations varies greatly. In addition, the needs of a large multinational organization are far different from the needs of a small, local organization. Thus, no one ERP software solution from a single vendor is "best" for all organizations. To help simplify comparisons, ERP vendors are classified as Tier I, II, or III according to the type of customers they target.[46]

Tier I vendors target large multinational firms with multiple geographic locations and annual revenue in excess of $1 billion. Tier I ERP system solutions are highly complex and expensive to implement and support. Implementation across multiple locations can take years. The primary Tier I vendors are Oracle and SAP.

Tier II vendors target medium-sized firms with annual revenues in the $50 million to $1 billion range operating out of one or more locations. Tier II solutions are much less complex and less expensive to implement and support. There are two dozen or more Tier II vendors including Oracle, SAP, Microsoft, Infor, Epicor, and Lawson.

Tier III vendors target smaller firms with annual revenues in the $10 million to $50 million range that typically operate out of a single location. Tier III solutions are comparatively easy and inexpensive to implement and support. There are dozens of Tier III vendors including ABAS, Bluebee Software, Cincom Systems, Compiere, ESP Technologies, Frontier Software, GCS Software, Microsoft, Netsuite, PDS, Plex, and Syspro. Many of the Tier I and Tier II vendors also offer solutions for smaller firms.

Large organizations were the leaders in adopting ERP systems as only they could afford the associated large hardware and software costs and dedicate sufficient people resources to the implementation and support of these systems. Smaller organizations moved to ERP systems about 10 years after larger organizations did. The smaller firms simply could not afford the investment required in hardware, software, and people to implement and support ERP. However, ERP software vendors created new ERP solutions with much lower start-up costs and faster, easier implementations. Some ERP vendors introduced cloud-based solutions, which further reduced the start-up costs by avoiding the need to purchase expensive ERP software and make major hardware upgrades. Instead, with a cloud-based solution, organizations could rent the software and run it on the vendor's hardware. Plex and NetSuite are two of the many cloud-based ERP solutions that enable users to access the ERP application using a Web browser and avoid paying for and maintaining high-cost hardware.

As an alternative, many organizations elect to implement open-source ERP systems from vendors such as Compiere. With open-source software, organizations can see and modify the source code to customize it to meet their needs. Such systems are much less costly to acquire and are relatively easy to modify to meet business needs.

Organizations frequently need to customize the vendor's ERP software to integrate other business systems, to add data fields or change field sizes from those in the standard system, or to meet regulatory requirements. A wide range of software service organizations can perform the system development and maintenance.

Supply Chain Management (SCM)

supply chain management (SCM): A system that includes planning, executing, and controlling all activities involved in raw material sourcing and procurement, converting raw materials to finished products, and warehousing and delivering finished products to customers.

Supply chain management (SCM) includes the planning, execution, and control of all activities involved in raw material sourcing and procurement, conversion of raw materials to finished products, and the warehousing and delivery of finished product to customers. The goal of SCM is to reduce costs and improve customer service, while at the same time reducing the overall investment in inventory in the supply chain.

The ERP system for a manufacturing organization typically encompasses SCM activities and manages the flow of materials, information and finances. Manufacturing ERP systems follow a systematic process for developing a production plan that draws on the information available in the ERP system database.

The process starts with *sales forecasting* to develop an estimate of future customer demand. This initial forecast is at a fairly high level, with estimates made by product group rather than by each individual product item. The sales forecast extends for months into the future. The sales forecast might be developed using an ERP software module or it might be produced by other means using specialized software and techniques. Many organizations are moving to a collaborative process with major customers to plan future inventory levels and production rather than relying on an internally generated sales forecast.

INFORMATION SYSTEMS @ WORK

Using ERP Systems to Accommodate Rapid Growth in the Meat Industry

Founded in 1976 as a series of butcher shops in the small village of Moygashel in County Tyrone in Northern Ireland, Dunbia today is one of Europe's leading red meat manufacturers for the retail and commercial markets. Since 2001, Dunbia has rapidly acquired an impressive list of competitors or related companies across the United Kingdom. They acquired Oriel Jones & Sons in Wales in 2001, Kepak Preston in the Republic of Ireland and Rhinds of Elgin in Scotland in 2007, Stevenson's & Co pork facility in Northern Ireland in 2009, and Heathfield Foods in England in 2011. In 2013 and 2014, Dunbia bought three additional companies in Wales, Scotland, and England. Meanwhile, Dunbia has been building new plants to debone meat, produce sausages, and package meats. In 2013, the company also revamped one of its Welsh meat plants, turning it into one of the most modern facilities of its kind in the world.

With each new acquisition, Dunbia inherited new information systems, workplace procedures, and decision-making processes. By 2011, Dunbia found itself with five different enterprise resource planning (ERP) systems. Moving to a single ERP solution not only offered Dunbia a chance to rid itself of the abundance of licensing and maintenance fees, the company decided to develop one ERP system that would standardize its existing systems and implement best practices.

Dunbia chose to deploy its existing meat industry factory-floor system, Emydex, in each of its 10 operating plants. The Emydex system is designed for the meat and fish industry, and provides customizable data collection and production management. Next, Dunbia integrated Emydex with other modules within the Microsoft Dynamic AX platform. The Microsoft Dynamic ERP system provides a wide range of modules that support administrative and operational processes: financial management, human capital management, manufacturing, supply chain management, project management and accounting, retail, and business intelligence and reporting. Moreover, because Dunbia already used numerous Microsoft products, including its SQL Server database, the integration of these new ERP modules was likely to proceed smoothly.

One of the most important features of Dunbia's ERP system is that it accommodates the rapid growth the company has experienced and anticipates for the future. Moreover, due to inconsistencies in the five separate systems, the company could not make the most out of the business intelligence it was generating. Dunbia is now using the new ERP's business intelligence module to enforce group reporting requirements.

The company rolled out the new system in 2014, starting at its state-of-the-art facility in Wales and adding another plant into the system every couple of months. It's an aggressive, innovative plan, but one that makes the estimated return on investment worth the risk.

Discussion Questions

1. What are the advantages of deploying a single ERP across all of Dunbia's facilities?
2. What factors should a company consider when adopting an ERP system? How can it avoid outgrowing the system?

Critical Thinking Questions

1. How might Dunbia use its new ERP system to change work processes in the companies it has acquired?
2. What challenges might Dunbia face when its employees begin to use the new system?

SOURCES: "Dunbia's £12m meat plant revamp safeguards 600 jobs in Llanybydde," BBC, June 7, 2013, *www.bbc.com/news/uk-wales-22813800*; "Our History," Dunbia Web site, *www.dunbia.com/Discover-Dunbia/Our-History*; "Dunbia Powering Growth with Columbus Manufacturing," Columbus Food Web site, *www.columbusglobal.com/en-GB/Food/Client-cases/Dunbia*; "New from Microsoft Dynamics AX," Microsoft Web site, *www.microsoft.com/en-us/dynamics/erp-ax-overview.aspx*.

The *sales and operations plan* takes demand and current inventory levels into account and determines the specific product items that need to be produced and when to meet the forecast future demand. Production capacity and any seasonal variability in demand must also be considered. The result is a high-level production plan that balances market demand and production capacity.

Demand management refines the production plan by determining the amount of weekly or daily production needed to meet the demand for individual products. The output of the demand management process is the master production schedule which is a production plan for all finished goods.

Detailed scheduling uses the production plan defined by the demand management process to develop a detailed production schedule specifying details such as which item to produce first and when production should be switched from one item to another. A key decision is how long to make the production runs for each product. Longer production runs reduce the number of machine setups required, thus reducing production costs. Shorter production runs generate less finished product inventory and reduce inventory holding costs.

Materials requirement planning determines the amount and timing for placing raw material orders with suppliers. The types and amounts of raw materials required to support the planned production schedule are determined based on the existing raw material inventory and the bill of materials, or BOM, a sort of "recipe" of ingredients needed to make each product item. The quantity of raw materials to order also depends on the lead time and lot sizing. Lead time is the time it takes from the time a purchase order is placed until the raw materials arrive at the production facility. Lot size has to do with discrete quantities that the supplier will ship and the amount that is economical for the producer to receive and/or store. For example, a supplier might ship a certain raw material in units of 80,000-pound rail cars. The producer might need 95,000 pounds of the raw material. A decision must be made to order one or two rail cars of the raw material.

Purchasing uses the information from materials requirement planning to place purchase orders for raw materials and transmit them to qualified suppliers. Typically, the release of these purchase orders is timed so that raw materials arrive just in time to be used in production and minimize warehouse and storage costs. Often, producers will allow suppliers to tap into data via an extranet that enables them to determine what raw materials the supplier needs thus minimizing the effort and lead time to place and fill purchase orders.

Production uses the detailed schedule to plan the details of running and staffing the production operation.

Kidrobot is a creator and retailer of limited-edition art toys, apparel, and accessories. The firm implemented a global supply chain management system with the flexibility to serve its toy, apparel, and accessory businesses. The system supports a complex domestic and international sales distribution strategy that encompasses multiple channels of distribution including retail stores, wholesale customers, Web-based B2B, and e-commerce B2C.[47]

Customer Relationship Management

Customer relationship management (CRM) software automates and integrates the functions of sales, marketing, and service in an organization. The objective is to capture data about every contact a company has with a customer through every channel and store it in the CRM system so the company can truly understand customer actions. See Figure 5.16. CRM software helps an organization build a database about its customers that describes relationships in sufficient detail so that management, salespeople, customer service providers—and even customers—can access information to match customer needs with product plans and offerings, remind them of service requirements, and know what other products they have purchased.

Air Animal Pet Movers is a small company based in Tampa, Florida, that coordinates the moving of pets both nationally and internationally. Pet owners are nervous about their pet's move and expect responsive, attentive service throughout the process. Air Animal implemented a CRM system that not only tracks every interaction with its clients but also updates its sales and

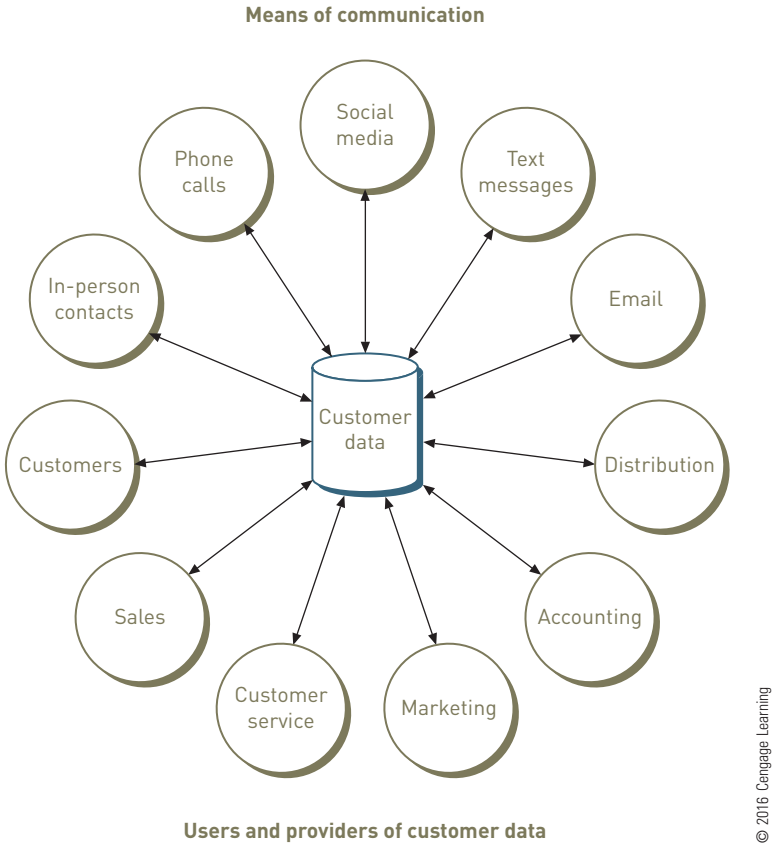


FIGURE **5.16**

Customer relationship management system

A CRM system provides a central repository of customer data used by the organization.

invoicing processes. Customers can complete an online form to provide details of their needs. This process generates an estimate for services and a new customer contact record. The system then captures details required to complete each step in the move including flight information, pet boarding, and required international documents. The system then provides reminder alerts to ensure that each step is completed.[48]

The key features of a CRM system include the following:

- **Contact management**: The ability to track data on individual customers and sales leads and access that data from any part of the organization.
- **Sales management**: The ability to organize data about customers and sales leads and then to prioritize the potential sales opportunities and identify appropriate next steps.
- **Customer support**: The ability to support customer service reps so that they can quickly, thoroughly, and appropriately address customer requests and resolve customers' issues while at the same time collecting and storing data about those interactions.
- **Marketing automation**: The ability to capture and analyze all customer interactions, generate appropriate responses, and gather data to create and build effective and efficient marketing campaigns.
- **Analysis**: The ability to analyze customer data to identify ways to increase revenue and decrease costs, identify the firm's "best customers," and determine how to retain them and find even more of them.
- **Social networking**: The ability to create and join groups like Facebook where salespeople can make contacts with potential customers.
- **Access by smartphones**: The ability to access Web-based customer relationship management software by devices such as the BlackBerry or Apple iPhone.

- **Import contact data**: The ability for users to import contact data from various data service providers such as Jigsaw, which offers company-level contact data that can be downloaded for free directly into the CRM application.

LEVIEV Extraordinary Diamonds has exclusive access to some of the world's most unique stones and sells large, rare, and colored diamonds through its boutiques in Dubai, London, New York, and Singapore. While carat, clarity, color, and cut are the factors that determine the value of a diamond, a one-of-a-kind diamond does not sell unless the customer has trust in the brand. Indeed LEVIEV CEO Paul Raps states: "Our relationships with customers are the most important part of our business." To that end, LEVIEV implemented a CRM system to ensure those relationships are formed and maintained. Its CRM system stores a photograph of every LEVIEV stone and piece of jewelry each customer has purchased, photos of any items the customer is creating with the company's designers, plus a wish list of future purchases. This data can only be accessed by the customer and his or her sales associate. The CRM system not only keeps track of customers' birthdays and anniversaries but also where they vacation during the summer and winter. The goal is to help the sales associates plan the relationship-building activities necessary to sustain and increase the business.[49]

Table 5.8 lists the highest-rated CRM systems.[50]

TABLE 5.8 Highest-rated CRM systems, 2014

Rank	Vendor	Select Customers	Pricing Starts At
1	Salesforce Sales Cloud	Dell Dr. Pepper Snapple	$5 per user/month
2	OnContact CRM 7	Prudential Carfax	$50 per user/month
3	Sage Software CRM	Panasonic Lockheed Martin	$39 per user/month
4	Prophet CRM	AT&T Century 21	$24 per user/month

Due to the popularity of mobile devices, shoppers can easily compare products and prices on their mobile phones and instantly tweet their experiences with a brand to dozens of friends. Savvy retailers today use their CRM systems to stay on top of what these customers are saying on social networks. Wells Fargo Bank uses social media to listen to what its customers are saying and then responds quickly to their issues and questions to improve customer satisfaction.[51]

Most CRM systems can now be accessed via smartphones so that employees can work with the most current customer information even while on the move. However, in a recent survey, just under 25 percent of salespeople who have a smartphone use it to access their firm's CRM system. Another 10 percent of salespeople worked for a company whose CRM system did not allow mobile access.[52]

product lifecycle management (PLM): An enterprise business strategy that creates a common repository of product information and processes to support the collaborative creation, management, dissemination, and use of product and packaging definition information.

Product Lifecycle Management (PLM)

Product lifecycle management (PLM) is an enterprise business strategy that creates a common repository of product information and processes to support the collaborative creation, management, dissemination, and use of product and packaging definition information.

ETHICAL & SOCIETAL ISSUES

Online Fundraising Supports Research into Rare Genetic Disorder

Prader-Willi Syndrome (PWS) is a rare genetic disorder that occurs about once in 15,000 children. It leads to life-threatening childhood obesity and other conditions, in part because the brain is convinced that the body is in a perpetual state of starvation. PWS has historically received little attention or support from medical researchers. The Foundation for Prader-Willi Research (FPWR) sought to change that situation.

FPWR was established in 2003 by 40 families to fund research into PWS. In 2005, the organization's $100,000 income came from a few large donors. The founders realized that increasing donations substantially required changing the way FPWR operated. In particular, the foundation had to establish an online presence. However, the organization had few information technology resources, limited financial resources, and no experience with the Web.

Online giving is a chancy process at best. Research has found that nearly half of the people who visit a charity's Web site, intending to make a donation, don't follow through. What's more, the fraction of visitors who don't donate varies a great deal from site to site. Simon Norris, CEO of consulting firm Nomensa, suggests that "Nonprofits should take a lesson from successful e-commerce brands to understand and deliver an optimal donation experience."

The key to this experience is creating a relationship between the charity and the donor. The FPWR founders understood this principle. They knew, as you learned in this chapter, that customer relationship management (CRM) systems can "help a company manage all aspects of customer encounters." Replace "customer" by "donor," and that help was exactly what the foundation needed: software to manage its donor relationships to strengthen the donors' connection to FPWR.

Fortunately, FPWR could choose from many available CRM packages—even if the C in CRM is taken as Constituent rather than Customer, as is more appropriate when donors are part of the picture. Unfortunately, the very abundance of CRM packages makes it difficult to choose one. FPWR's limited budget was a critical factor in selecting a CRM package. When the foundation learned of CiviCRM, designed specifically for charitable organizations and available at no charge, that system became the obvious answer.

CiviCRM is designed specifically for donor tracking. It can record contributions of cash, items or services of value (in-kind), and volunteer time. It can handle one-time gifts, recurring gifts, pledges of future gifts, and more. It can track offline gifts to provide a complete picture of a donor's contributions through all channels. The system also differentiates grants (which obligate FPWR to do something in return) from contributions (which don't). It tracks household and workplace affiliations to indicate who is connected to whom. It also lets the organization manage volunteers by skills and availability and create membership levels with various criteria and benefits.

Three people from FPWR plus a hired developer set up CiviCRM, and FPWR now takes in over $700,000 annually through online donations.

FPWR used CiviCRM to launch its OneSmallStep (OSS) for Research initiative. This initiative brought together over 500 fundraisers in 53 cities around the world to raise money for PWS research. OSS organizers in each city used CiviCRM to establish their campaigns and recruit fundraisers who, in turn, solicited donations. CiviCRM handles multiple currencies, languages, and payment processors as well as manages the legal donation tracking requirements of different countries.

The foundation has now awarded over $3 million in research grants to scientists working on possible cures. Without CiviCRM, this achievement would not have been possible.

Discussion Questions

1. How did FPWR leverage CiviCRM to grow its donor base?
2. Your university almost certainly solicits donations from its graduates. How do its donor management requirements differ from those of FPWR? How are they similar?

Critical Thinking Questions

1. What features does CiviCRM share with other CRM systems? What features are unique?
2. What difference would you expect to see between CiviCRM and a CRM designed to support a company in private industries, such as telecommunications or pharmacology?

SOURCES: CiviCRM Web site, *civicrm.org*, accessed March 29, 2014; Foundation for Prader-Willi Research Web site, *www.fpwr.org*, accessed May 2, 2012; Nomensa Web site, *www.nomensa.com*, accessed April 11, 2014; Norris, S. and Potts, J., "Designing the Perfect Donation Experience," Nomensa Ltd., *www.nomensa.com/insights/designing-perfect-donation-process-part-1* (requires free registration), October 2011; Sheridan, A., "Getting to Know You: CRM for the Charity Sector," Fundraising, *www.civilsociety.co.uk/fundraising/opinion/content/8759/getting_to_know_you_crm_for_the_sector*, April 6, 2011.

product lifecycle management (PLM) software: Software that provides a means for managing the data and processes associated with the various phases of the lifecycle of a product including sales and marketing, research and development, concept development, product design, prototyping and testing, process design, production and assembly, delivery and product installation, service and support, and product retirement and replacement.

Product lifecycle management (PLM) software provides a means for managing the data and processes associated with the various phases of the lifecycle of a product including sales and marketing, research and development, concept development, product design, prototyping and testing, manufacturing process design, production and assembly, delivery and product installation, service and support, and product retirement and replacement. See Figure 5.17. As products advance through these stages, product data is generated and distributed to various groups both within and outside the manufacturing firm. This data includes design and process documents, bill of material definitions, product attributes, product formulations, and documents needed for FDA and environmental compliance. PLM software provides support for the key functions of configuration management, document management, engineering change management, release management, and collaboration with suppliers and original equipment manufacturers (OEMs).

PLM software and its data are used by both internal and external users. Internal users include engineering, operations and manufacturing, procurement and sourcing, manufacturing, marketing, quality assurance, customer service, regulatory, and others. External users include the manufacturer's design partners, packaging suppliers, raw material suppliers, and contract manufacturers. These users must collaborate to define, maintain, update, and securely share product information throughout the lifecycle of the product. Frequently, these external users are asked to sign nondisclosure agreements to reduce the risk of proprietary information being shared with competitors.

Table 5.9 outlines the benefits a business can realize when using a PLM system effectively.

The Flovel Group is a supplier of hydropower equipment and valves for turbines. Its headquarters and manufacturing plant are located about 50 km apart in the state of Haryana in northern India. The firm's strategy for success is to beat its competitors in the quick delivery of products for small- and medium-sized hydropower projects. To this end, it implemented PLM technology. This has enabled Flovel to speed up the release of customized, innovative products to market; improve collaboration and information reuse across all

FIGURE **5.17**

Scope of PLM software

Using PLM software, you can manage the data and processes associated with the various phases of the lifecycle of a product.

TABLE 5.9 Benefits of a PLM system

Benefit	How Achieved
Reduce time to market	By connecting design, research and development, procurement, manufacturing, and customer service seamlessly through a flexible collaboration environment
	By improving collaboration among the organization and its suppliers, contract manufacturers, and OEMs
Reduce costs	By reducing prototyping costs through the use of software simulation
	By reducing scrap and rework through improved processes
	By reducing the number of product components through standardization
Ensure regulatory compliance	By providing a secure repository, tracking and audit trails, change and document management controls, workflow and communications, and improved security

business units involved in the product development lifecycle; and overcome the physical separation between its design center and manufacturing plant.[53]

Table 5.10 presents a list of some of the top-rated PLM software products (in alphabetical order) according to a 2013 report by Business-Software.com.[54]

TABLE 5.10 Top-rated PLM software products

Organization	Primary PLM Software Product	Technology Model	Select Customers
Arena	Cloud PLM	Cloud-based solution	SiriusXM, SunLink
Infor	Optiva	On-premise solution	Henkel, Sypris
Integware	Enovia Collaborative PLM	On-premise solution	Cummins, Steelcase
PTC	Windchill	SaaS solution	Medco Equipment, InterComm
SAP	PLM	On-premise solution	Porsche, Anadarko Petroleum
Siemens	Teamcenter	On-premise solution	Procter & Gamble, BAE Systems
Softech	ProductCenter PLM	SaaS solution	Hayward Tyler Motors, Monarch Hydraulics
Sopheon	Accolade	Cloud-based solution	PepsiCo, ConAgra

Overcoming Challenges in Implementing Enterprise Systems

Implementing an enterprise system, particularly for a large organization, is extremely challenging and requires tremendous amounts of resources, the best IS and businesspeople, and plenty of management support. In spite of all this, many enterprise system implementations fail, and problems with an enterprise system implementation can require expensive solutions. The following is a sample of major enterprise system implementation project failures:

- The United States Air Force wasted $1 billion in a failed attempt to implement an enterprise system to replace over 200 legacy systems involved with the global supply chain that ensures its men and women are well supported and provisioned. The scope of the system included product lifecycle management, planning and scheduling, repair and maintenance, and distribution and transportation.[55]
- Avon expended over $100 million on a new order management system that never was rolled out because it wreaked havoc on normal operations. The system was so difficult to use that sales reps quit the company rather than be forced to struggle with a "user-unfriendly" system.[56]
- The California state controller sued the enterprise software vendor of an integrated payroll and benefits program for $50 million. The software continued to generate significant errors even after an 8-month pilot testing period.[57]

Half of nearly 200 ERP implementations worldwide evaluated by Panorama, an ERP consulting firm, were judged to be failures. Table 5.11 lists and describes the most significant challenges to successful implementation of an enterprise system.[58]

The following list provides tips for avoiding many common causes for failed enterprise system implementations:

- Assign a full-time executive to manage the project.
- Appoint an experienced, independent resource to provide project oversight and to verify and validate system performance.
- Allow sufficient time for transition from the old way of doing things to the new system and new processes.
- Plan to spend considerable time and money training people; many project managers recommend that 30 to 60 days per employee be budgeted for training of personnel.
- Define metrics to assess project progress and to identify project-related risks.
- Keep the scope of the project well defined and contained to essential business processes.
- Be wary of modifying the enterprise system software to conform to your firm's business practices.

TABLE 5.11 Challenges to successful enterprise system implementation

Challenge	Description
Cost and disruption of upgrades	Most companies have other systems that must be integrated with the enterprise system, such as financial analysis programs, e-commerce operations, and other applications that communicate with suppliers, customers, distributors, and other business partners. This integration takes even more effort and time.
Cost and long implementation lead time	The average ERP implementation cost is $5.5 million with an average project duration just over 14 months.
Difficulty in managing change	Companies often must radically change how they operate to conform to the enterprise work processes. These changes can be so drastic to long-time employees that they depart rather than adapt to the change, leaving the firm short of experienced workers.
Management of software customization	The base enterprise system may need to be modified to meet mandatory business requirements. This modification can become extremely expensive and further delay implementation.
User frustration with the new system	Effective use of an enterprise system requires changes in work processes and in the details of how work gets done. Many users initially balk at these changes and require much training and encouragement.

Hosted Software Model for Enterprise Software

Many business application software vendors are pushing the use of the hosted software model for SMEs. The goal is to help customers acquire, use, and benefit from the new technology while avoiding much of the associated complexity and high start-up costs. Applicor, Intacct, NetSuite, SAP, and Workday are among the software vendors who offer hosted versions of their enterprise software at a cost of $50 to $200 per month per user.

This pay-as-you-go approach is appealing to SMEs because they can experiment with powerful software capabilities without making a major financial investment. Organizations can then dispose of the software without large investments if the software fails to provide value or otherwise misses expectations. Also, using the hosted software model means the small business does not need to employ a full-time IT person to maintain key business applications. The small business can expect additional savings from reduced hardware costs and costs associated with maintaining an appropriate computer environment (such as air conditioning, power, and an uninterruptible power supply).

Table 5.12 lists the advantages and disadvantages of hosted software.

A corset is an item of apparel worn to hold and shape the upper body into a desired shape for aesthetic or medical purposes. Corset Story is one of the world's biggest corset retailers with hundreds of styles, designs, and fabrics from which its demanding customers may choose. The firm needed a PLM system to support the development of its complex product line. It decided to implement a cloud-based PLM system because of the speed at which it could be deployed. It took just five weeks from initial implementation to the time its people were trained and ready to use the system to support the design, development, material management, approvals, and critical path management activities associated with the development of its product line for each new fashion season.[59]

TABLE 5.12 Advantages and disadvantages of hosted software model

Advantages	Disadvantages
Decreased total cost of ownership	Potential availability and reliability issues
Faster system start-up	Potential data security issues
Lower implementation risk	Potential problems integrating the hosted products of different vendors
Management of systems outsourced to experts	Savings anticipated from outsourcing may be offset by increased effort to manage vendor

SUMMARY

Principle:

Electronic and mobile commerce are evolving, providing new ways of conducting business that present both potential benefits and problems.

E-commerce is the conducting of business activities electronically over networks. Business-to-business (B2B) e-commerce allows manufacturers to buy at a low cost worldwide, and offers enterprises the chance to sell to a global market. B2B e-commerce is currently the largest type of e-commerce. Business-to-consumer (B2C) e-commerce enables organizations to sell directly to consumers, eliminating intermediaries. In many cases, this squeezes costs and inefficiencies out of the supply chain and can lead to higher profits and lower prices for consumers. Consumer-to-consumer (C2C) e-commerce involves consumers selling directly to other consumers. Online auctions are the chief method by which C2C e-commerce is currently conducted. e-Government is the use of information and communications technology to simplify the sharing of information, speed formerly paper-based processes, and improve the relationship between citizens and government.

Mobile commerce is the use of wireless devices such as cell phones and smartphones to facilitate the sale of goods or services—anytime, anywhere. The market for m-commerce in North America is expected to mature much later than in Western Europe and Japan. Although some industry experts predict great growth in this arena, several hurdles must be overcome, including improving the ease of use of wireless devices, addressing the security of wireless transactions, and improving network speed.

Electronic retailing (e-tailing) is the direct sale from a business to consumers through electronic storefronts designed around an electronic catalog and shopping cart model.

A cybermall is a single Web site that offers many products and services at one Internet location.

Manufacturers are joining electronic exchanges, where they can work with competitors and suppliers to use computers and Web sites to buy and sell goods, trade market information, and run back-office operations such as inventory control. They are also using e-commerce to improve the efficiency of the selling process by moving customer queries about product availability and prices online.

The Web allows firms to gather much more information about customer behavior and preferences than they could using other marketing approaches. This new technology has greatly enhanced the practice of market segmentation and enabled companies to establish closer relationships with their customers. Detailed information about a customer's behavior, preferences, needs, and buying patterns allows companies to set prices, negotiate terms, tailor

promotions, add product features, and otherwise customize a relationship with a customer.

Through m-commerce, companies can reach individual consumers and establish one-on-one marketing relationships and communicate whenever it is convenient.

With the recent economic downturn, many people and business have turned to bartering as a means of gaining goods and services. A number of Web sites have been created to support this activity.

Retargeting is a technique used by advertisers to recapture shoppers who leave a Web site without making a purchase.

An increasing number of companies provide mobile phone apps that enable shoppers to compare prices and products on the Web.

Many manufacturers and retailers now send mobile coupons directly to consumers' smartphones.

The Internet has also revolutionized the world of investment and finance, especially online stock trading and online banking.

The Internet has also created many options for electronic auctions, where geographically dispersed buyers and sellers can come together.

M-commerce provides a unique opportunity to establish one-on-one marketing relationships and support communications anytime and anywhere. M-commerce transactions are being used in many application arenas, including mobile banking, mobile price comparison, mobile advertising, and mobile coupons.

Businesses and people use e-commerce to reduce transaction costs, speed the flow of goods and information, improve the level of customer service, and enable the close coordination of actions among manufacturers, suppliers, and customers. E-commerce also enables consumers and companies to gain access to worldwide markets. E-commerce offers great promise for developing countries, helping them to enter the prosperous global marketplace, and hence helping to reduce the gap between rich and poor countries.

Principle:

E-commerce and m-commerce require the careful planning and integration of a number of technology infrastructure components.

A number of infrastructure components must be chosen and integrated to support a large volume of transactions with customers, suppliers, and other business partners worldwide. These components include hardware, Web server software, security and identification services, Web site development tools, e-commerce software, and Web services.

Electronic payment systems are a key component of the e-commerce infrastructure. A digital certificate is an attachment to an e-mail message or data embedded in a Web page that verifies the identity of a sender or a Web site. To help prevent the theft of credit card numbers and banking information, the Secure Sockets Layer (SSL) communications protocol is used to secure all sensitive data. Several electronic cash alternatives require the purchaser to open an account with an electronic cash service provider and to present proof of identity whenever payments are to be made. Payments can also be made by credit, charge, debit, p-, and smart cards. The use of cell phones to make purchases and transfer funds between consumers has become commonplace.

Principle:

An organization must have information systems that support the routine, day-to-day activities and that help a company add value to its products and services.

Transaction processing systems (TPSs) are at the heart of most information systems in businesses today. A TPS is an organized collection of people,

procedures, software, databases, and devices used to capture fundamental data about events that affect the organization (transactions) and use that data to update the official records of the organization.

The methods of transaction processing systems include batch and online. Batch processing involves the collection of transactions into batches, which are entered into the system at regular intervals as a group. Online transaction processing (OLTP) allows transactions to be entered as they occur.

Organizations expect TPSs to accomplish a number of specific objectives, including processing data generated by and about transactions, maintaining a high degree of accuracy and information integrity, compiling accurate and timely reports and documents, increasing labor efficiency, helping provide increased and enhanced service, and building and maintaining customer loyalty.

All TPSs perform the following basic activities: data collection, which involves the capture of source data to complete a set of transactions; data editing, which checks for data validity and completeness; data correction, which involves providing feedback of a potential problem and enabling users to change the data; data processing, which is the performance of calculations, sorting, categorizing, summarizing, and storing data for further processing; data storage, which involves placing transaction data into one or more databases; and document production, which involves outputting records and reports.

Traditional TPSs include the following types of systems: order processing, accounting, and purchasing systems.

The traditional TPSs that support the purchasing function include inventory control, purchase order processing, accounts payable, and receiving.

Many software packages provide integrated transaction processing solutions for SMEs.

Principle:

An organization that implements an enterprise system is creating a highly integrated set of systems, which can lead to many business benefits.

Enterprise resource planning (ERP) software supports the efficient operation of business processes by integrating activities throughout a business, including sales, marketing, manufacturing, logistics, accounting, and staffing.

Implementation of an enterprise system can provide many advantages, including providing access to data for operational decision making; elimination of costly, inflexible legacy systems; providing improved work processes; and creating the opportunity to upgrade technology infrastructure.

The production and supply chain management process starts with sales forecasting to develop an estimate of future customer demand. This initial forecast is at a fairly high level with estimates made by product group rather than by each individual product item. The sales and operations plan takes demand and current inventory levels into account and determines the specific product items that need to be produced and when to meet the forecast future demand. Demand management refines the production plan by determining the amount of weekly or daily production needed to meet the demand for individual products. Detailed scheduling uses the production plan defined by the demand management process to develop a detailed production schedule specifying details such as which item to produce first and when production should be switched from one item to another. Materials requirement planning determines the amount and timing for placing raw material orders with suppliers. Purchasing uses the information from materials requirement planning to place purchase orders for raw materials and transmit them to qualified

suppliers. Production uses the detailed schedule to plan the details of running and staffing the production operation.

The business processes required to capture and report accounting details are often included within the scope of an organization's ERP system.

Principle:

A company that implements a customer relationship management system is building a source of information about customers that can improve sales, marketing, and customer service.

A CRM helps an organization build a database about its customers that describes relationships in sufficient detail so that management, salespeople, customer service providers, and even customers can access information to match customer needs.

Principle:

A company that implements a product lifecycle management (PLM) software is building a means to manage all the data associated with the product development, engineering design, production, support, and disposal of manufactured products.

PLM software is used by users both internal and external to the organization. They use the system to collaborate and define, maintain, update, and securely share product information throughout the lifecycle of the product.

Some of the challenges in implementing enterprise systems are that they are costly and can cause disruption as various other systems must be upgraded, they cause radical changes in how an organization must operate, they are associated with long implementation times, the base ERP system may require expensive and time consuming modifications, and users can become frustrated with the system.

Business application software vendors are experimenting with the hosted software model to see if the approach meets customer needs and is likely to generate significant revenue.

KEY TERMS

batch processing system
business-to-business (B2B) e-commerce
business-to-consumer (B2C) e-commerce
certificate authority
consumer-to-consumer (C2C) e-commerce
customer relationship management (CRM) software
cybermall
data collection
data correction
data editing
data processing
data storage
digital certificate
document production
e-government
electronic cash
electronic commerce (e-commerce)
electronic exchange
electronic retailing (e-tailing)
enterprise system
market segmentation
online transaction processing (OLTP)
p-card (procurement card or purchasing card)
product lifecycle management (PLM)
product lifecycle management (PLM) software
Secure Sockets Layer (SSL)
smart card
source data automation
supply chain management (SCM)
transaction processing cycle

CHAPTER 5: SELF-ASSESSMENT TEST

Electronic and mobile commerce are evolving, providing new ways of conducting business that present both potential benefits and problems.

1. The largest B2C retailer in the United States is _____.
   a. Amazon
   b. Staples
   c. Apple
   d. Walmart
2. The average order size for B2C commerce is greater than for B2B. True or False?
3. _____ of total retail sales is sold online.
   a. Around 2 percent
   b. Roughly 5 percent
   c. 10 percent
   d. Nearly 20 percent

E-commerce and m-commerce require the careful planning and integration of a number of technology infrastructure components.

4. The amount of storage capacity and computing power required of a Web server depends primarily on _____.
   a. the geographical location of the server and number of different products sold
   b. the software that must run on the server and the volume of e-commerce transactions
   c. the size of the business organization and the location of its customers
   d. the number of potential customers and average dollar value of each transaction
5. Key Web site performance measures include response time, transaction success rate, and system availability. True or False?
6. When using the Secure Sockets Layer protocol in conducting e-commerce transactions, the data is always _____ to ensure that your transactions are not subject to interception or "sniffing" by a third party.

An organization must have information systems that support the routine, day-to-day activities and that help a company add value to its products and services.

7. The essential characteristic of a batch processing system is that there is some _____ between an event occurring and the eventual processing of the related transaction.
8. Business data goes through a data processing cycle that includes data collection, data _____, data correction, data processing, data storage, and documentation production.
9. Which of the following is *not* an objective of an organization's transaction processing system?
   a. Capture, process, and update databases of business data required to support routine business activities.
   b. Ensure that data is processed immediately upon occurrence of a business transaction.
   c. Avoid processing fraudulent transactions.
   d. Produce timely user responses and reports.

An organization that implements an enterprise system is creating a highly integrated set of systems, which can lead to many business benefits.

10. The individual application modules included in an ERP system are designed to support _____, the most efficient and effective ways to complete a business process.
11. _____ software provides a means for managing all the data associated with the product development, engineering design, production, support, and disposal of manufactured products.
12. The hosted software model for enterprise software helps customers acquire, use, and benefit from new technology while avoiding much of the associated complexity and high start-up costs. True or False?
13. _____ software helps a company manage all aspects of customer encounters, including marketing, sales, distribution, accounting, and customer service.

CHAPTER 5: SELF-ASSESSMENT TEST ANSWERS

1. a
2. False
3. b
4. b
5. True
6. encrypted
7. delay
8. editing
9. b
10. best practices
11. PLM
12. True
13. Customer relationship management (CRM)

REVIEW QUESTIONS

1. Briefly define the term electronic commerce, and identify five forms of electronic commerce based on the parties involved in the transactions.
2. How does the dollar volume of U.S. B2B e-commerce compare to the volume of B2C e-commerce?
3. What is electronic couponing and how does it work? What are some of the issues with electronic couponing?
4. What is an electronic exchange? Identify and briefly describe three types of exchanges based on who operates the exchange.
5. Identify the key elements of the technology infrastructure required to successfully implement e-commerce within an organization.
6. Identify and briefly describe six basic transaction processing activities performed by all transaction processing systems.
7. Provide an example for which the use of a batch processing system to handle transactions is appropriate. Provide an example for which the use of online transaction processing is appropriate.
8. What is an enterprise system? Identify and briefly discuss the goals of three types of enterprise systems.
9. What is a Tier I ERP software vendor?
10. How does materials requirement planning support the purchasing process? What are some of the issues and complications that arise in materials requirement planning?
11. Identify and briefly describe at least four key business capabilities provided by the use of a CRM system.
12. Identify the basic business processes included with the scope of product lifecycle management.

DISCUSSION QUESTIONS

1. Briefly discuss three models for selling mobile ad impressions. What are the primary measures for the success of mobile advertising?
2. What is retargeting? What are some strategies used to retarget Web site visitors?
3. The volume of mobile commerce in the United States is expected to reach only about 7 percent of total B2C sales by 2016. Do you think that mobile commerce is a significant capability for shoppers? Why or why not?
4. Identify and briefly describe three m-commerce applications you have used.
5. Identify and briefly discuss three reasons for the steady growth in B2C e-commerce.
6. Identify three kinds of business organizations that would have difficulty in becoming a successful e-commerce organization.
7. Identify and briefly discuss five challenges to the successful implementation of an enterprise system. Provide several tips to overcome these challenges.
8. Assume that you are the owner of a small bicycle sales and repair shop serving hundreds of customers in your area. Identify the kinds of customer information you would like your CRM system to capture. How might this information be used to provide better service or increase revenue? Identify where or how you might capture this data.
9. Briefly describe the hosted software model for enterprise software and discuss its primary appeal for SMEs.
10. Why were SMEs slow to adopt ERP software? What changed to make ERP software more attractive to SMEs?
11. Your friend has been appointed the project manager of your firm's PLM implementation system. What advice would you offer to help ensure the success of the project?
12. What benefits should the suppliers and customers of a firm that has successfully implemented an ERP system expect to see? What issues might arise for suppliers and customers during an ERP implementation?
13. Many organizations are moving to a collaborative process with their major suppliers to get their input on designing and planning future product modifications or new products. Explain how a PLM system might enhance such a process. What issues and concerns might a manufacturer have in sharing product data?

PROBLEM-SOLVING EXERCISES

1. Imagine that you are a new employee in the engineering organization of a large camping equipment and outdoor furniture manufacturing firm. The company is considering implementing a PLM system to better manage the design and manufacture of its products. You have been

invited to a meeting to share your thoughts on how such a system might be used and what capabilities are most important. How would you prepare for this meeting? What points would you make? Develop a presentation containing three or four slides that summarize your thoughts.

2. In a spreadsheet program, enter the ingredients and quantity required to make your favorite homemade cookie. This represents a simple bill of materials (BOM). Add a column to show the cost for each ingredient. Now "explode" the BOM to show the quantity and cost of each ingredient required to make 10,000 cookies.
3. Your refrigerator just gave out and must be replaced within the week! Use your Web-enabled smartphone (or borrow a friend's) to perform a price and product comparison to identify the manufacturer and model that best meets your needs and the retailer with the lowest delivered cost. Obtain peer input to validate your choice. Write a brief summary of your experience and identify the Web sites you found most useful.

TEAM ACTIVITIES

1. With your team members, interview several business managers at a firm that has implemented an enterprise system (ERP, CRM, or PLM system). Interview them to document the scope, cost, and schedule for the overall project. Find out why the organization decided it was time to implement the enterprise system? Make a list of what they see as the primary benefits of the implementation. What were the biggest hurdles they had to overcome? Are there any remaining issues that must be resolved before the project can be deemed a success? What are they? With the benefit of 20–20 hindsight, is there anything they would have done differently to make the project go more smoothly?
2. As a team, develop a list of seven key criteria that a nonprofit charitable organization should consider in selecting a CRM system. Discuss each criterion and assign a weight representing the relative importance of that criterion. Develop a simple spreadsheet to use in scoring various CRM alternatives in terms of how well they meet these criteria on a scale of 0 to 4. Do research on the Web to identify three candidate CRM software packages. Based on information presented on their Web site, score each alternative using your set of criteria. Which candidate CRM software does your team select?

WEB EXERCISES

1. Do research on the Web to find several sources that discuss the challenges associated with the implementation of an enterprise system. Is there general agreement among the sources as to the most significant challenges? What advice is offered as to the most effective way to overcome these challenges? Develop your own list of the five most significant challenges and five most effective tactics for overcoming these challenges.
2. Using the Web, identify several software services firms that offer consulting services to help organizations implement enterprise systems. Gain an understanding of what sort of services they offer and become familiar with several of their success stories. If you had to choose one of the software services firms to assist your SME organization, which one would you choose and why?

CAREER EXERCISES

1. Do research to identify three organizations that develop and operate e-commerce Web sites for their clients. Visit their Web sites and identify current job openings. What sort of responsibilities are associated with these positions? What experience and education requirements are needed to fill these positions? Do any of these positions appeal to you? Why or why not?
2. Imagine that you are a commercial solar heating salesperson for a manufacturing and installation firm. You make frequent sales calls on potential

customers in a three-state area. The purpose of these sales calls is to acquaint the firms with your company's products and get them to consider purchase of your products. Describe the basic functionality you would want in your organizations' CRM system for it to help identify potential new customers and to support you in preparing and making presentations to these people.

CASE STUDIES

Case One

From Stand-Alone to Integrated Applications

YIOULA Group is the largest glass manufacturer in the Balkans, producing over 625,000 glass containers annually as well as over 30,000 tons of tableware. Starting in the 1990s in Greece, the company expanded by acquiring other glassmaking firms in Romania, Bulgaria, and Ukraine. The company has seven factories in four countries, about 2,100 employees, and net annual sales of about €180 million (about U.S. $240 million).

As a result of its growth through acquisition, YIOULA Group found itself with a confusing variety of information systems. The group was unable to compare production costs for the same item across factories, could not improve efficiencies by coordinating purchasing and financial management across all its plants, and was not positioned for continued growth or expansion into new market areas. Clearly, its legacy stand-alone applications needed to be replaced.

YIOULA Group CIO Zacharias Maridakis had previous experience using integrated enterprise software when he worked at Mobil Oil's Greek subsidiary, Mobil Oil Hellas S.A., in the 1990s. Therefore, he was well acquainted with the advantages of such software. Under his direction, YIOULA Group investigated various software packages. They selected JD Edwards EnterpriseOne, named for a company that had become part of Oracle Corporation in 2005. Part of the reason for this choice was that most other ERP packages, including the SAP software with which Maridakis had worked at Mobil, are designed primarily for much larger organizations. EnterpriseOne was always intended for medium-sized firms.

Because YIOULA Group had little experience with EnterpriseOne, it enlisted the help of Oracle partner Softecon to help configure the software to the company's needs, meet the legal requirements of each region in which it operates, and manage implementation in each area. Support for the Greek language (as well as English and eighteen others) is a standard JD Edwards EnterpriseOne capability available from Oracle; Softecon added the other languages that YIOULA Group needed to the user interface. YIOULA Group also added a specialized cost comparison module from Softecon to the basic EnterpriseOne package. This module helps the group choose the lowest-cost facility to manufacture a product.

The conversion to a single enterprise package gave YIOULA Group the expected benefits. Time from order to invoice, delivery time, and cash collection have all been accelerated. Financial data is now available two weeks after the end of a period versus one month previously. A consolidated view of inventory across all plants has enabled the group to manage inventory more efficiently and comprehensively and to use just-in-time purchasing methods.

Perhaps even more importantly, YIOULA Group is now positioned to grow. As Maridakis puts it, "Oracle's JD Edwards EnterpriseOne is a key enabler of our strategy to enhance market leadership in the Balkans, grow our business in the Ukraine, and continue to improve productivity, efficiency, and profitability as we expand into new markets."

Discussion Questions

1. What problems had the YIOULA Group's stand-alone legacy software created for the company?
2. What are the advantages of ERP systems over stand-alone software packages?

Critical Thinking Questions

1. What immediate and long-term needs did EnterpriseOne fill for the YIOULA Group?
2. The YIOULA group adopted a general ERP system that was not industry specific. What are the advantages and disadvantages of general ERP systems and industry-specific systems?

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Case Two

Kramp Group, A Million Spare Parts—and Counting

Kramp Group is Europe's largest distributor of accessories and parts for motorized equipment, agriculture, and construction machines. That may not sound glamorous, but as IT manager Robert Varga explains, "Modern agriculture is highly mechanized: it is impossible to run a farm successfully without tractors, harvesters and other machinery. If a critical component fails and puts one of our customers' machines out of action, the loss of productivity can cost them serious

amounts of money. We have a catalogue of more than 700,000 spare parts which can be delivered within a single working day from any of our European warehouses to their nearest dealership, helping them get back up and running as quickly as possible."

Kramp Group CEO Eddie Perdok says, "We believe in the future and the power of e-commerce. Compared to other sales channels, the Internet gives us significant cost advantages."

Yet, to Kramp's customers, using the Internet isn't automatic. Kramp takes more than 50,000 customer orders every day from various channels. Prior to 2010, "nearly 40 percent of our customers still placed their orders by phone, which meant that our call center staff had to spend a lot of time on basic order-processing," says Varga. To reduce that figure, Kramp had to make its online store easier to use—but their existing store, which had been developed in-house, did not have the flexibility to achieve this goal.

Kramp turned to software packages from IBM and German software firm Heiler AG to modernize its e-commerce systems. Hans Scholten, a member of Kramp Group's executive board, says, "We deliberately opt for the 'best of breed' solution for all packages. That means we choose the best available software for different applications." That philosophy helped determine the packages the company chose.

From IBM, the firm obtained WebSphere Commerce for the customer-facing side of its system. This software's multilanguage capability was important: Operating throughout Europe as Kramp does, being able to have one site that can operate in any of 10 languages was crucial. Nevertheless, Kramp had to translate the content into all the languages, because in 2012 even the best automatic translation software couldn't replace a skilled person. However, the advantage was that the company didn't have to develop and support different sites.

Kramp also uses Heiler Software's Product Information Management (PIM) solution. That software manages product data in the catalog behind WebSphere Commerce. Kramp wants to expand its deliverable stock to more than 1 million items and could not do so without PIM. Expanding to more than 1 million stocked items is crucial to Kramp's *long tail* strategy: the concept that each of the slow-selling items may not account for much revenue but that the total of all slow-selling items is large enough to make a difference to Kramp's success.

Finally, though Kramp has the in-house capability to manage its e-commerce system, it turned to CDC Software to help integrate the pieces. Doing so itself would have required the company to hire additional staff, which it wouldn't need when the project was done.

The result was that after Kramp's new system had been online, 90 percent of their customers chose to order online via the WebSphere Commerce solution. As a result, the company saw a significant reduction in the average cost per transaction." Varga reported, "Our call center staff now has more time to help customers solve complex problems, which improves customer service. Better service and lower operational costs are helping Kramp Group achieve 10 to 12 percent annual growth, so the solution is making a real contribution to the success of our business."

Discussion Questions

1. How do other types of e-commerce, such as business-to-consumer (B2C), differ from Kramp Group's business-to-business (B2B) e-commerce?
2. Kramp sees ecommerce as a complement to its call center operations. In this light, what risks did Kramp need to accommodate when creating the IT infrastructure they now possess?

Critical Thinking Questions

1. What is Kramp's "long-tail" strategy and why has it been effective?
2. What other types businesses and industries might benefit from the use of a "long-tail" strategy?

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Questions for Web Cases

See the Web site for this book to read about the Altitude Online case for this chapter. The following are questions concerning this Web case.

Altitude Online: E-Commerce Considerations

Discussion Questions

1. How does Altitude Online's Web site contribute to the company's commerce?
2. How will the new ERP system impact Altitude Online's Web presence?

Critical Thinking Questions

1. How can companies like Altitude Online, which sell services rather than physical products, use e-commerce to attract customers and streamline operations?
2. Consider a company like Fluid by reviewing its site: *www.fluid.com*. Fluid is similar to Altitude Online in the services it offers. What site features do you think are effective for e-commerce? How might you design the site differently?

Altitude Online: Enterprise System Considerations

Discussion Questions

1. Judging from the ERP features, how important is an ERP to the functioning of a business? Explain.
2. What consideration do you think led Altitude Online to decide to host the ERP on its own servers rather than using SaaS? What are the benefits and drawbacks of both approaches?

Critical Thinking Questions

1. What challenges lay ahead for Altitude Online as it rolls out its new ERP system?
2. How might the ERP affect Altitude Online's future growth and success?

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6 Information and Decision Support Systems

Principles	Learning Objectives
• Good decision-making and problem-solving skills are the key to developing effective information and decision support systems.	• Define the stages of decision making. • Discuss the importance of implementation and monitoring in problem solving.
• The management information system (MIS) must provide the right information to the right person in the right format at the right time.	• Explain the uses of MISs and describe their inputs and outputs. • Discuss information systems in the functional areas of business organizations.
• The focus of a decision support system (DSS) is on decision-making effectiveness when faced with unstructured or semistructured problems.	• List and discuss important characteristics of DSSs that give them the potential to be effective management support tools. • Identify and describe the basic components of a DSS.
• A group decision support system (GSS) uses the overall approach of a DSS to improve the decision-making process of a group.	• State the goals of a GSS and identify the characteristics that distinguish it from a DSS.

Information Systems in the Global Economy

UTTARAKHAND POWER CORPORATION LTD., INDIA

Lighting Up India with Management Information Systems

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Uttarakhand, a state in northeast India located along the foothills of the Himalayan mountains, has one of the fastest growing economies in the nation, reporting a 10 percent growth in its gross domestic product in recent years. With a rapidly developing economy, the state faces a sharply rising demand for electricity as businesses expand and as rural villages are added to the power grid. Uttarakhand Power Corporation Ltd. (UPCL) manages the distribution of electricity to 1.69 million consumers throughout the state. Until recently, however, UPCL lacked access to data that it needed to assess the performance of its power system. UPCL relied on an outside vendor that tracked electricity usage by manual methods.

"In the past, we would send out meter readers to manually record meter data and forward it to private agencies, who then used the information to create bills and send them to our customers," explains UPCL Superintending Engineer JMS Rauthan. "Customers would frequently file complaints about inaccurate charges, forcing bills to be revised, a time-consuming and costly process."

The company also lacked the ability to pinpoint faults in the power grid because they did not have an automated system of tracking outages and interruptions in service. Furthermore, UPCL did not have the ability to monitor power usage to improve efficiency of the grid and observe spikes in usage that would help the company detect incidents of electricity theft.

As a result, UPCL decided to adopt the IBM mPower Smart Utility Suite, a management information system (MIS) that handles meter-to-cash and customer care. A geographic information system (GIS) and a metrics dashboard are integrated into the system. The GIS allows UPCL managers to track outage and interruptions in service, so that they can schedule repairs to target weaknesses in the grid and establish a more efficient routine maintenance schedule. The system also reads the location of each meter and identifies defective meters. Technicians use handheld computers and terminals to record meter readings electronically rather than on paper that can be lost. Managers have used this information to improve UPCL's billing system, increasing customer satisfaction.

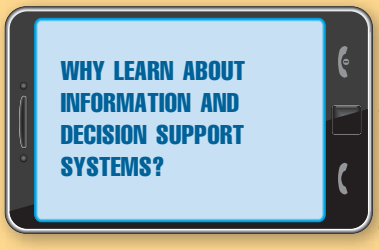
To meet the growing energy demands of the state, UPCL is expected to report how many customer service requests it receives and how many it addresses. Prior to implementing the new MIS, UPCL had incurred substantial financial penalties for failing to show that it was meeting expanding service levels. With service request and response now automated, UPCL is generating reports for the state's electricity regulatory commission and avoiding such fines.

Finally, the system automatically calculates and reports electrical consumption. When consumption rises or falls 10 to 15 percent above average rates, the system flags the spikes or drop in usage and sends an email to the vigilance department. Members of this department then investigate potential theft.

Deploying the new MIS system solved many problems for UPCL. Now the company is ready to begin its next big task: developing hydroelectric power to support increasing energy demands of the rapidly developing state.

As you read this chapter, consider the following:

- What types of information and decision support systems are used in different industries and organizations?
- What purposes do they serve, and how can they be used to support innovation and development?



You have seen throughout this book how information systems can make you more efficient and effective through the use of database systems, the Internet, e-commerce, enterprise systems, and many other technologies. The true potential of information systems, however, is in helping you and your coworkers make more informed decisions. This chapter shows you how to slash costs, increase profits, and uncover new opportunities for your company using management information and decision support systems. A financial planner can use management information and decision support systems to find the best investments for clients. A loan committee at a bank or credit union can use a group support system to help determine who should receive loans. Store managers can use decision support systems to help them decide what and how much inventory to order to meet customer needs and increase profits. An entrepreneur who owns and operates a temporary storage company can use vacancy reports to help determine what price to charge for new storage units. Everyone can become a better problem solver and decision maker. This chapter shows you how information systems can help. It begins with an overview of decision making and problem solving.

As shown in the opening vignette, information and decision support are the lifeblood of today's organizations. Thanks to information and decision support systems, managers and employees can obtain useful information in real time. Transaction processing systems and enterprise systems capture a wealth of data. When this data is filtered and manipulated, it can provide powerful support for managers and employees. The ultimate goal of management information and decision support systems is to help managers and executives at all levels make better decisions and solve important problems. The result can be increased revenues, reduced costs, and the realization of corporate goals. No matter what type of information and decision support system you use, its primary goal should be to help you and others become better decision makers and problem solvers.

DECISION MAKING AND PROBLEM SOLVING

Every organization needs effective decision makers. In most cases, strategic planning and the overall goals of the organization set the course for decision making, helping employees and business units achieve their objectives and goals. Often, information systems also assist with problem solving, helping people make better decisions and meet corporate goals as discussed in the opening vignette.

Baosteel is a leading steel manufacturer in China that, until recently, relied on simple manual methods to support its supply chain-related decision making. Unfortunately, these methods were time consuming and inefficient, resulting in frequent out-of-stock positions on key items as well as high inventory and production costs. Over a period of six years, Baosteel gradually upgraded its decision-making processes to include the use of information systems employing creative optimization techniques. Its new decision-making processes led to increased plant productivity and reduced consumption of energy and resources. Management estimates that the improved decision making led to a total cost savings of over $76 million.[1]

Decision Making as a Component of Problem Solving

Problem solving is a critical activity for any business organization. It is generally accepted that problem solving ability differs dramatically from one person to the next with some people having good problem-solving skills, while

decision-making phase: The first part of problem solving, including three stages: intelligence, design, and choice.

others do not. In business, one of the highest compliments you can receive is to be recognized by your colleagues and peers as a "real problem solver." A well-known model developed by Herbert Simon divides the **decision-making phase** of the problem-solving process into three stages: intelligence, design, and choice.[2] This model was later incorporated by George Huber into an expanded model of the entire problem-solving process.[3] See Figure 6.1.

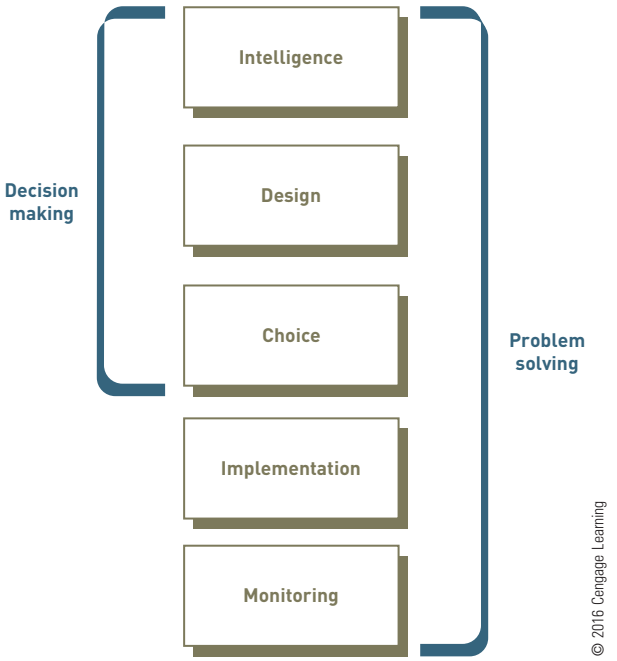


FIGURE **6.1**

How decision making relates to problem solving

The three stages of decision making—intelligence, design, and choice—are augmented by implementation and monitoring to result in problem solving.

intelligence stage: The first stage of decision making in which you identify and define potential problems or opportunities.

The first stage in the problem-solving process is the **intelligence stage**. During this stage, you identify and define potential problems or opportunities. You also investigate resource and environmental constraints. For example, flood control is a critical issue for the Netherlands with over 50 percent of this densely populated country below sea-level and subject to flooding. Natural sand dunes, human-made dikes, dams, and floodgates are all employed to protect the Dutch against storm surges from the sea. In addition, river dikes are needed to prevent flooding from water flowing into the country from the Rhine and Meuse rivers. The Second State Delta Committee, commissioned by the Dutch Secretary of Public Works and Water Management, was deeply troubled by the dike failures in New Orleans when it was hit by Hurricane Katrina. As a result of this and other factors, the committee recommended that measures be taken to raise flood protection levels in all diked areas and set a budget of 1 percent of gross national product, or about €1.2 billion to €1.6 billion, per year until 2050 to implement the necessary measures. Historical data was gathered and new sea water level forecasts were generated for use in developing new flood risk assessments.[4] This completed the intelligence stage for this problem and clearly framed the issue—how should this large sum of money be allocated across 3,500 km of dikes?

design stage: The second stage of decision making in which you develop alternative solutions to the problem and evaluate their feasibility.

In the **design stage**, you develop alternative solutions to the problem and evaluate their feasibility. In the Dutch flooding problem, a new methodology was developed for making flood risk assessments based on cost benefit analysis. Multiple flood risk assessments were made based on the historical data and new sea level forecasts gathered during the intelligence stage. Mixed integer nonlinear programming techniques were used to generate optimal strategies for all areas of the country protected by the dikes.[5]

choice stage: The third stage of decision making, which requires selecting a course of action.

The last stage of the decision-making phase, the **choice stage**, requires selecting a course of action. In the Dutch flooding example, the various strategies were analyzed and a decision was made to implement a set of economically efficient flood protection standards for different parts of the Netherlands that varied greatly from the existing standards. The new cost/benefit analysis showed that it was necessary and economically efficient to raise protection standards along the Rhine and Meuse rivers and two other areas of the country. Meanwhile, for many areas in the coastal region, the existing legal flood protection standards were judged to be more than adequate. There was no need to increase the legal flood protection standards for all flood-prone areas in the Netherlands by a factor 10, as was originally recommended.[6]

problem solving: A process that goes beyond decision making to include the implementation stage.

implementation stage: A stage of problem solving in which a solution is put into effect.

monitoring stage: The final stage of the problem-solving process in which decision makers evaluate the implementation.

Problem solving includes and goes beyond decision making. It also includes the **implementation stage** when the solution is put into effect. This would include making the recommended changes to each individual dike in the Dutch flooding example. The final stage of the problem-solving process is the **monitoring stage**. In this stage, decision makers evaluate the implementation to determine whether the anticipated results were achieved and to modify the implementation if needed. For example, should flooding occur due to unusually high sea levels or other unexpected weather conditions, or should dike modification prove more expensive than anticipated, the implementation would be modified appropriately.

Programmed versus Nonprogrammed Decisions

programmed decision: A decision made using a rule, procedure, or quantitative method.

In the choice stage, various factors influence the decision maker's selection of a solution. One factor is whether the decision can be programmed. **Programmed decisions** are routine and repetitive decisions. Often a rule, procedure, or quantitative method is employed to make these kinds of decisions. For example, to determine that a stock keeping unit should be reordered when the inventory level drops below the reorder point is a programmed decision because it adheres to a rule. Programmed decisions are easy to implement using traditional information systems.

Kraft is a global leader in the food and beverage industry with its popular brands in the beverage, cheese, and refrigerated meals categories found in nearly every North American household. It operates a large, complex supply chain with operations in some 72 countries and more than 150 manufacturing and processing locations worldwide. Many of the Kraft stock keeping units are seasonal products with a short shelf-life. The firm also offers frequent new product introductions and sales promotions. All this makes it critical for Kraft to manage its inventory in a highly efficient and cost-effective manner. To this end, Kraft implemented a sophisticated inventory management system that controls its inventory levels using programmed decisions based on preprogrammed reorder points and safety stock targets. See Figure 6.2. The programmed decision-making process has improved forecasting accuracy and reduced the possibility of manufacturing the wrong types of inventory, which has saved money and preserved cash reserves.[7]

nonprogrammed decision: A decision that deals with unusual or exceptional situations.

Nonprogrammed decisions are typically one-time decisions that in many cases are difficult to quantify. Determining the appropriate training program for a new employee, deciding whether to develop a new type of product line, and weighing the benefits and drawbacks of installing an upgraded pollution control system are examples. Each decision contains unique characteristics, and standard rules or procedures might not apply to them.

Structured, Semistructured, and Unstructured Decisions

structured decisions: Decisions where the variables that comprise the decision are known and can be measured quantitatively.

Anthony Gorry and Michael Scott Morton developed a framework that became the foundation of much of the research done on decision support systems.[8] Their work classified decisions based on their degree of structure. **Structured decisions** are ones where the variables that comprise the decision are known

FIGURE **6.2**

Programmed decisions

Kraft controls its inventory levels using programmed decisions embedded into its computer systems.

unstructured decisions: Decisions where the variables that affect the decision cannot be measured quantitatively.

semistructured decisions: Decisions where only some of the variables can be measured quantitatively.

and can be measured quantitatively. **Unstructured decisions** are ones where the variables that affect the decision cannot be measured quantitatively. **Semi-structured decisions** are ones where only some of the variables can be measured quantitatively. Most business decisions are semistructured. All three types of decisions can be encountered at each level of the organization—operational, tactical, and strategic. Table 6.1 identifies examples of each type of decision.

TABLE 6.1 Gorry-Morton framework

	Operational Control	Management Control	Strategic Control
Structured	Accounts receivable Order entry Inventory control	Budget analysis Short-term forecasting	Tanker fleet mix Warehouse and factory location
Semistructured	Production scheduling	Budget variance analysis	Mergers and acquisitions
Unstructured	Critical path scheduling	Sales and production	Research and development planning

Gorry and Morton believed that decision support systems helped solve many nonprogrammed decisions in which the problem is not routine and rules and relationships are not well defined (unstructured or semistructured problems). These problems can include deciding on the best location for a manufacturing plant or whether to rebuild a hospital that was severely damaged from a hurricane or tornado.

Optimization, Satisficing, and Heuristic Approaches

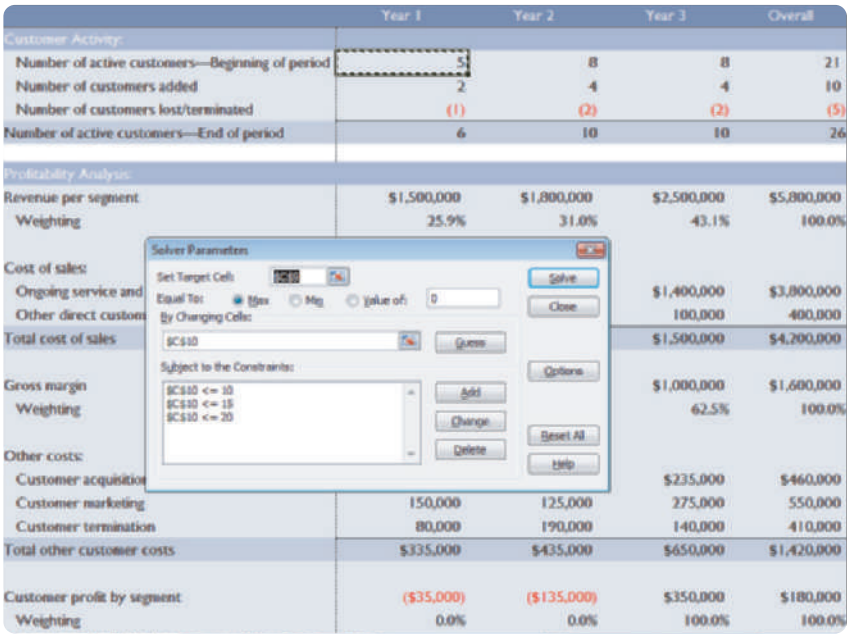
optimization model: A process to find the best solution, the one that will best help the organization meet its goals.

In general, computerized decision support systems can either optimize or satisfice. An **optimization model** finds the best solution, the one that will best help the organization meet its goals. Optimization models use problem constraints. A limit on the number of available work hours in a manufacturing facility is an example of a problem constraint.

Südzucker AG operates 29 sugar factories and 3 refineries in 11 European countries that produce more than 5 million tons of sugar annually. The sugar is converted into more than 2,000 products that are distributed to thousands of customers across Europe. In an effort to support its growth plans, the company

developed a sophisticated model to analyze trade-offs between production, warehousing, transportation costs, and service requirements. For example, Südzucker can accurately determine the financial value of moving the production of specific sugar products to a facility in Belgium versus opening new warehouse locations in Austria. The model enables the quick generation and evaluation of options for a given set of assumptions and constraints (such as labor costs, factory production capacity, and storage costs) from which the optimal option can be determined.[9]

Some spreadsheet programs, such as Excel, have optimizing features, as shown in Figure 6.3. Optimization software also allows decision makers to explore various alternatives.



Microsoft product screenshots used with permission from Microsoft Corporation

FIGURE 6.3

Optimization software

Some spreadsheet programs, such as Microsoft Excel, have optimizing routines. This figure shows Solver, which can find an optimal solution given certain constraints.

satisficing model: A model that will find a good—but not necessarily the best—solution to a problem.

A **satisficing model** is one that finds a good—but not necessarily the best—solution to a problem. Satisficing is used when modeling the problem properly to get an optimal decision would be too difficult, complex, or costly. Satisficing normally does not look at all possible solutions but only at those likely to give good results.

For example, the traveling salesman problem is a classic problem that seeks to find the answer to the question: Given a set of destinations, what is the shortest route that allows the salesperson to visit every destination and return to the starting place? The solution of the problem has an obvious application to the routing of delivery trucks. It also has practical applications to solving other problems such as drilling holes in circuit boards, scheduling tasks on a computer, and ordering features of a genome. As it turns out, no general algorithm guarantees an optimal solution to this problem when the number of destinations is large. For a small number of destinations, the problem can be easily solved by computing every round-trip route to find the shortest one. But as the number of destinations increases, the number of possible routes grows exponentially—for 15 destinations, the number of possible routes exceeds 87 billion.[10]

UPS relies on a route optimization tool called ORION (On-Road Integrated Optimization and Navigation) to recommend a delivery route for each of its 55,000 drivers who make some 16 million deliveries each day. The tool must incorporate promised delivery times into its calculations. While ORION cannot possibly optimize each route, it must develop a solution that is close to the optimal as the stakes are high. The cost to UPS per year if each driver drives just one more mile each day than necessary is $30 million.[11]

heuristics: Commonly accepted guidelines or procedures that usually find a good solution.

Heuristics, also known as "rules of thumb," are commonly accepted guidelines or procedures that experience has shown usually leads to a good solution. These rule-of-thumb strategies shorten decision-making time and enable people to function without constantly deliberating over what course of action to take. While heuristics are helpful in many situations, they can also lead to biases and place too much emphasis on the past.

A heuristic that baseball team managers use is to place batters most likely to get on base at the top of the lineup, followed by the power hitters who can drive them in to score. An example of a heuristic that an organization might use to manage its assets is "Don't allow total accounts payable to exceed cash on hand by more than 50 percent."

ESET is a Slovakia-based IT security company that develops leading-edge security solutions against cyber threats. Its products provide the ability to detect unknown malware (such as a virus, worm, or Trojan horse) based on the use of advanced heuristics. This approach looks for certain instructions or commands within a program that are not found in typical application programs. As a result, it is able to detect potentially malicious functionality in new, previously unexamined, malware.[12]

Benefits of Information and Decision Support Systems

The information and decision support systems covered in this chapter and the next help individuals, groups, and organizations make better decisions, solve problems, and achieve their goals. These systems include management information systems, decision support systems, group support systems, executive support systems, knowledge management systems, and a variety of special-purpose systems. As shown in Figure 6.4, the benefits of these systems are a measure of increased performance of the systems versus the cost to deliver them. The plus sign (+) by the arrow from *performance* to *benefits* indicates that increased performance has a positive impact on benefits. The minus sign (−) from *cost* to *benefits* indicates that increased cost has a negative impact on benefits.

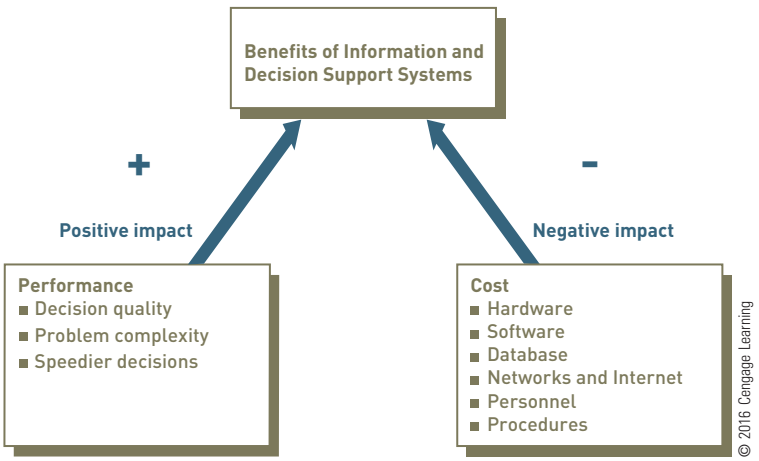


FIGURE **6.4**

Benefits of information and decision support systems

The benefits are increased performance of the information and decision support systems compared to the cost to deliver them.

The performance of these systems is typically a function of decision quality, problem complexity, and decision-making speed. Decision quality can result in increased effectiveness, increased efficiency, higher productivity, and many other measures. Problem complexity depends on how hard the problem is to solve and implement. Speed of decision making is improved, resulting in quicker implementation of a solution. The costs of delivering these systems are the expenditures of the information technology components, including hardware, software, databases, networks and the Internet, people, and procedures. But how do these systems actually deliver benefits to the individuals,

groups, and organizations that use them? It depends on the system. We begin our discussion with traditional management information systems.

AN OVERVIEW OF MANAGEMENT INFORMATION SYSTEMS

A management information system (MIS) is an integrated collection of people, procedures, databases, and devices that provides managers and decision makers with information to help achieve organizational goals. MISs can often give companies and other organizations a competitive advantage by providing the right information to the right people in the right format and at the right time.

Management Information Systems in Perspective

The primary purpose of an MIS is to help an organization achieve its goals by providing managers with insight into the regular operations of the organization so that they can control, organize, and plan more effectively. One important role of the MIS is to provide the right information to the right person in the right format at the right time. In short, an MIS provides managers with information, typically in reports, that supports effective decision making and provides feedback on daily operations. Figure 6.5 shows the role of MISs within the flow of an organization's information. Note that business transactions can enter the organization via traditional methods, via the Internet, or via an extranet connecting customers and suppliers to the firm's ERP or transaction processing systems. The use of MISs spans all levels of management; that is, they provide support to and are used by employees throughout the organization.

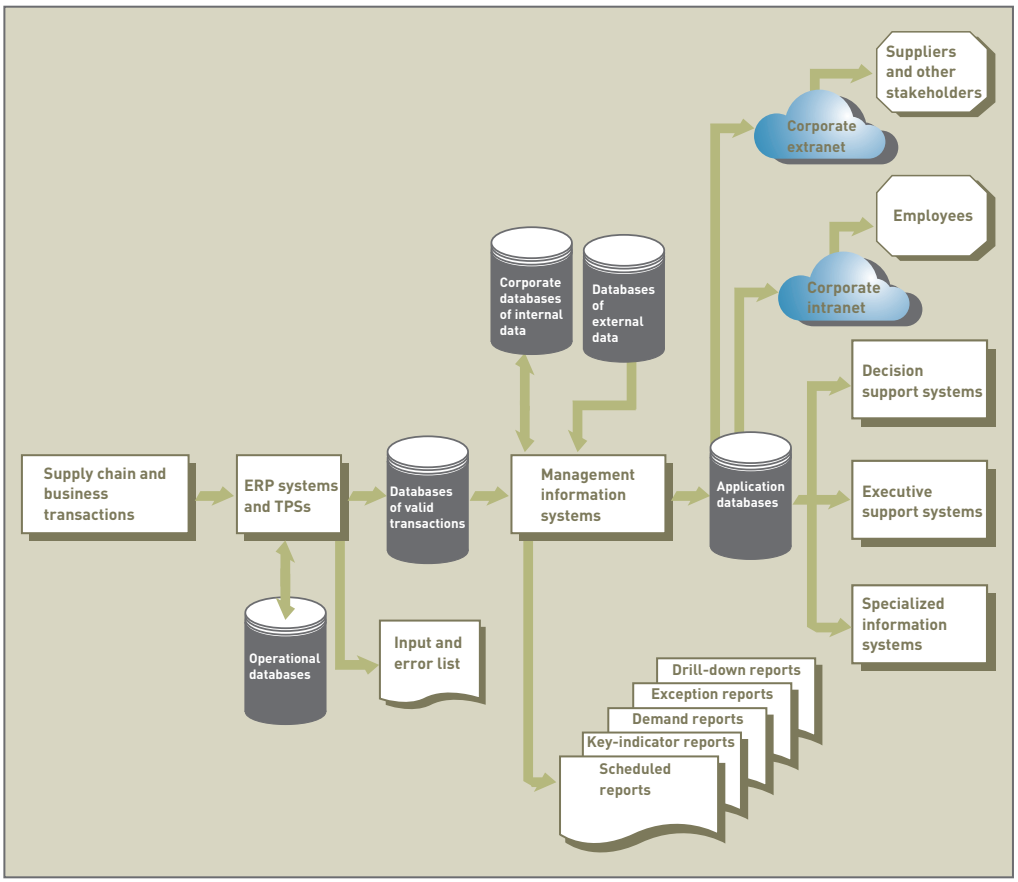


FIGURE **6.5**

Sources of managerial information

The MIS is just one of many sources of managerial information. Decision support systems, executive support systems, and expert systems also assist in decision making.

Inputs to a Management Information System

As shown in Figure 6.5, data that enters an MIS originates from both internal and external sources, including a company's supply chain. The most significant internal data sources for an MIS are the organization's various TPS and ERP systems and related databases. External sources of data can include customers, suppliers, competitors, and stockholders, whose data is not already captured by the TPS and enterprise systems, as well as other sources, such as the Internet. Companies also use data warehouses and data marts to store valuable business information that can be used across the organization.

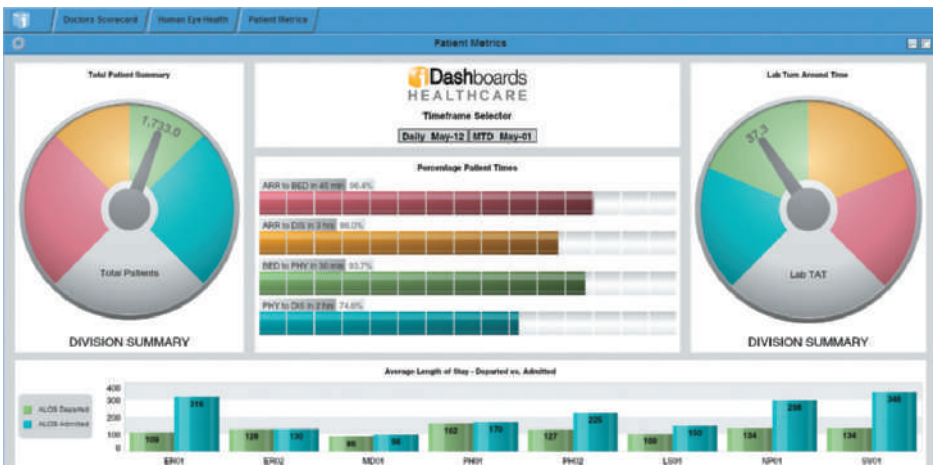
Outputs of a Management Information System

The output of most MISs is a collection of reports that are distributed to managers. Many MIS reports are generated using the data in an organization's databases. These reports can be tailored for each user and can be delivered in a timely fashion.

Aarogyasri Health Care Trust is a not-for-profit project for the Andhra Pradesh state of India. It provides healthcare coverage for millions of low income families connected to over 340 network hospitals through primary care centers and medical camps. The Trust worked with Tata Consultancy Services to create a database of critical patient, hospital, and insurance information to provide services and monitor operations. Hundreds of doctors and staff at the network hospitals and over 1,000 users from third-party insurance companies use a reporting software tool to access this database and deliver information to make better informed and quicker decisions.[13] Many reporting systems can also create an **executive dashboard** that presents a set of key performance indicators about the state of a process at a specific point in time to enable managers make better real-time decisions. For example, a dashboard like that shown in Figure 6.6 can provide hospital bed managers a real-time view of bed availability and discharge status including:

executive dashboard: A diagram that presents a set of key performance indicators about the state of a process at a specific point in time to enable managers make better real-time decisions.

- Occupied and available beds across the system and by unit
- Number of critical and telemetry beds available
- Number of observation patients
- Length of stay (LOS) and discharge statistics from time a discharge order is written until the patient actually leaves the room
- Key hospital support service performance relative to bed turns, such as Environmental Services: stat turnaround, clean next bed turnaround, last bed on the unit turnaround, and routine turnaround



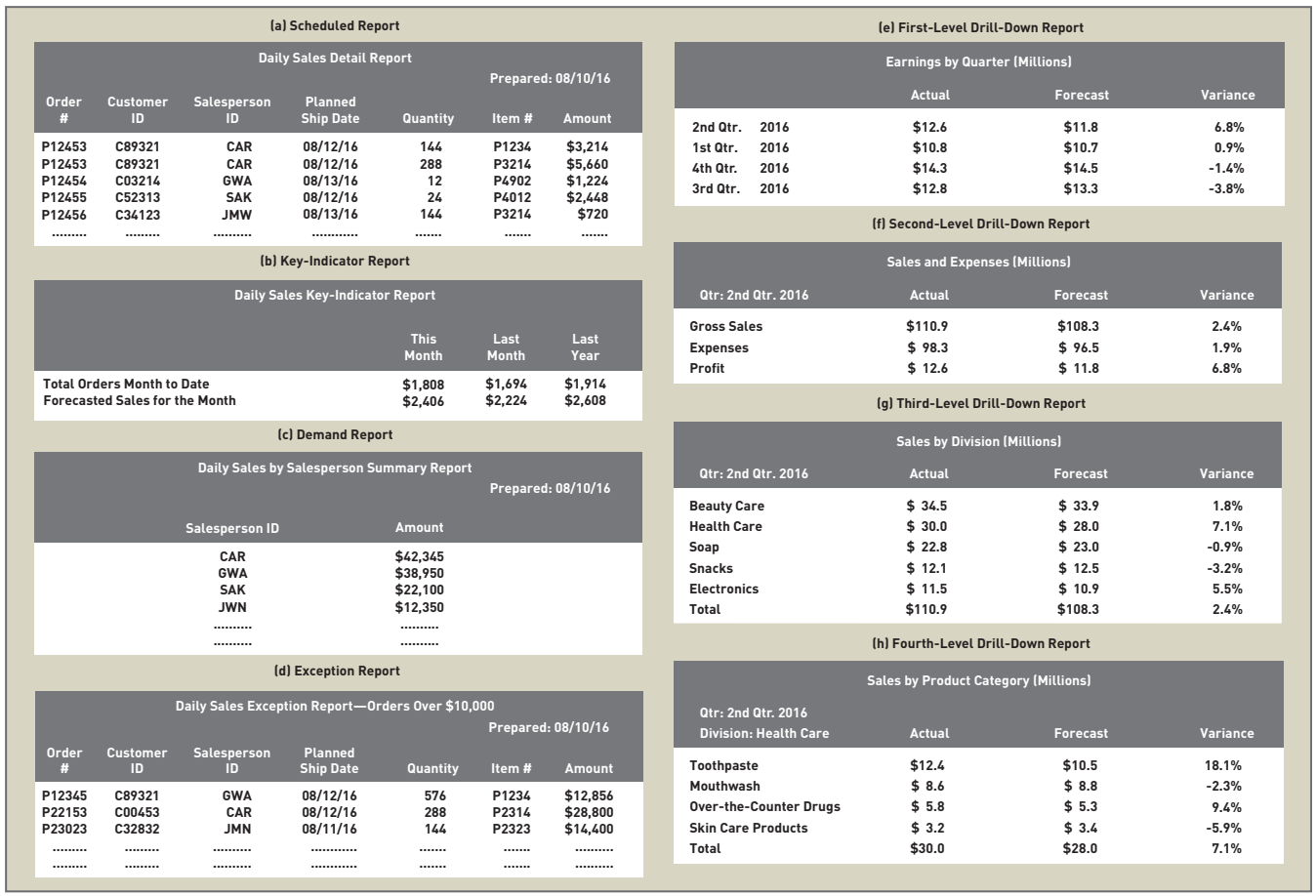
Source: www.idashboards.com

FIGURE **6.6**

Executive dashboard

Reporting software tools can create executive dashboards that present a set of key performance indicators about the state of a process at a specific point.

Management reports can come from various company databases, data warehouses, and other sources. These reports include scheduled reports, key-indicator reports, demand reports, exception reports, and drill-down reports in addition to executive dashboards. See Figure 6.7.



(a) Scheduled Report

Daily Sales Detail Report — Prepared: 08/10/16

Order #	Customer ID	Salesperson ID	Planned Ship Date	Quantity	Item #	Amount
P12453	C89321	CAR	08/12/16	144	P1234	$3,214
P12453	C89321	CAR	08/12/16	288	P3214	$5,660
P12454	C03214	GWA	08/13/16	12	P4902	$1,224
P12455	C52313	SAK	08/12/16	24	P4012	$2,448
P12456	C34123	JMW	08/13/16	144	P3214	$720
.....	.....	.....	.....	.....	.....	.....

(b) Key-Indicator Report

Daily Sales Key-Indicator Report

	This Month	Last Month	Last Year
Total Orders Month to Date	$1,808	$1,694	$1,914
Forecasted Sales for the Month	$2,406	$2,224	$2,608

(c) Demand Report

Daily Sales by Salesperson Summary Report — Prepared: 08/10/16

Salesperson ID	Amount
CAR	$42,345
GWA	$38,950
SAK	$22,100
JWN	$12,350
.....	.....
.....	.....

(d) Exception Report

Daily Sales Exception Report—Orders Over $10,000 — Prepared: 08/10/16

Order #	Customer ID	Salesperson ID	Planned Ship Date	Quantity	Item #	Amount
P12345	C89321	GWA	08/12/16	576	P1234	$12,856
P22153	C00453	CAR	08/12/16	288	P2314	$28,800
P23023	C32832	JMN	08/11/16	144	P2323	$14,400
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....

(e) First-Level Drill-Down Report

Earnings by Quarter (Millions)

	Actual	Forecast	Variance
2nd Qtr. 2016	$12.6	$11.8	6.8%
1st Qtr. 2016	$10.8	$10.7	0.9%
4th Qtr. 2016	$14.3	$14.5	-1.4%
3rd Qtr. 2016	$12.8	$13.3	-3.8%

(f) Second-Level Drill-Down Report

Sales and Expenses (Millions)

Qtr: 2nd Qtr. 2016	Actual	Forecast	Variance
Gross Sales	$110.9	$108.3	2.4%
Expenses	$ 98.3	$ 96.5	1.9%
Profit	$ 12.6	$ 11.8	6.8%

(g) Third-Level Drill-Down Report

Sales by Division (Millions)

Qtr: 2nd Qtr. 2016	Actual	Forecast	Variance
Beauty Care	$ 34.5	$ 33.9	1.8%
Health Care	$ 30.0	$ 28.0	7.1%
Soap	$ 22.8	$ 23.0	-0.9%
Snacks	$ 12.1	$ 12.5	-3.2%
Electronics	$ 11.5	$ 10.9	5.5%
Total	$110.9	$108.3	2.4%

(h) Fourth-Level Drill-Down Report

Sales by Product Category (Millions)

Qtr: 2nd Qtr. 2016 Division: Health Care	Actual	Forecast	Variance
Toothpaste	$12.4	$10.5	18.1%
Mouthwash	$ 8.6	$ 8.8	-2.3%
Over-the-Counter Drugs	$ 5.8	$ 5.3	9.4%
Skin Care Products	$ 3.2	$ 3.4	-5.9%
Total	$30.0	$28.0	7.1%

FIGURE **6.7**

Reports generated by an MIS

The types of reports are (a) scheduled, (b) key-indicator, (c) demand, (d) exception, and (e–h) drill down.

Scheduled Reports

scheduled report: A report produced periodically, such as daily, weekly, or monthly.

Scheduled reports are produced periodically, such as daily, weekly, or monthly. For example, a production manager might use a weekly scheduled report that lists total payroll costs to monitor and control labor and job costs. Other scheduled reports can help managers control customer credit, monitor the performance of sales representatives, check inventory levels, and more.

key-indicator report: A summary of the previous day's critical activities, typically available at the beginning of each workday.

A **key-indicator report** summarizes the previous day's critical activities and is typically available at the beginning of each workday. These reports can summarize inventory levels, production activity, sales volume, and the like. Key-indicator reports are used by managers and executives to take quick, corrective action on significant aspects of the business.

The North Carolina Community College System serves over 800,000 students. Each year it produces a report called "Performance Measures for Student Success," based on data compiled from the previous year. The report informs

colleges and the public on the performance of its 58 community colleges. The following eight key performance indicators are included:[14]

- Basic Skills Student Progress
- Developmental Student Success Rate in College-Level English Courses
- First Year Progression
- Licensure and Certification Passing Rate
- GED Diploma Passing Rate
- Developmental Student Success Rate in College-Level Math Courses
- Curriculum Student Completion
- College Transfer Performance

Demand Reports

demand report: A report developed to give certain information at someone's request rather than on a schedule.

Demand reports are developed to provide certain information upon request. In other words, these reports are produced on demand rather than on a schedule. Like other reports discussed in this section, they often come from an organization's database system. For example, an executive might want to know the production status of a particular item. A demand report can be generated to provide the requested information by querying the company's database. Suppliers and customers can also use demand reports. FedEx, for example, provides demand reports on its Web site to allow customers to track packages from their source to their final destination.

Exception Reports

exception report: A report automatically produced when a situation is unusual or requires management action.

Exception reports are reports automatically produced when a situation is unusual or requires management action. For example, a manager might set a parameter that generates a report of all inventory items with fewer than the equivalent of five days of sales on hand. This unusual situation requires prompt action to avoid running out of stock on the item. The exception report generated by this parameter would contain only items with fewer than five days of sales in inventory.

Capital One 360 is a large savings bank whose customers conduct most of their transactions online. The bank closely monitors several critical data files throughout the course of its operations. For example, one file holds data about payments that are scheduled to be sent overnight to other banks and financial institutions. There is a cut-off time when this file can no longer be modified. If a change is requested after the cut-off time, an exception report is generated. The report identifies when the change was requested and by whom. Then an employee manually checks the report to make sure that all changes were properly authorized and conducted correctly. The report ensures that no data has been tampered or transactions interfered with.[15]

As with key-indicator reports, exception reports are most often used to monitor aspects important to an organization's success. In general, when an exception report is produced, a manager or executive takes action. Parameters, or *trigger points*, should be set carefully for an exception report. Trigger points that are set too low might result in too many exception reports; trigger points that are too high could mean that problems requiring action are overlooked. For example, if the purchasing manager of a large manufacturing company wants an exception report that shows all purchases of raw materials over $100, the system might retrieve almost every purchase. The $100 trigger point is probably too low. A trigger point of $10,000 might be more appropriate.

Drill-Down Reports

drill-down report: A report providing increasingly detailed data about a situation.

Drill-down reports provide increasingly detailed data about a situation. Using these reports, analysts can see data at a high level first (such as sales for the entire company), then at a more detailed level (such as the sales for one department of the company), and then a very detailed level (such as sales for one sales representative). Companies and organizations of all sizes and types use drill-down reports.

Characteristics of a Management Information System

Dashboard, scheduled, key-indicator, demand, exception, and drill-down reports have all helped managers and executives make better, more timely decisions. In general, MISs perform the following functions:

- Provide reports with fixed and standard formats.
- Produce hard-copy and soft-copy reports.
- Use internal data stored in the computer system.
- Allow users to develop custom reports.
- Require user requests for reports developed by systems personnel.

FUNCTIONAL ASPECTS OF THE MIS

Most organizations are structured along functional areas such as finance, manufacturing, marketing, human resources, and other specialized areas of the business. The MIS can also be divided along those functional lines to produce reports tailored to the individual functions. See Figure 6.8.

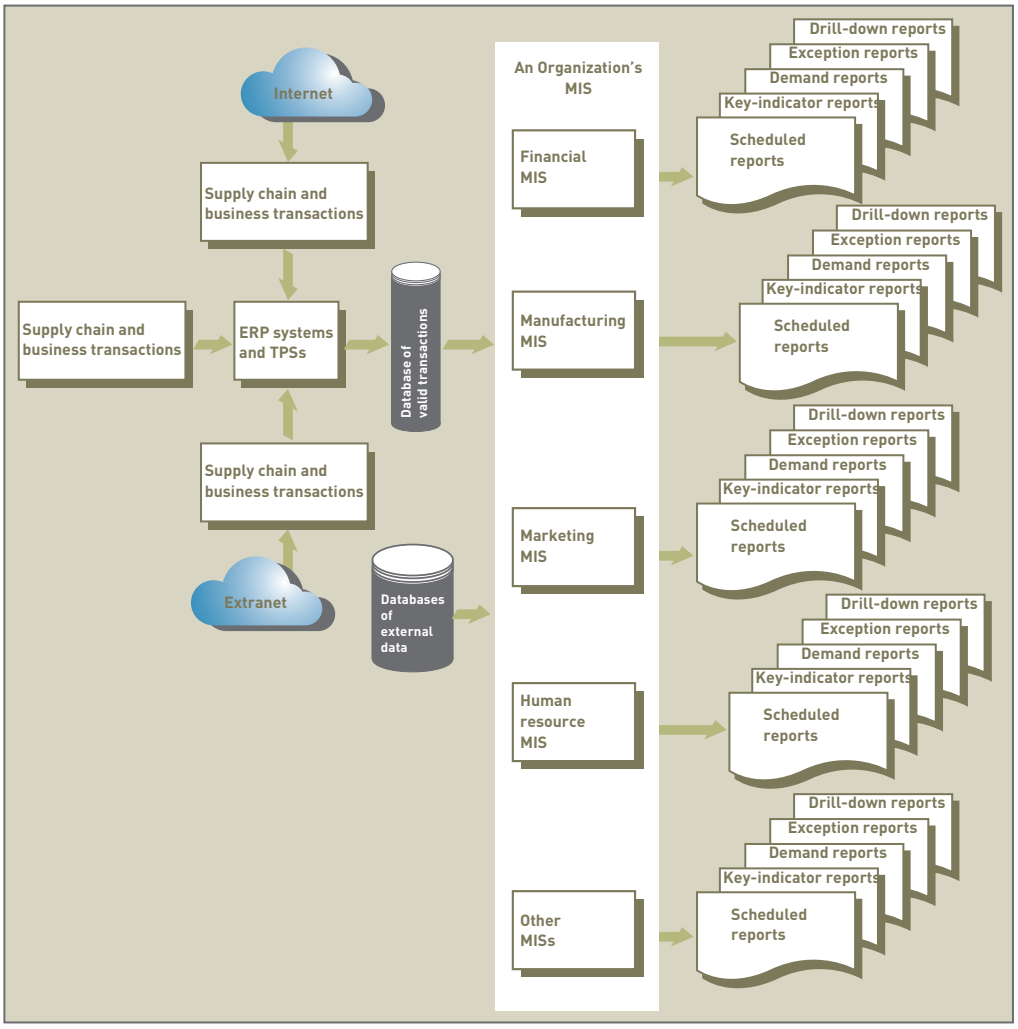


FIGURE **6.8**

An organization's MIS

The MIS is an integrated collection of functional information systems, each supporting particular functional areas.

Financial Management Information Systems

financial MIS: An information system that provides financial information for workers who need to make better decisions on a daily basis.

A **financial MIS** provides financial information for workers who need to make better decisions on a daily basis. Most financial MISs perform the following functions:

- Integrate financial and operational information from multiple sources, including the Internet, into a single system.
- Provide easy access to data for both financial and nonfinancial users, often through the use of a corporate intranet to access corporate Web pages of financial data and information.
- Make financial data immediately available to shorten analysis turnaround time.
- Enable analysis of financial data along multiple dimensions—time, geography, product, plant, and customer.
- Analyze historical and current financial activity.
- Monitor and control the use of funds over time.

The general ledger defines the accounting categories of a business and is a key component of the financial MIS. It is often divided into categories, including assets, liabilities, revenue, expenses, and equity. These categories, in turn, are subdivided into subledgers to capture details such as cash, accounts payable, and accounts receivable. The business processes required to capture and report these accounting details are essential to the operation of any organization. Input to the general ledger occurs simultaneously with the input of a business transaction to a specific module. The following are several examples of how this process occurs:

- An order clerk records a sale generating an accounts receivable entry indicating that a customer owes money for goods received.
- A buyer enters a purchase order, generating an accounts payable entry in the general ledger registering that the company has an obligation to pay for goods that will be received at some time in the future.
- A dock worker enters a receipt of purchased materials from a supplier generating a general ledger entry to increase the value of inventory on hand.
- A production worker withdraws raw materials from inventory to support production generating a record to reduce the value of inventory on hand.

Transaction processing systems or enterprise systems capture transactions entered by workers in all functional areas of the business. These systems then create the associated general ledger records to track the financial impact of the transaction. This set of records is an extremely valuable resource that companies can use to support financial and managerial accounting.

Financial accounting consists of capturing and recording all the transactions that affect a company's financial state and then using these documented transactions to prepare financial statements to external decision makers, such as stockholders, suppliers, banks, and government agencies. These financial statements include the income statement, balance sheet, and cash-flow statement. See Table 6.2. They must be prepared in strict accordance to rules and guidelines of agencies such as the Securities and Exchange Commission, the Internal Revenue Service, and the Financial Accounting Standards Board. Data gathered for financial accounting can also form the basis for tax accounting because it involves external reporting of a firm's activities to the local, state, and federal tax agencies.

Managerial accounting involves using both historical and estimated data in providing information that management needs to conduct daily operations, plan future operations, and develop overall business strategies. Managerial accounting provides data to enable the firm's managers to assess the

TABLE 6.2 Income statement

An income statement shows an organization's business results, including revenues and costs including taxes.

Pinnacle Peak Manufacturing Income Statement			
Date Prepared: July 3, 2017			
Fiscal year	**2016**	**2015**	**2014**
Total Revenue	**$28,365,000**	**$25,296,000**	**$22,956,000**
Cost of Goods Sold	$5,191,000	$3,455,000	$3,002,000
Gross Profit	$23,174,000	$21,841,000	$$19,954,000
Operating Expense			
Research and Development	$4,307,000	$4,379,000	$3,775,000
Selling, General, and Administrative Expenses	$6,957,000	$5,742,000	$5,242,000
Operating Income			
Operating Income	$11,910,000	$11,720,000	$10,937,000
Total Other Income and Expenses Net	($397,000)	($195,000)	$3,338,000
Earnings Before Interest and Taxes	$11,513,000	$11,525,000	$14,275,000
Interest Expense	N/A	N/A	N/A
Income Before Taxes	$11,513,000	$11,525,000	$14,275,000
Income Tax Expense	$3,684,000	$3,804,000	$4,854,000
Net Income	**$7,829,000**	**$7,721,000**	**$9,421,000**

profitability of a given product line or specific product, identify underperforming sales regions, establish budgets, make profit forecasts, and measure the effectiveness of marketing campaigns.

All transactions that affect the financial state of the firm are captured and recorded in the financial MIS. This data is used to prepare the statements required by various constituencies. The data can also be used in the managerial accounting modules of the MIS system along with various assumptions and forecasts to perform different analyses such as generating a forecasted profit-and-loss statement to assess the firm's future profitability. The use of an MIS to perform financial and managerial accounting can contribute significantly to a company's success.

BMW developed a financial MIS to plan the volume and profitability of its future business. The results of these analyses were integrated into an enterprise-wide reporting system while meeting the requirements of regulatory agencies and reducing the manual effort of its financial managers.[16]

Figure 6.9 shows typical inputs, function-specific subsystems, and outputs of a financial MIS, including profit and loss, auditing, and uses and management of funds.

Some of the financial MIS subsystems and outputs include:

profit center: An independent business unit that is treated as a distinct entity enabling its revenues and expenses to be determined and its profitability to be measured.

revenue center: An organizational unit that gains revenue from the sale of products or services.

- **Profit/loss and cost systems.** A **profit center** is an independent business unit that is treated as a distinct entity enabling its revenues and expenses to be determined and its profitability to be measured. Profit centers are separated for accounting purposes so that the management can monitor how much profit each center makes and compare their relative effectiveness and profit. The manager of a profit center is held accountable for both revenue and costs. The investment division of a large insurance company and the service department of an auto dealer are examples of profit centers. A **revenue center** is an organizational unit

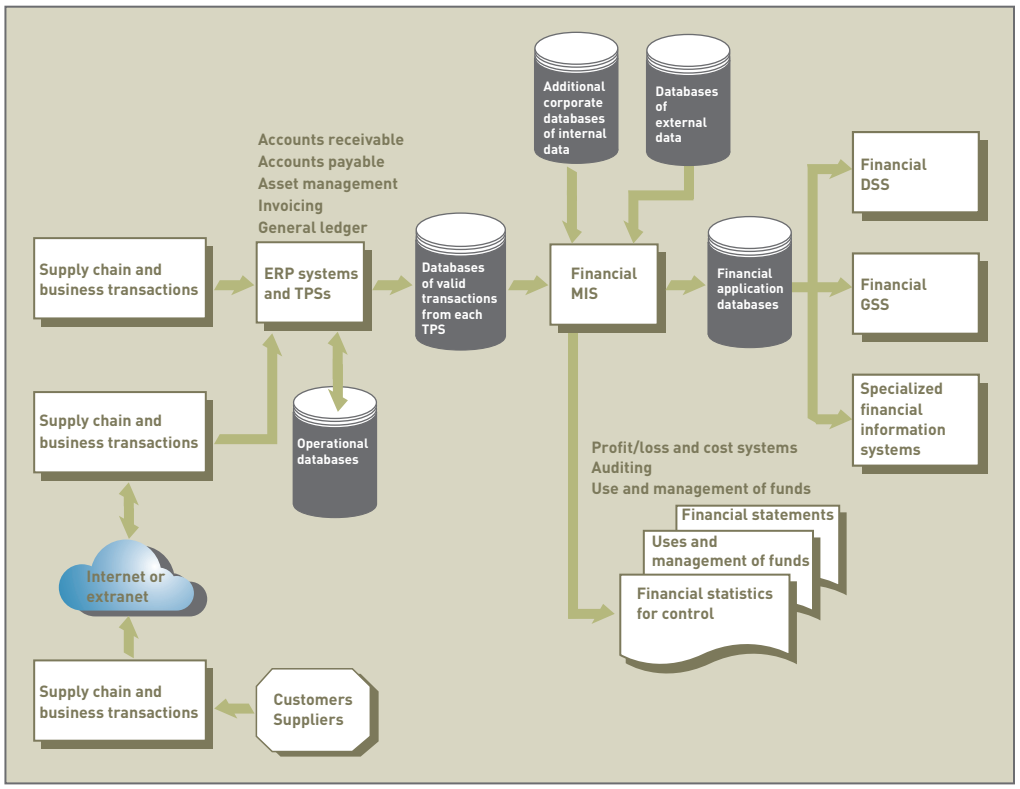


FIGURE **6.9**

Overview of a financial MIS

A financial MIS shows profit and loss, auditing, and uses and management of funds.

cost center: A division within a company that does not directly generate revenue.

auditing: Provides an objective appraisal of the accounting, financial, and operational procedures and information of an organization.

financial audit: A thorough assessment of the reliability and integrity of the organization's financial information and the methods used to process it.

operational audit: An assessment of how well management uses the resources of the organization and how effectively organizational plans are being executed.

internal auditing: Auditing performed by individuals within the organization.

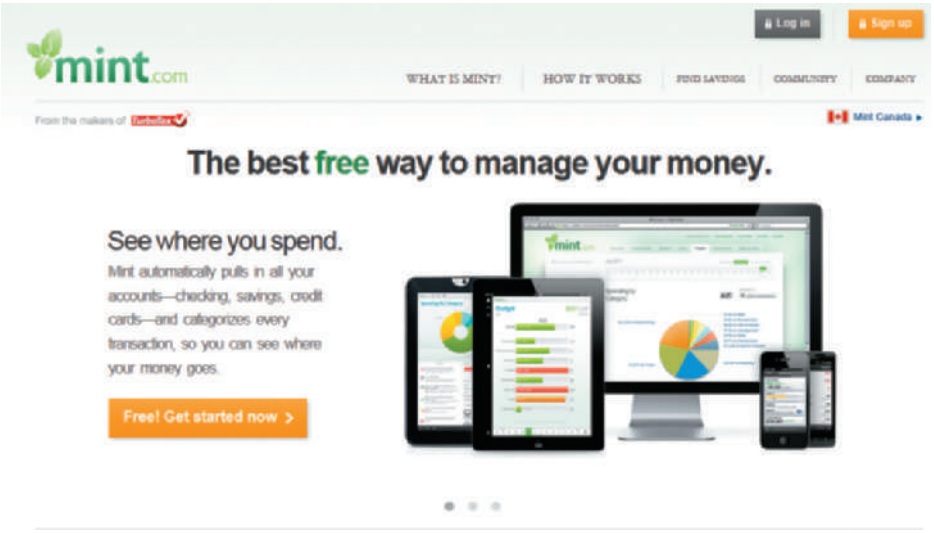
external auditing: Auditing performed by an outside group.

that gains revenue from the sale of products or services. The manager of a revenue center is responsible for revenue generation only. Still other organizational units, such as manufacturing or research and development, can be **cost centers**, which are divisions within a company that do not directly generate revenue. Information systems are used to compute revenues, costs, and profits.

- **Auditing.** **Auditing** provides an objective appraisal of the accounting, financial, and operational procedures and information of an organization. Several types of audits may be conducted. A **financial audit** is a thorough assessment of the reliability and integrity of the organization's financial information and the methods used to process it. An **operational audit** is an assessment of how well management uses the resources of the organization and how effectively organizational plans are being executed. **Internal auditing** is performed by individuals within the organization. For example, the finance department of a corporation might use a team of employees to perform an audit of its accounts payable operation to ensure that it is adhering to company standards and policies. **External auditing** is performed by an outside group, usually an accounting firm such as PricewaterhouseCoopers, Deloitte & Touche, or one of the other major international accounting firms. Computer systems are used in all aspects of internal and external auditing. An audit of the New York State Common Retirement Fund (CRF) revealed several information system problems at the Office of the State Comptroller (OSC). If left unmitigated, these problems could lead to a disaster for New Yorkers that rely on OSC to administer and distribute their retirement savings. The audit by the Department of Financial Services (DFS) revealed that the mainframe

computer that processes pension transactions is over 25 years old and uses a computer language from the 1950s in which few programmers are still trained. To make matters even worse, key software used for the pension fund is no longer supported by its manufacturer so that it is not updated with security patches to protect against new security threats.[17]

- **Uses and management of funds.** Internal uses of funds include purchasing additional inventory, updating plants and equipment, hiring new employees, acquiring other companies, buying new computer systems, increasing marketing and advertising, purchasing raw materials or land, investing in new products, and increasing research and development. Personal finance software can also help you manage your expenditures and financial decisions. See Figure 6.10.



Source: mint.com

FIGURE **6.10**

Mint personal finance software

Mint helps you organize and categorize your spending so you know where every dime goes and helps you to be comfortable with your financial decisions.

Manufacturing Management Information Systems

Without question, advances in information systems have revolutionized manufacturing. As a result, many manufacturing operations have been dramatically improved over the last decade. The use of computerized systems is emphasized at all levels of manufacturing—from the shop floor to the executive suite.

The Daimler Group produces Mercedes-Benz cars, Daimler trucks, Mercedes-Benz vans, and Daimler buses. Daimler produces 10,000 cylinder heads per day at its light-metal foundry in Stuttgart, Germany. If the cylinder heads do not pass exacting standards, they must be rejected, melted down, and then remanufactured. The firm uses a manufacturing MIS to gather over 500 factors related to production that enables workers to monitor and control the manufacturing process. The use of this system has increased productivity by over 25 percent.[18] Figure 6.11 gives an overview of some of the manufacturing MIS inputs, subsystems, and outputs.

The manufacturing MIS subsystems and outputs are used to monitor and control the flow of materials, products, and services through the organization. As raw materials are converted to finished goods, the manufacturing MIS monitors the process at every stage. The success of an organization can depend on the manufacturing function. Some common information subsystems and outputs used in manufacturing are provided in the following list:

- **Design and engineering**. Manufacturing companies often use computer-assisted design (CAD) with new or existing products. For example, The Boeing Company employs 3D CAD/CAM (computer-aided

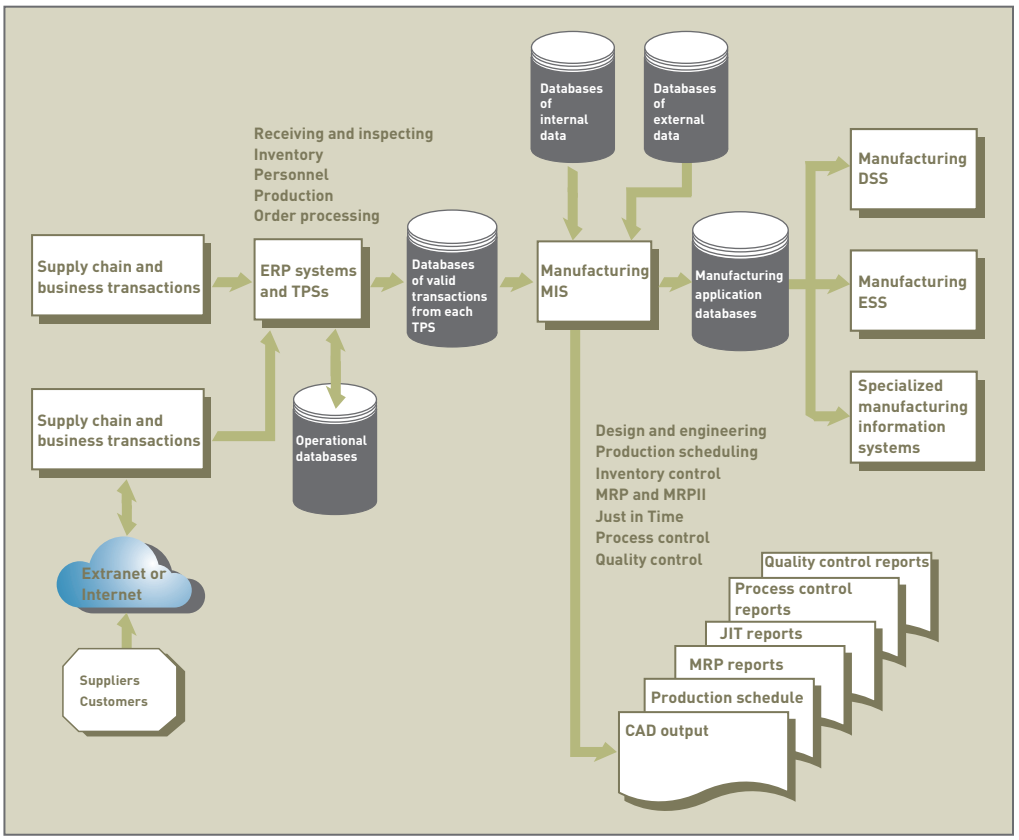


FIGURE **6.11**

Overview of a manufacturing MIS

Manufacturing MIS subsystems and outputs are used to monitor and control the flow of materials, products, and services through the organization.

design/computer-aided manufacturing) technology to model airplane parts as 3D solids in a CATIA (computer-aided three-dimensional interactive application) system. See Figure 6.12. This system, along with several Boeing proprietary applications, enabled Boeing engineers to simulate the geometry of an airplane design and avoid the need for the costly and time-consuming effort to create physical mock-ups.[19]

FIGURE **6.12**

Design and engineering

Boeing uses computer-assisted design (CAD) and computer-aided manufacturing (CAM) in the development and design of its aircraft.

- **Master production scheduling.** Scheduling production is a critical activity for any manufacturing company. The overall objective of master production scheduling is to provide detailed plans for both short-term and long-range scheduling of manufacturing facilities. Sumida AG designs, manufactures, and sells electronic parts for automotive, industrial, and consumer use. The 175 or so employees in the manufacturing department at its Lehesten, Germany, factory must fill production orders to meet long-term contracts as well as orders that arrive on short notice. The factory implemented a new production scheduling system to improve its manufacturing planning process. Now, instead of considering the production order as a whole, the new system plans every process step of the order in the production schedule. This means that the start time, end time, and processing time are taken into account in planning production. The system is also capable of optimizing the number of units to be produced based on the availability of staff and equipment. A production schedule is generated for each piece of equipment for all three work shifts.
- **Inventory control.** Most inventory control techniques are used to minimize inventory costs. Fisher Scientific International, Inc., provides researchers and clinicians in labs around the world with the instruments, equipment, and laboratory supplies they need. It serves over 350,000 customers in pharmaceutical and biotech companies, colleges and universities, medical research institutions, hospitals, and quality control, process control, and R&D labs.[20] Fisher Scientific implemented an inventory management system that enabled it to reduce its overall inventory by $5 million while increasing its customer service. This was accomplished by improving the alignment between its product inventory and customer demand. Inventory control techniques determine when to restock and how much inventory to order. One method of determining the amount of inventory to order is called the **economic order quantity (EOQ)**. This quantity is calculated to minimize the total inventory costs. The "when to order" question is based on inventory usage over time. Typically, the question is answered in terms of a **reorder point (ROP)**, which is a critical inventory quantity level. When the inventory level for a particular item falls to the reorder point, or critical level, the system generates a report so that an order is immediately placed for the EOQ of the product.

economic order quantity (EOQ): The quantity that should be reordered to minimize total inventory costs.

reorder point (ROP): A critical inventory quantity level.

- **Just-in-time (JIT) inventory** and manufacturing is an approach that maintains inventory at the lowest levels without sacrificing the availability of finished products. With this approach, inventory and materials are delivered just before they are used in a product. At one time, Harley Davidson was a highly inefficient manufacturer that avoided production problems by carrying an excessive amount of inventory to avoid stock outs. However, the investment in inventory led to excessive storage and handling costs plus tied up a lot of capital. The firm implemented JIT and became an agile manufacturer able to meet customer demand and provide short lead times to produce products. Use of JIT enabled Harley Davidson to increase productivity and reduce its inventory levels by 75 percent.

just-in-time (JIT) inventory: An inventory management approach in which inventory and materials are delivered just before they are used in manufacturing a product.

- **Process control.** Managers can use a number of technologies to control and streamline the manufacturing process. Computers can directly control manufacturing equipment using computer-aided manufacturing (CAM) systems to control drilling machines, assembly lines, and more. See Figure 6.13. **Computer-integrated manufacturing (CIM)** uses computers to link the components of the production process into an effective system. CIM's goal is to tie together all aspects of production, including order processing, product design, manufacturing, inspection and quality control, and shipping. A **flexible manufacturing system (FMS)** is an approach that allows manufacturing facilities to rapidly and efficiently change from making one product to another. In the middle of a production run, for

computer-integrated manufacturing (CIM): Using computers to link the components of the production process into an effective system.

flexible manufacturing system (FMS): An approach that allows manufacturing facilities to rapidly and efficiently change from making one product to making another.

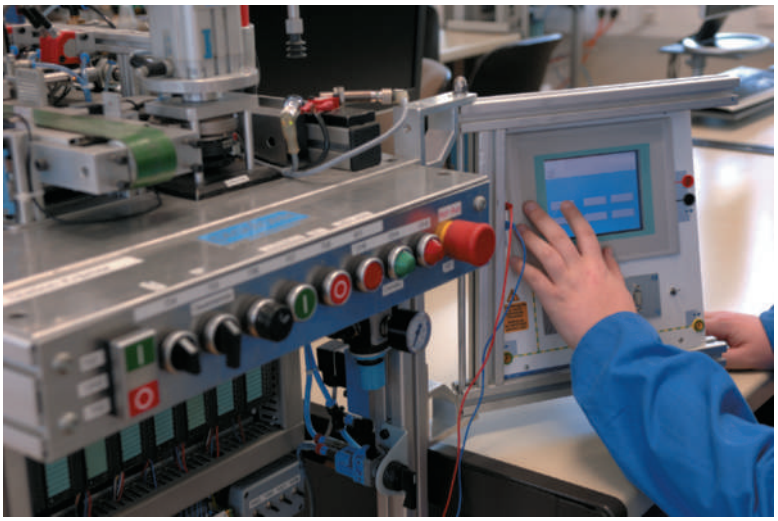


FIGURE **6.13**

Computer-aided manufacturing

Computer-assisted manufacturing systems control complex processes on the assembly line and provide users with instant access to information.

example, the production process can be changed to make a different product or to switch manufacturing materials. By using an FMS, the time and cost to change manufacturing jobs can be substantially reduced, and companies can react quickly to market needs and competition. The Willi Elbe Group, based in Germany, produces steering modules and steering components for passenger cars and commercial vehicles. The firm implemented a flexible manufacturing system that includes five horizontal machining centers. The centers are loaded and unloaded by robots and connected to a parts-cleaning system by a custom feed belt. The work pieces from these centers are automatically integrated into the later process stages.

- **Quality control and testing.** With increased pressure from consumers and a general concern for productivity and high quality, today's manufacturing organizations are placing more emphasis on **quality control**, a process that ensures that the finished product meets the customers' needs. Information systems are used to monitor quality and take corrective steps to eliminate possible quality problems.

quality control: A process that ensures that the finished product meets the customers' needs.

Marketing Management Information Systems

Marketing is the process of determining the needs and wants of consumers and creating, communicating, and delivering products that satisfy those needs and wants. Marketing covers a broad range of activities including:

- Performing market research to determine the needs and wants of consumers
- Designing a product or service that will appeal to consumers
- Setting a price that will be attractive to the consumer and profitable to the organization
- Determining the various media to be used to inform potential customers about your product or service
- Advertising using the selected forms of media
- Deciding on the chain of businesses and/or intermediaries through which the product or service will travel to reach the consumer (channels of distribution)
- Determining the handling, movement, and storage of goods from the point of origin to the point of consumption (physical distribution)

marketing: The process of determining the needs and wants of consumers and creating, communicating, and delivering products that satisfy those needs and wants.

A **marketing MIS** is a system that uses data gathered from both internal and external sources to provide reporting and aid decision making in all areas of marketing.

marketing MIS: A system that uses data gathered from both internal and external sources to provide reporting and aid decision making in all areas of marketing (market research, product design, pricing, media selection, advertising, selling, channel distribution, and product distribution).

Figure 6.14 shows the inputs, subsystems, and outputs of a typical marketing MIS. The subsystems for the marketing MIS and their outputs help marketing managers and executives increase sales, reduce marketing expenses, and develop plans for future products and services to meet the changing needs of customers. These subsystems include market research, product design, media selection, advertising, selling, channel distribution, and product pricing.

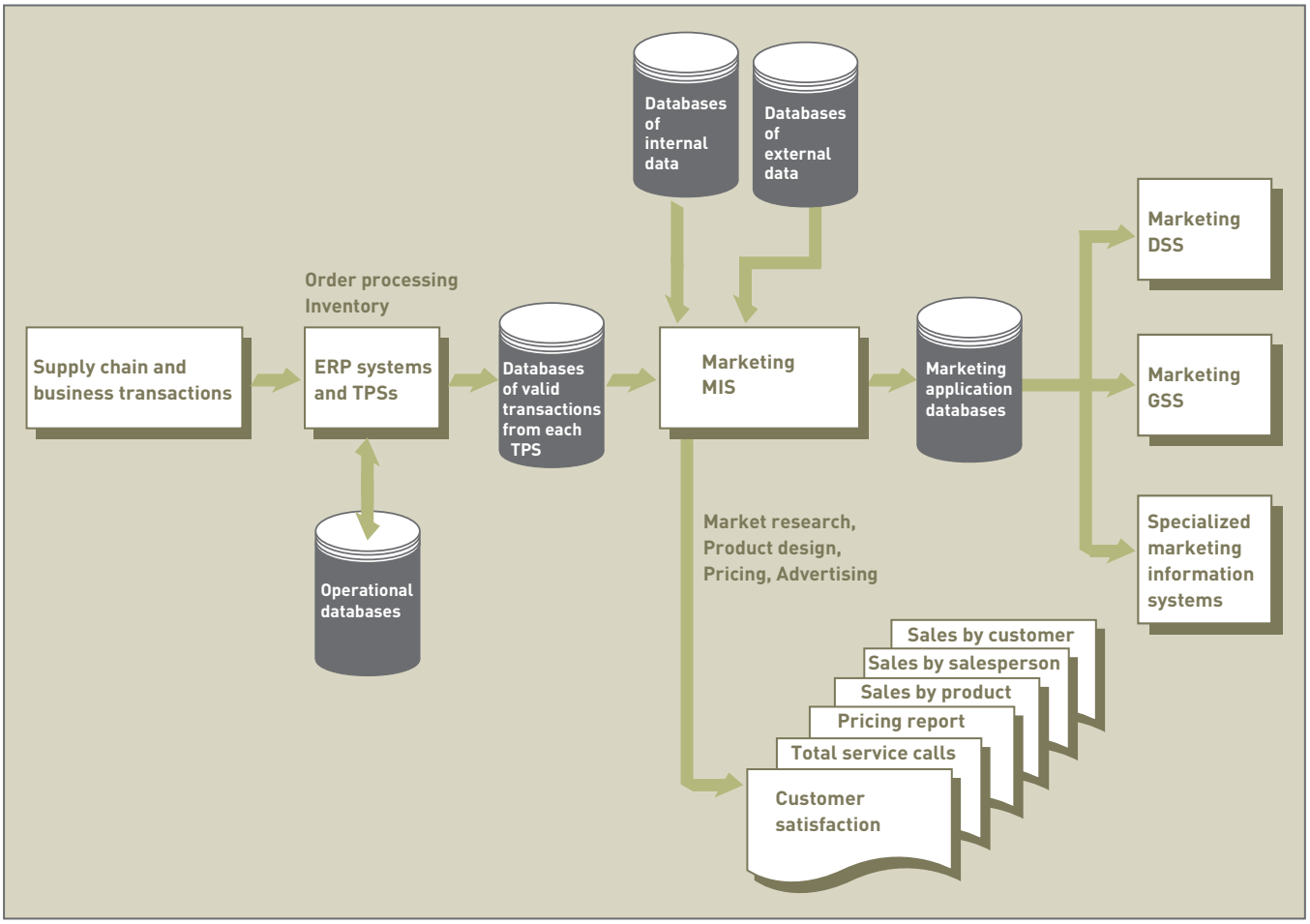


FIGURE **6.14**

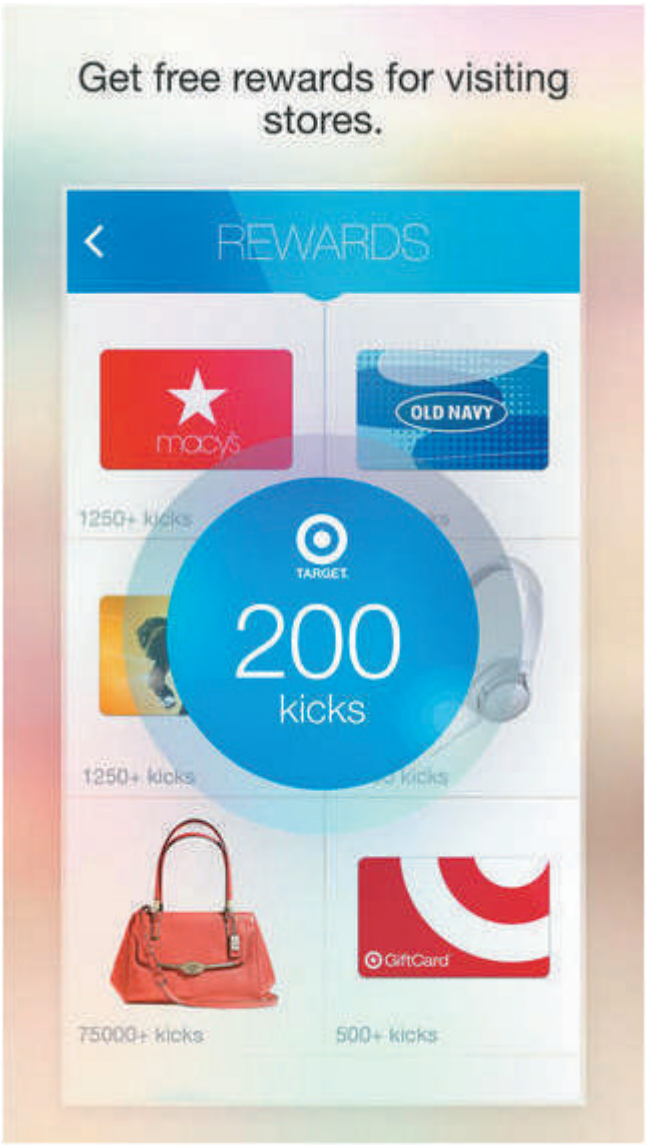
Overview of a marketing MIS

A marketing MIS helps marketing managers and executives increase sales, reduce marketing expenses, and develop plans for future products and services to meet the changing needs of customers.

- **Market research.** The purpose of market research is to analyze the market to identify threats, opportunities, and customer needs and wants. Companies use the Internet as an important source of market research data by browsing social media Web sites to find postings about their organization and products, requesting site visitors to fill out an online questionnaire, and gathering online feedback forms from customers. Marketing MIS systems are used to summarize and report the results of surveys, questionnaires, pilot studies, consumer panels, and interviews. People who place messages on social networks, such as Facebook, may be surprised to discover that what they post is used in market research to provide input to design new or improved products and to develop more effective ads. An Internet marketing firm did market research with the

help of the National Hot Rod Association (NHRA) to raise attendance at race tracks. Together they gathered data to build a marketing MIS that included a database of racing ticket buyers and NHRA members that held data about their attendance at races and the types of tickets purchased. This data was used to launch an email marketing campaign that helped NHRA-member tracks sell more tickets.[21]

- **Product design.** Product design is the process of generating a new product or service to be sold by an organization to its customers. The product may be entirely new or it may be a revised version of an existing product. The design process begins with the identification of customer needs and desires and requires a clear understanding of the functions and the performance expected of that product. Much of this data is stored within the marketing MIS. In addition, the product designer's role has been aided by digital tools that enable designers to visualize, analyze, communicate, and produce new product ideas in a manner that would have taken greater effort and elapsed time than in the past.
- **Pricing.** Product pricing is another key marketing function that involves setting the retail price, wholesale price, and price discounts. Marketing MIS systems are often used to store data showing the relationship between prices and consumer purchasing behavior. Nestle's used Decision Insight's proprietary online virtual shopping platform called SimuShop with the roll out of a new ice cream novelty product. Shoppers were recruited online to participate in a virtual shopping experience that was closely monitored to determine alternate shelf placements and prices for the product.[22] Companies try to develop pricing policies that will maximize total sales revenues. Some companies use *Internet behavioral pricing*, where the price customers pay online depends on what they are willing to pay based on large databases of personal information that reveal individual shopping behaviors and practices. Other companies resort to attracting customers as they walk by the store. Shopkick, Inc., for example, makes smartphone applications that offer discounts and rewards to customers simply for entering a store. See Figure 6.15. Over 6 million people use this application when shopping at Best Buy, Crate & Barrel, Macy's, Old Navy, Target, and other retailers.[23]
- **Media selection.** Media mix is the combination of various advertising channels (radio, TV, billboard, Internet, or newspaper) used to meet the objectives of a marketing program. The goal of media selection is to determine the best mix of media that will meet the objective of the campaign (e.g., raise brand awareness of the firm among the 18–24 age group, send prospects to a retail store, or generate more traffic to the organization Web site) at minimal cost. The marketing MIS can store the data necessary to make media selection trade-offs. Most marketing organizations choose a combination of both Internet and offline media to achieve their marketing goal. However, with an estimated 85 percent of buyers going online to research their purchases, the Internet is becoming an increasingly important component of the media mix.[24] The Internet media channel includes several components—one can choose from among dozens of highly popular social media Web sites (page or group), email, blog, or organizational Web site. Each Internet channel has its strengths and weaknesses depending on the goal of the marketing campaign. Some 43 percent of surveyed small business owners spend six or more hours per week on social media marketing by posting their messages to Facebook, Google +, Instagram, LinkedIn, Pinterest, Twitter, and YouTube. The owner of Daily Melt in midtown Miami brands his store as a restaurant that sells comfort through its delicious sandwich melts, laid-back atmosphere, and pleasant workers. The owner hired a social media marketing firm to engage his customers online with photos of weekly specials and a cheery message.[25]



Source: shopkick.com

FIGURE **6.15**

Shopkick

Shopkick makes smartphone applications that offer discounts and rewards to customers simply for entering a store.

- **Advertising.** One of the most important functions of any marketing effort is promotion and advertising. Product success is a direct function of the types of advertising and sales promotion done. Increasingly, organizations are using the Internet, smartphones, and other mobile devices to advertise and sell products and services. See Figure 6.16. Many small businesses are effectively advertising their products and services using Internet sites such as Groupon. With Groupon, users receive a daily advertisement for a deal from a local company, which can be as much as a 50 percent discount over normal prices.[26] Many companies promote their products on games and other applications for the Apple iPhone and other devices. In some cases, the advertising is hidden within free gaming applications. When you download and start playing the game, the advertising pops up on the screen. However, some people are not happy with Internet advertising. They complain that popular Internet search programs often display ads for completely unrelated searches. Some physicians and dentists, for example, claim that ads for their services are displayed to people searching for taxicab companies, barbers, and hair stylists, or other unrelated services.
- **Selling.** The marketing MIS can produce reports that identify products, sales personnel, and customers that contribute to profits and those that do

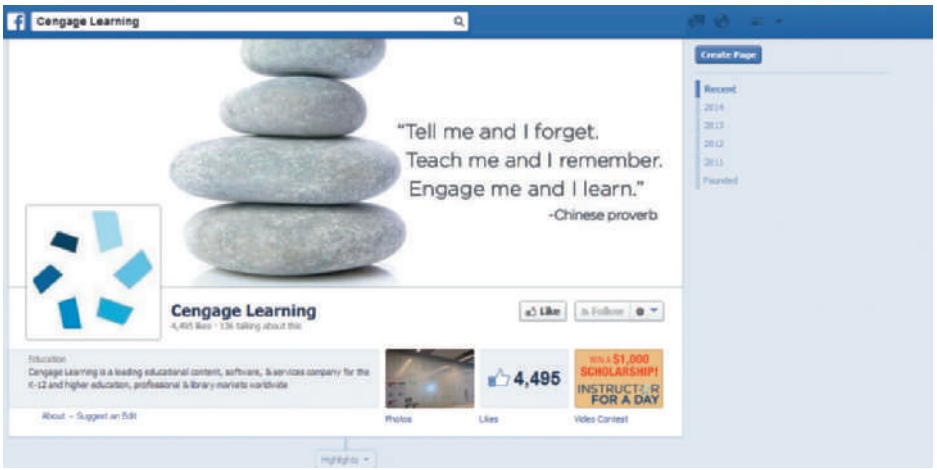


FIGURE **6.16**

Internet advertising

The Internet is an important component of advertising for many organizations. Corporate marketing departments use social networking sites, such as Facebook (www.facebook.com) to advertise their products and perform market research.

not. This analysis can be done for sales and ads that help generate sales. Engagement ratings, for example, show how ads convert to sales. Several reports can be generated to help marketing managers make good sales decisions. See Figure 6.17. The sales-by-product report lists all major products and their sales for a specified period of time. This report shows which products are doing well and which need improvement or should be discarded altogether. The sales-by-salesperson report lists total sales for each salesperson for each week or month. This report can also be subdivided by product to show which products are being sold by each salesperson. The sales-by-customer report is a tool that can be used to identify high- and low-volume customers. Swedbank is a large financial institution operating in Scandinavia and the Baltic states of Estonia, Latvia, and Lithuania. The bank employs 16,000 people and serves over 4 million customers in Sweden alone. Over the course of about a year, the bank developed a Customer Analysis tool to analyze customers for cross-selling

(a) Sales by Product

Product	August	September	October	November	December	Total
Product 1	34	32	32	21	33	152
Product 2	156	162	177	163	122	780
Product 3	202	145	122	98	66	633
Product 4	345	365	352	341	288	1,691

(b) Sales by Salesperson

Salesperson	August	September	October	November	December	Total
Jones	24	42	42	11	43	162
Kline	166	155	156	122	133	732
Lane	166	155	104	99	106	630
Miller	245	225	305	291	301	1,367

(c) Sales by Customer

Customer	August	September	October	November	December	Total
Ang	234	334	432	411	301	1,712
Braswell	56	62	77	61	21	277
Celec	1,202	1,445	1,322	998	667	5,634
Jung	45	65	55	34	88	287

FIGURE **6.17**

Reports generated to help marketing managers make good decisions

(a) This sales-by-product report lists all major products and their sales for the period from August to December. (b) This sales-by-salesperson report lists total sales for each salesperson for the same time period. (c) This sales-by-customer report lists sales for each customer for the period. Like all MIS reports, totals are provided automatically by the system to show managers at a glance the information they need to make good decisions.

opportunities and planning marketing campaigns. Customer advisers and branch managers use the tool to plan which customers to meet, when, and for what purpose.[27]

- **Channel distribution.** Distribution channel optimization involves defining the chain of intermediary organizations through which a product flows to reach the final consumer. Distribution channel participants can include wholesalers, retailers, distributors, and the Internet. A direct distribution channel is one that enables the consumer to buy the product directly from the manufacturer. Distribution partners enable manufacturers to provide goods and services to customers and often offer some forms of customer service that the manufacturer does not (e.g., financing, maintenance, or training). Distribution channel optimization is a key factor in reaching customers where they prefer to buy as well as expanding sales into new markets and regions. There are three phases to distribution channel optimization: 1) evaluation of current channel partner effectiveness, 2) identification of new, high-growth opportunities and selection of appropriate partners to capture these opportunities, and 3) ongoing assessment and support of the performance of distribution partners.[28] An organization's marketing MIS can contain much data about existing and potential distribution partners as well as data about marketing opportunities to support channel optimization. Canadian Blood Services (CBS) is responsible for the collection, testing, manufacturing, procurement, and distribution of safe blood and blood products for patient care in Canada. The organization recognized that many in the general public wanted to give blood but simply were not following through and donating. So CBS decided to use an online distribution channel to nudge these intenders into action. The organization created an online community called Operation LifeBlood with the goal of alleviating potential donors' apprehensions and educating them about the donor process. It also built a social network Web site where donors and potential donors could share their experiences and engage in discussions. The program raised the conversion rate for potential donors to 16 percent, well above the goal of 10 percent.[29]
- **Product distribution.** Product distribution involves determining the best way to get products to customers. Organizations use their marketing MIS in an attempt to minimize distribution costs while still meeting customer time for delivery requirements. Grocery stores (e.g., Target, Walmart, and Meijer) allow shoppers to order products online and then pick them up or have them delivered at an agreed time. Mabe is a Mexican-owned, Mexican-based company that designs, produces, and distributes 15 brands of appliances to more than 70 countries around the world. A serious concern was drop and impact damage to its products as they traveled over the firm's distribution network from production floor to multiple warehouses via multiple freight carriers to the customer. Mabe decided to reapply the same computer-aided engineering tools used to design its appliances to the optimization of product packaging. The firm developed a new package design that minimized potential damage while reducing material costs and packaging weight. Some organizations (such as The Apple Store, The Microsoft Store, shop411, Newegg, and VioSoftware) use the Internet to serve as their primary channel of distribution and employ digital distribution to send audio, video, software, video games, and books to their customers.

human resource MIS (HRMIS): An information system that is concerned with activities related to previous, current, and potential employees of an organization, also called a personnel MIS.

Human Resource Management Information Systems

A **human resource MIS (HRMIS)** is concerned with activities related to previous, current, and potential employees of the organization. The complexity of the human resource management function has increased dramatically over the last decade primarily due to the need to conform with new laws and regulations.

The HRMIS is being used more and more to oversee and manage part-time employees, virtual work teams, and job sharing in addition to traditional job titles and duties. Because the human resource function relates to all other functional areas in the business, the HRMIS plays a valuable role in ensuring organizational success. Some of the activities performed by this important MIS include workforce analysis and planning, hiring, training, job and task assignment, and many other personnel-related issues. An effective HRMIS allows a company to keep personnel costs at a minimum while serving the required business processes needed to achieve corporate goals. Although traditional human resource information systems focus on cost reduction, many of today's HR systems concentrate on hiring and managing existing employees to get the total potential of the human talent in the organization. Figure 6.18 shows some of the inputs, subsystems, and outputs of the human resource MIS.

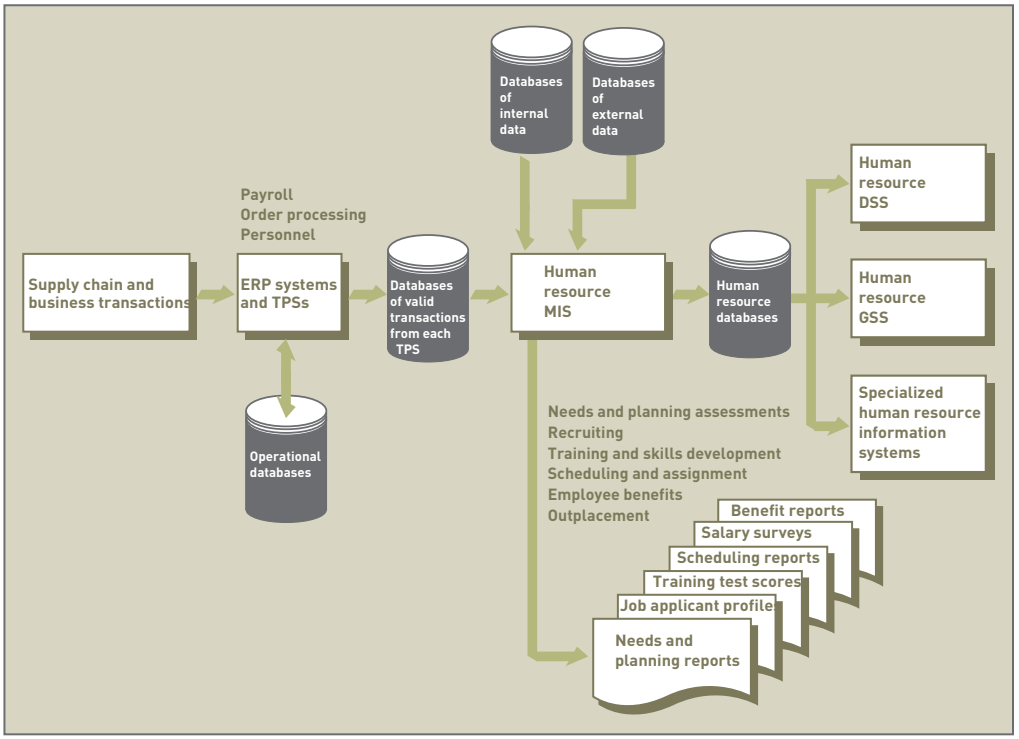


FIGURE **6.18**

Overview of a human resource MIS

A human resource MIS (HRMIS) helps to determine human resource needs and hiring through retirement and outplacement.

Human resource subsystems and outputs range from the determination of human resource needs and hiring through retirement and outplacement. Most medium and large organizations have computer systems to assist with human resource planning, hiring, training and skills inventorying, and wage and salary administration. See Figure 6.19. Outputs of the HRMIS include reports, such as human resource planning reports, job application review profiles, skills inventory reports, and salary surveys. Most human resource departments start with planning, discussed next.

- **Human resource planning.** One of the first aspects of any human resource MIS is determining the human resources required to meet the organization's goals and developing strategies to meet those needs. The overall purpose of this MIS subsystem is to place the right number and

FIGURE **6.19**

Users of an HRMIS

Human resource MIS subsystems help to determine personnel needs and match employees to jobs.

type of employees in the right jobs when needed, including internal employees who work exclusively for the organization and outside workers who are hired when they are needed. Determining the best use of existing employees is a key component of human resource planning. Surprisingly, many companies and industries face serious shortages of workers due to lack of human resource planning. Landscape companies employ some 40,000 workers in Colorado and contribute around $2 billion to the state's economy, but many firms say they must turn down jobs because they do not have enough workers.[30] United States airlines are facing a critical shortage of pilots.[31] The oil and gas production industry has a labor shortage.[32] Well-managed organizations are looking ahead and planning how their work force needs will change over time. They then develop plans to meet these changing needs. The Tualatin Valley Water District (TVWD) provides water to the people of Beaverton, Oregon. TVWD needed additional workers to keep up with the growth in demand for water; however, 10 percent of its workers were eligible to retire within the next five years. The organization faced some serious challenges of succession planning, personnel selection and recruiting, training, and job placement. Human resource planning enabled TVWD to identify these issues well before they created a staffing crisis. TVWD was able to develop a timely solution that allowed a smooth transition to meet its staffing needs.[33]

- **Personnel selection and recruiting.** If the human resource plan reveals that additional personnel are required, the next logical step is recruiting and selecting personnel. Companies seeking new employees often use computers to schedule recruiting efforts and trips and to test potential employees' skills. Most companies now use the Internet to advertise open positions and screen for job applicants. Applicants use a template to load their résumés onto the Internet site. HR managers can then access these résumés and identify applicants they are interested in interviewing.
- **Training and skills inventory.** Some jobs, such as programming, equipment repair, and tax preparation, require very specific training for new employees. Other jobs may require general training about the organizational culture, company orientation, norms for interacting with other employees and customers, and expectations of the organization. When training is complete, employees often take computer-scored tests to evaluate their mastery of skills and new material. TTI Success Insights, based in

Scottsdale, Arizona, has developed a sophisticated online talent profiling system that evaluates job candidates based on several measures of superior performance: personal behaviors, motivators, acumen (a person's keenness and depth of perception), competencies in 25 personal skills directly related to the business environment, and emotional intelligence. The system was used by a national retailer to help complete the management team for a new chain of stores. Job benchmarks were created for assistant manager, general manager, and district manager positions. Candidates were evaluated against the benchmark as well as current employees. Development programs for current employees were defined based on gaps uncovered in the benchmark process.

- **Scheduling and job placement.** Schedules are developed for each employee, showing job assignments over the next week or month. Job placements are often determined based on skills inventory reports showing which employee might be best suited to a particular job. Sophisticated scheduling programs are often used in the airline industry, the military, and many other areas to get the right people assigned to the right jobs at the right time. Queen Anne's County DES EMS in Centerville, Maryland, employs more than 40 full-time people on rotation plus additional part-time people to fill in for vacationing employees and special events. Scheduling for this many people to ensure around-the-clock coverage is challenging. Scheduling became especially difficult when someone called in sick, needed time off, or requested overtime. Queen Anne's implemented on an online, Web-based scheduling system and trained the entire staff. Each member of the EMS can view their schedule and initiate their own trades when they need time off. The system enforces company rules on scheduling and ensures that sufficient numbers of workers are always available. All this happens with no supervisor intervention.
- **Wage and salary administration.** Another human resource MIS subsystem involves determining wages, salaries, and benefits, including medical payments, savings plans, and retirement accounts. Wage data, such as industry averages for positions, can be taken from the corporate database and manipulated by the HRMIS to provide wage information and reports to higher levels of management. Most organizations provide a self-service Web-based system component to their HRMIS. This enables employees to enter their timesheets, make changes to their W-4 withholding data, change their selection of various company benefit programs, and request W-2 statements or a printout of their paycheck.
- **Outplacement.** Employees leave a company for a variety of reasons. Outplacement services are offered by many companies to help employees make the transition. *Outplacement* can include job counseling and training, job and executive search, retirement and financial planning, and a variety of severance packages and options. Many employees use the Internet to plan their future retirement or to find new jobs, using job sites such as *www.monster.com* and *www.linkedin.com*.

Other Management Information Systems

In addition to finance, manufacturing, marketing, and human resource MISs, some companies have other functional management information systems. For example, most successful companies have well-developed accounting functions and a supporting accounting MIS. Also, many companies use geographic information systems for presenting data in a useful form.

accounting MIS: An information system that provides aggregate information on accounts payable, accounts receivable, payroll, and many other applications.

Accounting MISs

In some cases, accounting works closely with financial management. An **accounting MIS** performs a number of important activities, providing

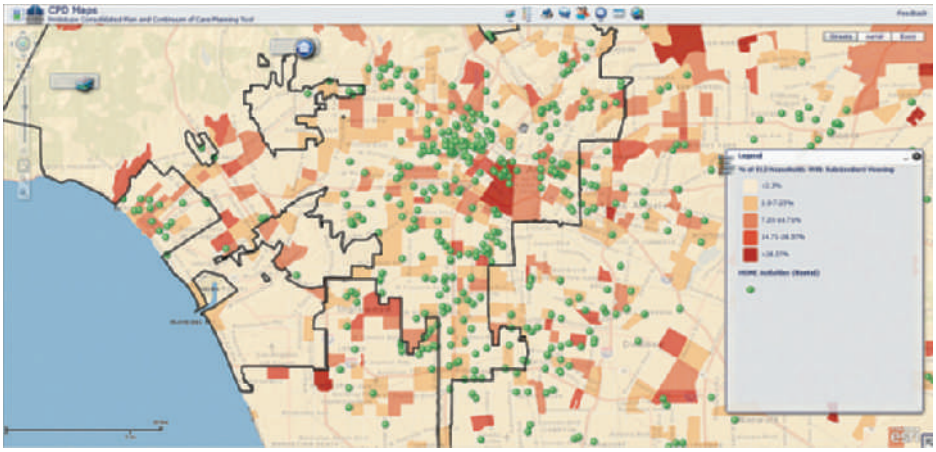
aggregate information on accounts payable, accounts receivable, payroll, and many other applications. The organization's enterprise resource planning and transaction processing system captures accounting data, which is also used by most other functional information systems.

Some smaller companies hire outside accounting firms to assist them with their accounting functions. These outside companies produce reports for the firm using raw accounting data. In addition, many excellent integrated accounting programs are available for personal computers in small companies. Depending on the needs of the small organization and its staff's computer experience, using these computerized accounting systems can be a very cost-effective approach to managing information.

Geographic Information Systems

geographic information system (GIS): A computer system capable of assembling, storing, manipulating, and displaying geographic information, that is, data identified according to its location.

Increasingly, managers want to see data presented in graphical form. A **geographic information system (GIS)** is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information; that is, data identified according to its location. The US Department of Housing and Urban Development (HUD) grants funds to state and local governments to provide people with decent housing. These funding decisions are based on an evaluation of needs and market conditions in each grantee's jurisdiction. The Office of Community Planning and Development (CPD) Maps is a geospatial application that provides data and maps to help grantees understand how to target aid based on where needs are greatest. For example, grantees can now see concentrated poverty on the map. See Figure 6.20.



Source: www.esri.com

FIGURE **6.20**

CPD Maps

CPD Maps is a tool in the HUD eCon Planning Suite, a GIS application used to make affordable housing and community development planning decisions.

Loopt's mobile application and website (*http://looptworks.com*) enable its users to tap into local intelligence about places that make it easy to find friends and the locations of stores with the best deals. WHERE is another mobile app that helps you search and discover what's nearby with real-time information on the local news and weather plus recommendations on restaurants, movies, and places to shop.

AN OVERVIEW OF DECISION SUPPORT SYSTEMS

A decision support system (DSS) is an organized collection of people, procedures, software, databases, and devices used to help make decisions that solve problems. The focus of a DSS is on decision-making effectiveness when faced with unstructured or semistructured business problems. Decision support systems offer the potential to generate higher profits, lower costs, and better products and services. Decision support systems, although skewed

ETHICAL & SOCIETAL ISSUES

You Want to Put That *Where*?

Land use is often a contentious topic. Everyone wants the benefits that airports, electricity-generating plants, prisons, and all-night railroad freight car classification yards bring to society. Still, few people want to live next door to one of these operations.

Fortunately, geographic information systems (GISs) can help sort out the issues involved with siting these and other operations. In fact, the government of Queensland, Australia, used a GIS to figure out the best locations for poultry farms in the southern part of that state.

As background, chicken is the most popular form of meat for Australians. Queensland has about 22 percent of Australia's population and produces about 20 percent of its chicken. Chicken farming is split between two major centers: near the town of Mareeba in the north and near the capital city of Brisbane in the south. Owing to the larger number of competing land uses near Brisbane, the government of Queensland needed to develop objective ways to allocate this scarce resource.

Poultry farms are not nearly as objectionable as some other operations that modern society finds necessary, but many factors still determine the best places to put them. William Mortimer, senior spatial analyst at Queensland Government, writes that "Geographic information systems and spatial analysis tools enable the departmental decision makers to visualize and understand complex issues on a site specific and regional scale basis." Among these issues are what he calls *primary constraints*. The location of a poultry farm *may* not be:

- Too close (under 1 km, about 0.6 miles) to another poultry farm
- In a key mineral resource extraction area
- In an urban or residential area (a 2 km buffer, about 1.2 miles, is desirable)
- In an area of high ecological significance
- In a low-lying, flood-prone area
- In a koala conservation area
- In a designated water catchment area
- Within the Royal Australian Air Force base at Amberley

As secondary constraints, a poultry farm *should* not be:

- On land that is too steep (over 10 percent slope)
- Next to a watercourse
- On good quality agricultural land
- On land suitable for strategic crops
- In a national park or other protected area
- On an oil or gas pipeline
- On acid sulphate soil

Conversely, it is desirable for a poultry farm to be:

- Near poultry processing plants
- Near paved roads
- Near a reliable supply of clean water
- Near a supply of electricity
- Near poultry feed mills

Using these constraints and ESRI's ArcGIS software, the Queensland government was able to produce maps of the southern part of Queensland, showing areas that were suitable for new poultry farms, calculating automatically the amount of land available in each of them, and showing areas

of different sizes in different colors. This mapping provides a good basis for future planning—both for the poultry industry and for those affected by it.

Discussion Questions

1. How could this approach be used to help choose locations for new wind farms? What primary constraints would have to be changed? What could stay essentially the same?
2. When considering where to locate public resources such as power plants, prisons, and public schools, who should have say in defining the primary constraints for choosing the location?

Critical Thinking Questions

1. Is the Queensland decision regarding where to locate chicken farms an example of a satisficing model? Why or why not?
2. How can GIS be used to facilitate the siting of public and private facilities and to resolve disputes over zoning? What other types of technologies can help resolve these contentious issues?

SOURCES: Australia Chicken Meat Federation Web site, *www.chicken.org.au*, accessed June 4, 2014; Department of Local Government and Planning, Queensland Government, "Rural Planning: The Identification and Constraint Mapping of Potential Poultry Farming Industry Locations within Southern Queensland," OZRI 2011 conference, *www10.giscafe.com/link/Esri-Australia-Rural-Planning-identification-constraint-mapping-potential-poultry-farming-industry-locations-within-Southern-Queensland./36838/view.html*, October 14, 2011; Queensland Government Web site, *www.qld.gov.au*, accessed June 4, 2014; ESRI ArcGIS software Web site, *www.esri.com/software/arcgis*, accessed June 4, 2014.

somewhat toward the top levels of management, can be used at all levels. DSSs are also used in a wide range of applications in business, sports, government, law enforcement, and nonprofit organizations. See Figure 6.21. TDX is a debt liquidation organization with headquarters in the United Kingdom. It provides banking, utility, and government creditors with technology, data, and advisory solutions to optimize returns from their debt portfolios. It has £8.4 billion (slightly over $14 billion) of debt under management and

FIGURE **6.21**

Decision support systems

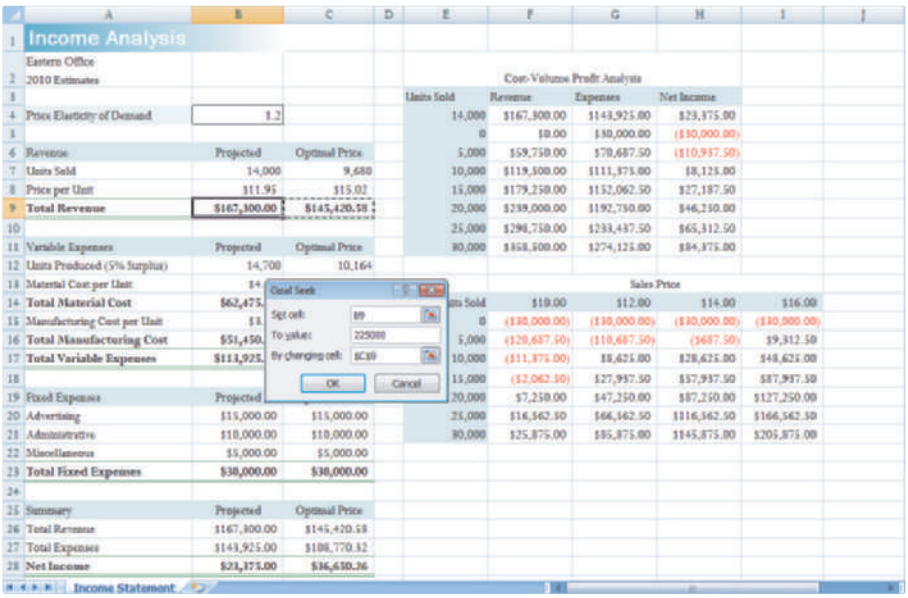
Decision support systems are used by government and law enforcement professionals in many settings.

works with over 200 clients.[34] One service that TDX provides is to advise its clients which debt collection agency it should use for each of its various debts. TDX employs a decision support system to optimize the choice of collection agency to maximize the net return (amount received from the debtor minus debt collection agency fees) to the creditor.[35]

Characteristics of a Decision Support System

Decision support systems have many characteristics that allow them to be effective management support tools. Of course, not all DSSs work the same. The following list shows some important characteristics of a DSS:

- Provide rapid access to information. Handle large amounts of data from different sources. Harrah's Entertainment, Inc., gathers data from more than 19 million customers across its 21 casinos as input to a DSS that helps target its marketing campaigns and offer tailor-made packages to clients based on their individual gaming preferences.[36]
- Provide report and presentation flexibility.
- Offer both textual and graphical orientation.
- Support drill-down analysis. Canopius Managing Agents Unlimited, a division of a specialist underwriting business and insurer, deployed a DSS with drill-down analysis capability to over 100 underwriting, claims, actuarial, and senior management users. The system enables users to view data at their preferred level of granularity—from summary level down to the details of individual policies and claims.[37]
- Perform complex, sophisticated analyses and comparisons using advanced software packages. A number of sophisticated clinical decision support systems are under development to improve a clinician's ability to distinguish among a variety of complex diagnoses and avoid prescribing medicines, that may cause a bad drug-to-drug or allergic interaction.[38]
- Support optimization, satisficing, and heuristic approaches. See Figure 6.22.



Microsoft product screenshots used with permission from Microsoft Corporation

FIGURE **6.22**

Spreadsheet as a DSS tool

With a spreadsheet program, a manager can enter a goal, and the spreadsheet will determine the input needed to achieve the goal.

- Perform simulation analysis. A DSS has the ability to duplicate the features of a real system, where probability or uncertainty is involved. Anyone who wants to offer fishing and sailing charters, drive a dive boat, run sightseeing tours, or captain a large ocean-going cruise ship must first earn an

appropriate license. However, it is extremely difficult for non-licensed mariners to get "practice time" on an actual ship. Thus many mariner schools use a computer-based simulation to engage students in real-life situations. The system enables the candidates to demonstrate their ability to handle different situations to obtain credentials for licenses and helps them in applying for new jobs or assignments.

- Forecast a future opportunity or problem. Staples uses a decision support system to reduce customer attrition. The system tracks millions of customers' purchases and, if spending for regular customers drops, it sends personalized offers to bring them back.

Capabilities of a Decision Support System

Developers of decision support systems strive to make them more flexible than management information systems and to give them the potential to assist decision makers in a variety of situations. Warathas Rugby is the professional rugby team of the Australian state of New South Wales. Rugby is not a game for the meek. It is physically demanding and during the course of a match, a player is typically involved in 20 to 40 violent collisions. Over the course of a season, roughly 25 percent of the players on a team will be injured to the extent that they cannot participate in one or more matches. Warathas piloted the use of a decision support system to identify those players likely to be injured. The system was fed performance statistics, medical data, and data from sensors attached to the players during training sessions and matches. The system was able to detect early warning signs of injury and was successful in identifying three players who sustained an injury in the following weeks. With the accuracy of the system proven, the coaching staff will now use the system to prevent injuries by modifying an individual player's training regime or resting them during a match.[39]

In addition to being flexible, DSSs can assist with all or most problem-solving phases, decision frequencies, and varying degrees of problem structure. DSS approaches can also help at all levels of the decision-making process. A single DSS, however, might provide only a few of these capabilities, depending on its uses and scope.

Support for Problem-Solving Phases

The objective of most decision support systems is to assist decision makers during the phases of problem solving. As previously discussed, these phases include intelligence, design, choice, implementation, and monitoring. A specific DSS might support only one or a few phases. By supporting all types of decision-making approaches, a DSS gives the decision maker a great deal of flexibility in getting computer support for decision-making activities.

Support for Various Decision Frequencies

Decisions can range on a continuum from one-of-a-kind to repetitive decisions. One-of-a-kind decisions are typically handled by an ad hoc DSS. An **ad hoc DSS** is concerned with situations or decisions that come up only a few times during the life of the organization; in small businesses, they might happen only once. For example, a company might need to decide whether to build a new manufacturing facility in another area of the country. Repetitive decisions are addressed by an institutional DSS. An **institutional DSS** handles situations or decisions that occur more than once, usually several times per year or more. It is used repeatedly and refined over the years. Examples of institutional DSSs include systems that support portfolio and investment decisions and production scheduling. These decisions might require decision support numerous times during the year. Between these two extremes are decisions that managers make several times but not routinely.

ad hoc DSS: A DSS concerned with situations or decisions that come up only a few times during the life of the organization.

institutional DSS: A DSS that handles situations or decisions that occur more than once, usually several times per year or more. It is used repeatedly and refined over the years.

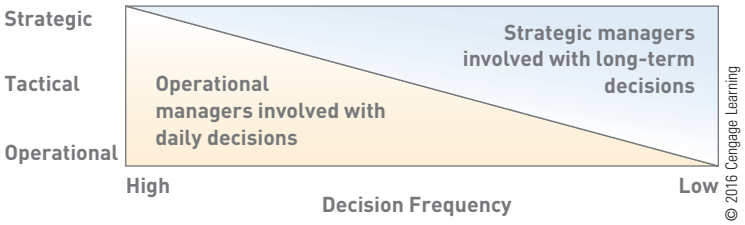
Support for Various Decision-Making Levels

Decision support systems can provide help for managers at various levels within an organization. Operational managers can get assistance with daily and routine decision making. Tactical decision makers can use analysis tools to ensure proper planning and control. At the strategic level, DSSs can help managers by providing analysis for long-term decisions requiring both internal and external information. See Figure 6.23.

FIGURE **6.23**

Decision-making level

Strategic managers are involved with long-term decisions, which are often made infrequently. Operational managers are involved with decisions that are made more frequently.



A Comparison of DSS and MIS

A DSS differs from an MIS in numerous ways, including the type of problems solved, the support given to users, the decision emphasis and approach, and the type, speed, output, and development of the system used. Table 6.3 lists brief descriptions of these differences.

TABLE 6.3 Comparison of DSSs and MISs

Factor	DSS	MIS
Approach	Serves as a direct support system that provides interactive reports on computer screens.	Typically serves as an indirect support system that uses regularly produced reports.
Development	Has users who are usually more directly involved in its development. User involvement usually means better systems that provide superior support. For all systems, user involvement is the most important factor for the development of a successful system.	Is frequently several years old and often was developed for people who are no longer performing the work supported by the MIS.
Emphasis	Emphasizes actual decisions and decision-making styles.	Usually emphasizes information only.
Output	Produces reports that are usually screen oriented, with the ability to generate reports on a printer.	Is oriented toward printed reports and documents.
Problem type	Can handle unstructured problems that cannot be easily programmed.	Normally used only with structured problems.
Speed	Is flexible and can be implemented by users, so it usually takes less time to develop and is better able to respond to user requests.	Provides response time usually longer than a DSS.
Support	Supports all aspects and phases of decision making; it does not replace the decision maker—people still make the decisions.	In some cases, makes automatic decisions and replaces the decision maker.
System	Uses computer equipment that is usually online (directly connected to the computer system) and related to real time (providing immediate results). Computer terminals and display screens are examples—these devices can provide immediate information and answers to questions.	Uses printed reports that might be delivered to managers once per week, so it cannot provide immediate results.
Users	Supports individuals, small groups, and the entire organization. In the short run, users typically have more control over a DSS.	Primarily supports the organization. In the short run, users have less control over an MIS.

COMPONENTS OF A DECISION SUPPORT SYSTEM

dialogue manager: A user interface that allows decision makers to easily access and manipulate the DSS and to use common business terms and phrases.

At the core of a DSS are a database and a model base. In addition, a typical DSS contains a user interface, also called a **dialogue manager**, which allows decision makers to easily access and manipulate the DSS and to use common business terms and phrases. Finally, access to the Internet, networks, and other computer-based systems permits the DSS to tie into other powerful systems, including the TPS or function-specific subsystems. Figure 6.24 shows a conceptual model of a DSS, although specific DSSs might not have all the components shown in this figure.

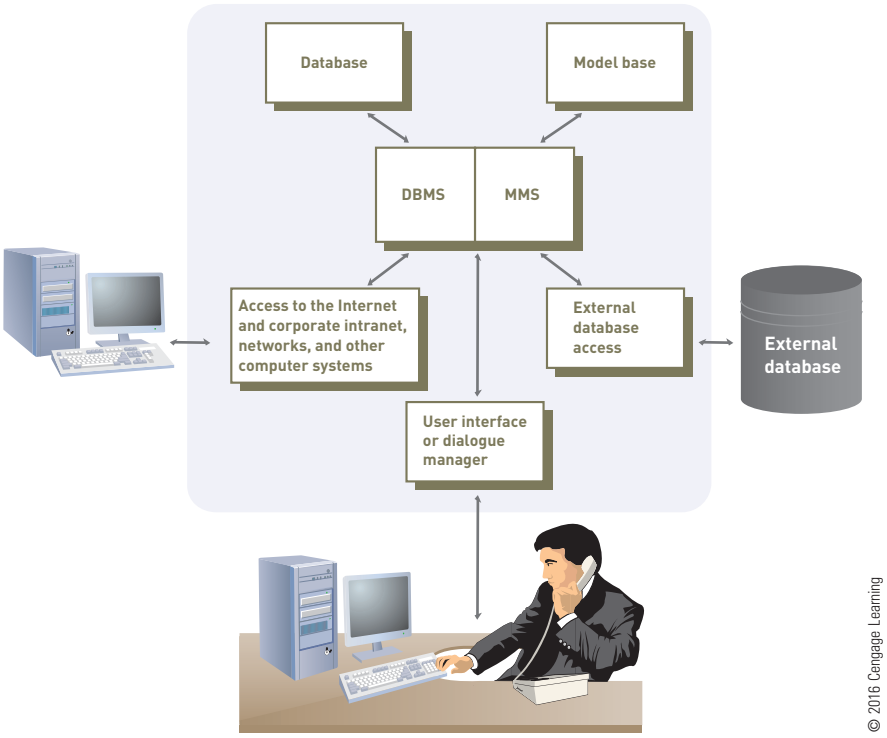


FIGURE **6.24**

Conceptual model of a DSS

DSS components include a model base; database; external database access; access to the Internet and corporate intranet, networks, and other computer systems; and a user interface or dialogue manager.

The Database

The DSS database management system allows managers and decision makers to perform *qualitative analysis* on the company's vast stores of data in databases, data warehouses, and data marts, using data mining and business intelligence, introduced in Chapter 3. While business organizations frequently use a DSS, such systems are also used by governmental agencies and nonprofit organizations. Indeed, many city governments use the data they routinely collect to improve services.

Each year, about 1 percent of 330,000 inspectable buildings in New York City break out in a major fire. (One and two-family houses are not inspected.) The New York City Fire Department is piloting the use of data mining to predict which houses are most likely to catch fire. Analysts have identified some 60 characteristics (e.g., neighborhood income level, age of the building, the presence of sprinklers, and whether the building is vacant or occupied) that indicate which buildings are more likely to catch fire than others. The DSS uses this data and an algorithm to assign each building a risk score. Now when fire inspectors set out on their weekly inspections, the DSS provides a priority list of buildings ranked by their risk score to be inspected.[40]

The DSS database management system can also connect to external databases to give managers and decision makers even more information and decision support. External databases can include the Internet, libraries, and government databases, among others. Access to a combination of internal and external databases can improve the performance of DSS systems. For example, Twitter generates a lot of data with its millions of users publicly sending on the order of 500 million tweets. Many of these tweets are tagged with precise location and time data and, if processed properly, can become valuable input to DSS systems. For example, researchers have found that for 19 of the 25 crime types studied, the addition of Twitter data improves crime prediction performance.[41]

The Model Base

model base: Part of a DSS that allows managers and decision makers to perform quantitative analysis on both internal and external data.

The **model base** allows managers and decision makers to perform *quantitative analysis* on both internal and external data. Once large databases have been collected and stored, companies use models (analytics) to turn the data into future products, services, and profits. The model base gives decision makers access to a variety of models so that they can explore different scenarios and see their effects. Ultimately, it assists them in the decision-making process.

model management software (MMS): Software that coordinates the use of models in a DSS, including financial, statistical analysis, graphical, and project-management models.

Model management software (MMS) can coordinate the use of models in a DSS, including financial, statistical analysis, graphical, and project-management models. Depending on the needs of the decision maker, one or more of these models can be used. See Table 6.4. What is important is how the mathematical models are used, not the number of models that an organization has available. In fact, too many model-based tools can be a disadvantage. MMS can often help managers effectively use multiple models in a DSS.

TABLE 6.4 Model management software

Model Type	Description	Software
Financial	Provides cash flow, internal rate of return, and other investment analysis	Spreadsheet, such as Microsoft Excel
Statistical	Provides summary statistics, trend projections, hypothesis testing, and more	Statistical programs, such as SPSS or SAS
Graphical	Assists decision makers in designing, developing, and using graphic displays of data and information	Graphics programs, such as Microsoft PowerPoint
Project Management	Handles and coordinates large projects; also used to identify critical activities and tasks that could delay or jeopardize an entire project if they are not completed in a timely and cost-effective fashion	Project management software, such as Microsoft Project

The User Interface, or Dialogue Manager

The user interface, or dialogue manager, allows users to interact with the DSS to obtain information. It assists with all aspects of communications between the user and the hardware and software that constitute the DSS. In a practical sense, to most DSS users, the user interface is the DSS. Upper-level decision makers are often less interested in where the information came from or how it was gathered than that the information is both understandable and accessible.

Nielsen provides its clients with data about what consumers watch and buy. The firm is testing a technology called the IBM Watson Engagement Advisor for supporting individuals at client organizations who are responsible for buying ads based on Nielsen ratings. These users can ask questions about how Nielsen compiles its results or ask for advice on how best to spend their advertising dollars. Software called Ask Watson provides an interface that

allows clients to communicate with the technology via instant message, text message, email, Web chat, or a dedicated app on their mobile phone.[42]

GROUP DECISION SUPPORT SYSTEMS

group decision support system (GSS): Software application that consists of most of the elements in a DSS, plus software to provide effective support in group decision-making settings; also called *group support system* or *computerized collaborative work system*.

The DSS approach has resulted in better decision making for all levels of individual users. However, some DSS approaches and techniques are not suitable for a group decision-making environment. A **group decision support system (GSS)**, also called a *group support system* and a *computerized collaborative work system*, consists of most of the elements in a DSS, plus software to provide effective support in group decision-making settings. See Figure 6.25.

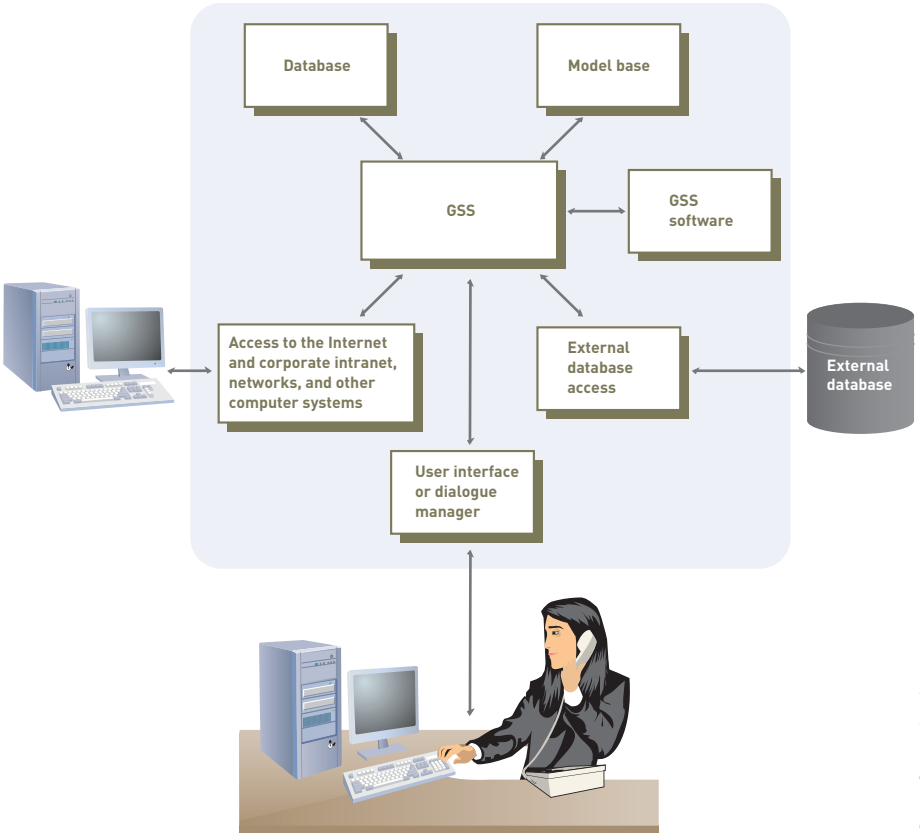


FIGURE **6.25**

Configuration of a GSS

A GSS contains most of the elements found in a DSS, plus software to support group decision making.

Group decision support systems are used in business organizations, nonprofits, government units, and the military. They are also used between companies when the firms are involved in the same supply chain, as first discussed in Chapter 1. For example, an organization might get raw materials and supplies from one company and use another company to distribute finished products to consumers. These separate companies involved in the same supply chain often use group decision support systems to coordinate joint forecasting, planning, and other activities critical to delivering finished products and services to customers.

Characteristics of a GSS That Enhance Decision Making

When it comes to decision making, a GSS's unique characteristics have the potential to result in better decisions. Developers of these systems try to build on the advantages of individual support systems while adding new approaches unique to group decision making. For example, some GSSs allow

the exchange of information and expertise among people without direct face-to-face interaction, although some face-to-face meeting time is usually beneficial. The following sections describe characteristics that can improve and enhance decision making.

Special Design

The GSS approach acknowledges that special procedures, devices, and approaches are needed in group decision-making settings. These procedures must foster creative thinking, effective communications, and good group decision-making techniques.

Ease of Use

Like an individual DSS, a GSS must be easy to learn and use. Systems that are complex and hard to operate will seldom be used. Many groups have less tolerance than do individual decision makers for poorly developed systems.

Flexibility

Two or more decision makers working on the same problem might have different decision-making styles and preferences. Each manager makes decisions in a unique way, in part because of different experiences and cognitive styles. An effective GSS not only has to support the approaches that managers use to make decisions but also must find a means to integrate their different perspectives into a common view of the task at hand. GSS flexibility is also important with customers and outside companies.

Decision-Making Support

delphi approach: A structured, interactive, iterative decision-making method that relies on input from a panel of experts.

A GSS can support different decision-making approaches, including the **delphi approach**, a structured, interactive, iterative decision-making method that relies on input from a panel of experts. Its purpose is to solicit responses from a panel of experts regarding a particular problem or situation and hopefully converge on a "correct" answer. The experts are provided a questionnaire stating the problem and soliciting their opinion. A facilitator collects the responses and provides an anonymous summary of the experts' forecasts as well as the basis for their judgments. The experts are then encouraged to revise their earlier answers in light of the replies of the other members of the panel of experts. This process is repeated until a predefined number of rounds is completed or the group has achieved a consensus. Typically the range of the answers will decrease and the group will converge toward a common answer. The technique had its genesis at the Rand Corporation in the early 1950s where it was used to forecast the impact of technology on warfare.

brainstorming: A decision-making approach that consists of members offering ideas "off the top of their heads," fostering creativity and free thinking.

In another approach, called **brainstorming**, members offer ideas "off the top of their heads," fostering creativity and free thinking. How2Media is a 21st century television production company whose award winning programming includes "World's Greatest …… (fill in the blank)." The company frequently employs brainstorming to come up with new ideas for its programming.[43]

group consensus approach: A group decision-making process that seeks the consent of all participants.

The **group consensus approach** is a group decision-making process that seeks the *consent* of the participants. Giving consent does not mean that the solution being considered is a participant's first choice. Group members can vote their consent to a proposal because they choose to work with the group to accomplish some result, rather than insist on their personal preference. A group must decide on the level of agreement necessary to finalize a decision—unanimous agreement, unanimous consent, super majority (two-thirds is common), or simple majority. The group must also decide which members of the group can vote on the decision (such as all or executive committee members only). The Shuttle Project Engineering Office at the Kennedy Space Center has used the Consensus-Ranking Organizational-Support System (CROSS) to evaluate space projects in a group setting. See Figure 6.26.

Source: NASA

FIGURE **6.26**

Using the GSS approach

NASA engineers use the Consensus-Ranking Organizational-Support System (CROSS) to evaluate space projects in a group setting.

The group consensus approach analyzes the benefits of various projects and their probabilities of success. CROSS is used to evaluate and prioritize advanced space projects.

nominal group technique (NGT): A structured method for group brainstorming that encourages contributions from everyone.

The **nominal group technique (NGT)** is a structured method for group brainstorming that encourages contributions from everyone. It has several advantages over simple brainstorming. It avoids the domination of discussion by a single person and gets all participants involved in making suggestions. It reduces the likelihood of heated discussions to "defend" ideas not accepted by others. Participants feel more "ownership" in the solution. It results in a set of prioritized solutions or recommendations. The steps involved in the nominal group technique are as follow:

1. The facilitator states the subject of the brainstorming session and works to clarify the problem statement until everyone understands it.
2. Each participant silently identifies and writes down as many ideas as possible in a set period of time.
3. The facilitator then calls on each participant in turn to state aloud *one* of his or her ideas. The facilitator records the idea on a flipchart or whiteboard for all to see. Ideas may be discussed to add clarity or answer questions, but no attempt is made to evaluate the idea or reject it. Duplicate ideas are discarded. Wording may be changed to add clarity.
4. The facilitator continues to poll each participant until all participants' ideas have been recorded. The participants then prioritize the ideas using multivoting.

multivoting: Any one of a number of voting processes used to reduce the number of options to be considered.

Multivoting is any one of a number of voting processes used to reduce the number of options to be considered. For example, following the first four steps of a nominal group technique session, the group may have identified 14 options for consideration. One multivoting approach is to allow each participant to vote for half the identified options. On a cue from the facilitator, the participants go to the flipchart or whiteboard and place one vote next to each of the seven options they think are best. The facilitator then adds the votes for each option. The seven options that received the most votes are used to create a reduced list of options. Again, the ideas are discussed to add clarity or answer questions and the voting process is repeated. This process continues until the number of options remaining is acceptable to the group.

Anonymous Input

Many GSSs allow anonymous input, where the person giving the input is not known to other group members. For example, some organizations use a GSS to help rank the performance of managers. Anonymous input allows the group decision makers to concentrate on the merits of the input without considering who gave it. In other words, input given by a top-level manager is given the same consideration as input from employees or other members of the group. Some studies have shown that groups using anonymous input can make better decisions and have superior results compared with groups that do not use anonymous input.

Reduction of Negative Group Behavior

One key characteristic of any GSS is the ability to suppress or eliminate group behavior that is counterproductive or harmful to effective decision making. In some group settings, dominant individuals can take over the discussion, thereby preventing other members of the group from participating. In other cases, one or two group members can sidetrack or subvert the group into areas that are nonproductive and do not help solve the problem at hand. At other times, members of a group might assume they have made the right decision without examining alternatives—a phenomenon called *groupthink*. If group sessions are poorly planned and executed, the result can be a tremendous waste of time. Today, many GSS designers are developing software and hardware systems to reduce these types of problems. Procedures for effectively planning and managing group meetings can be incorporated into the GSS approach. A trained meeting facilitator is often employed to help lead the group decision-making process and to avoid groupthink. See Figure 6.27.

© iStockphoto.com/Golden KB

FIGURE **6.27**

Importance of a trained facilitator

A trained meeting facilitator can help lead the group decision-making process and avoid groupthink.

Parallel and Unified Communication

With traditional group meetings, people must take turns addressing various issues. One person normally talks at a time. With a GSS, every group member can address issues or make comments at the same time by entering text messages to the GSS. These comments and issues are displayed for every group member to see immediately. *Parallel communication* can speed meeting times and result in better decisions. Organizations are using unified communications to support group decision making. *Unified communications* ties together and integrates various communication systems, including

traditional phones, cell phones, email, text messages, and the Internet. With unified communications, members of a group decision-making team use a wide range of communications methods to help them collaborate and make better decisions.

Automated Record Keeping

Most GSSs can automatically keep detailed records of a meeting. Each comment that is entered by a group member can be recorded. In some cases, literally hundreds of comments can be stored for future review and analysis. In addition, most GSS packages have automatic voting and ranking features. After group members vote, the GSS records each vote and makes the appropriate rankings.

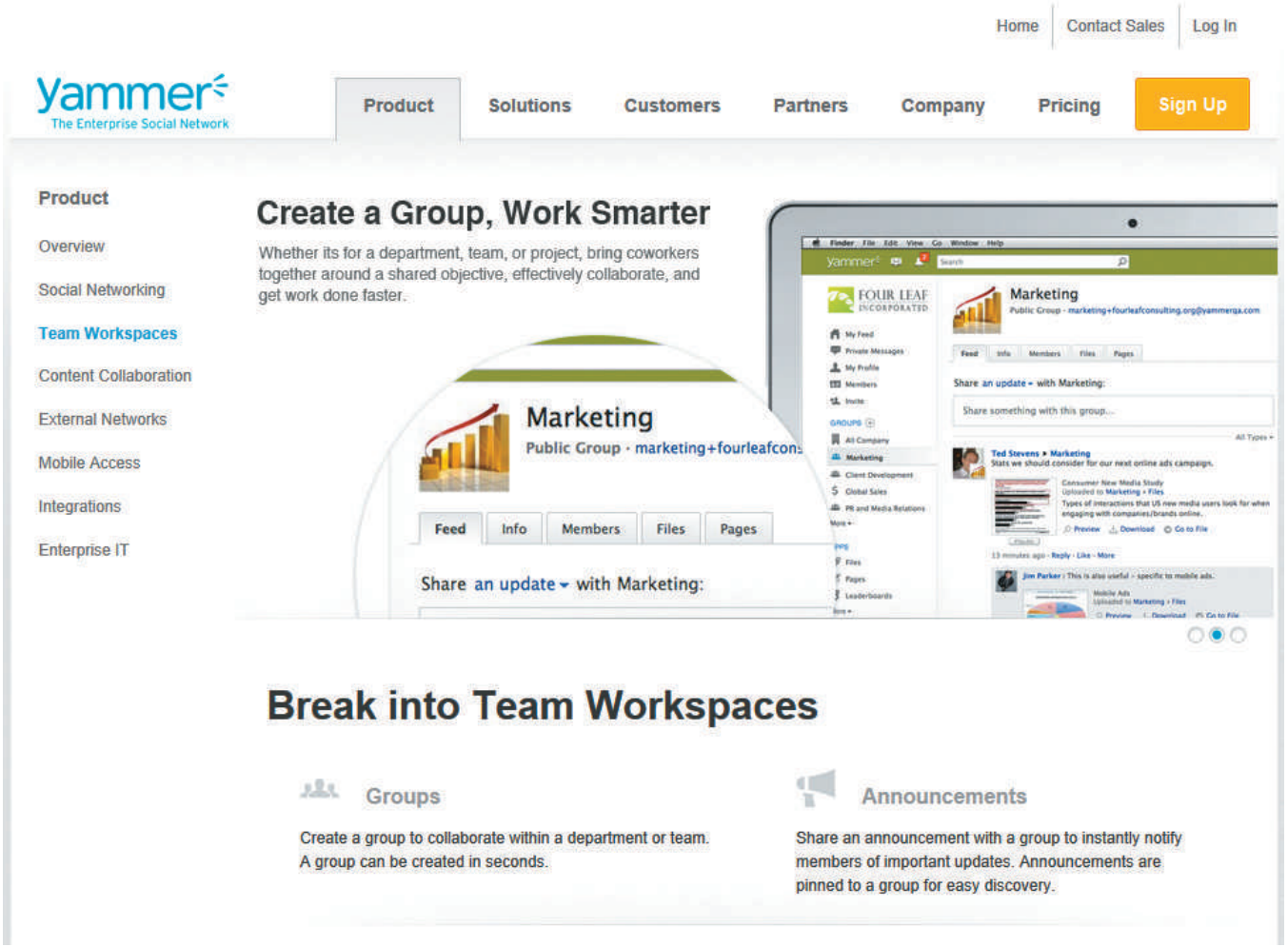
GSS Hardware and Software Tools

Today, executives and corporate managers are collaborating with smartphones and tablet computers to a greater extent. GSS software, often called *groupware* or *workgroup software*, helps with joint workgroup scheduling, communication, and management. One popular package, IBM Lotus Notes, can capture, store, manipulate, and distribute memos and communications that are developed during group projects. Some companies standardize on messaging and collaboration software, such as Lotus Notes. Lotus Connections is a feature of Lotus Notes that allows people to post documents and information on the Internet. The feature is similar to popular social networking sites such as Facebook and LinkedIn, but it is designed for business use. Microsoft has invested billions of dollars in GSS software to incorporate collaborative features into its Office suite and related products. Office Communicator, for example, is a Microsoft product developed to allow better and faster collaboration. Other GSS software packages include Collabnet, OpenMind, and TeamWare. All of these tools can aid in group decision making. *Shared electronic calendars* can be used to coordinate meetings and schedules for decision-making teams. Using electronic calendars, team leaders can block out time for all members of the decision-making team.

A number of additional collaborative tools are available. SharePoint (*www.microsoft.com*), WebEx WebOffice (*www.weboffice.com*), and BaseCamp (*www.basecamp.com*) are just a few examples. Fuze (*www.fuze.com*) provides video collaboration tools on the Internet. The service can automatically bring participants into a live chat, allow workers to share information on their computer screens, and broadcast video content in high definition. Twitter (*www.twitter.com*) and Google+ (*plus.google.com*) are Internet sites that some organizations use to help people and groups stay connected and coordinate work schedules. Yammer (*www.yammer.com*) is a Web site that helps companies provide short answers to frequently asked questions. See Figure 6.28. Managers and employees must first log into their private company network on Yammer to get their questions answered. Teamspace (*www.teamspace.com*) is yet another collaborative software package that assists teams to successfully complete projects. Many of these Internet packages embrace the use of Web 2.0 technologies. Some executives, however, worry about security and corporate compliance issues with any new technology.

GSS Alternatives

Group support systems can take on a number of network configurations, depending on the needs of the group, the decision to be supported, and the geographic location of group members. GSS can be used to improve both the speed and quality of decision making. GSS alternatives include a combination



Source: www.yammer.com

FIGURE **6.28**

Yammer

Yammer helps organizations provide short answers to frequently asked questions.

of decision rooms, local area networks, teleconferencing, and wide area networks:

decision room: A room that supports decision making, with the decision makers in the same building, and that combines face-to-face verbal interaction with technology to make the meeting more effective and efficient.

- The **decision room** is a room that supports decision making, includes decision makers in the same building, and combines face-to-face verbal interaction with technology to make the meeting more effective and efficient. It is ideal for situations in which decision makers are located in the same building or geographic area, and the decision makers are occasional users of the GSS approach. A typical decision room is shown in Figure 6.29.
- The *local area decision network* can be used when group members are located in the same building or geographic area and under conditions in which group decision making is frequent. In these cases, the technology and equipment for the GSS approach is placed directly into the offices of the group members.
- *Teleconferencing* is used when the decision frequency is low and the location of group members is distant. These distant and occasional group meetings can tie together multiple GSS decision-making rooms across the country or around the world. The video game creator Activision Publishing

INFORMATION SYSTEMS @ WORK

Flaws in Group Support Systems

At 11:38 am on January 28, 1986, the shuttle orbiter Challenger launched from Cape Canaveral, Florida. Less than a second later, gray smoke streamed out from a hot flare burning in the rocket motor. The flare ignited liquid hydrogen and nitrogen inside the fuel tank, which exploded 73 seconds after liftoff. As the Challenger was torn apart, all seven astronauts on board were killed.

In the days and weeks that followed the disaster, it became clear that two O-rings designed to separate the sections of the rocket booster had failed. Engineers working for the space agency had warned of just such a failure. They had expressed concerns that the O-ring seals could fail when outside temperatures dropped below 53 degrees Fahrenheit. On the morning of January 28, the temperature was 36 degrees. The launch pad was covered with solid ice.

Group support systems facilitate communication and data exchange between employees making important decisions. In fact, NASA had just such a system in place to coordinate its work with engineers at Morton Thiokol, the manufacturer of the shuttle's solid rocket motor, which included the faulty O-rings.

On the evening of January 27, 1986, Morton Thiokol engineers expressed concerns about launching the shuttle under such abnormally cold weather conditions. The data provided by their group decision support system indicated that the O-ring seals would withstand such low temperatures. However, the engineers doubted the accuracy of the database analysis. They recommended that NASA wait to launch until the temperature outside reached 53 degrees. One NASA manager asked, "My God, Thiokol, when do you want me to launch, next April?" That NASA manager then asked a second NASA manager to intervene. The second NASA manager responded that he was "appalled at Thiokol's recommendation but would not launch over the contractor's objection." The NASA manager continued to maintain that the arguments presented by the Thiokol engineers were inconclusive. Thiokol managers then requested to have five minutes offline to discuss the issue with their engineers. When Thiokol representatives logged back into the system, they supported the decision to launch and NASA welcomed this decision.

After the disaster, the president ordered a commission to investigate the disaster and find out what went wrong. The commission interviewed those involved in the decision-making process and looked over documentation, such as that recorded by the group support system.

One of the Thiokol engineers explained to the presidential commission investigating the data that the engineers just didn't have enough data to determine whether the O-rings could seal properly at lower temperatures. Unlike other Thiokol managers, however, one engineer did not sign the launch recommendation on that fateful evening of January 27. As a result, he stayed with the company and was put in charge of redesigning the solid rocket motor. The redesign was used in 110 successful shuttle mission launches.

Discussion Questions

1. The group support system recorded the interaction between the Thiokol and NASA teams. What was this recorded interaction used for?
2. In what other ways can tracking individual contributions to a GSS be used to support the goals of an organization?

Critical Thinking Questions

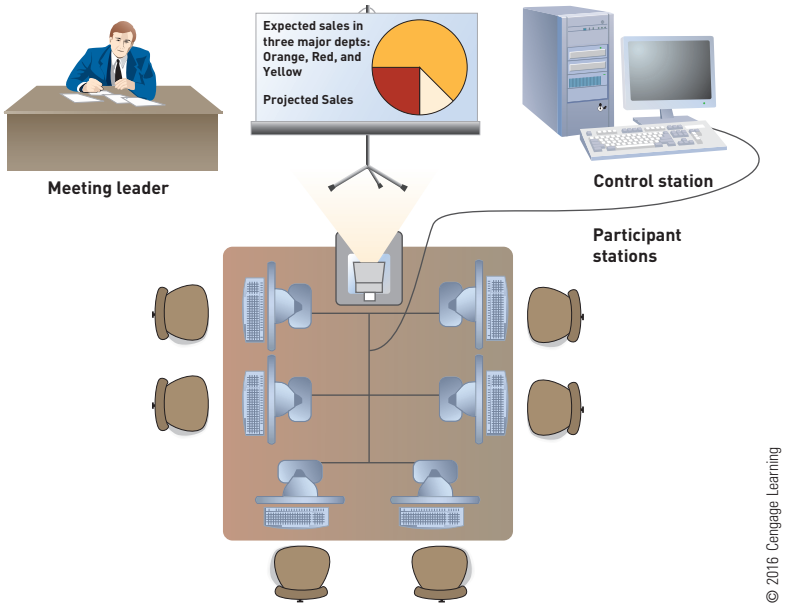
1. The Thiokol engineers doubted the reliability of the analyses they ran on the data in their system. Why do you think Thiokol and NASA managers found it so hard to believe that the engineers might be right and the system output might be wrong?
2. What lessons can be learned from the Challenger disaster that can be applied to the implementation of other group decision support systems?

SOURCES: Oberg, James, "7 Myths About the Challenger Shuttle Disaster," NBC News, January 25, 2011, *www.nbcnews.com/id/11031097/ns/technology_and_science-space/t/myths-about-challenger-shuttle-disaster/#.U2AsyIFdUrU*, accessed April 29, 2014; "Engineer Who Opposed Challenger Launch Offers Personal Look at Tragedy," Researcher News, NASA Web site, October 5, 2012, *www.nasa.gov/centers/langley/news/researchernews/rn_Colloquium1012.html*, accessed April 29, 2014; Challenger Disaster, History Channel, *www.history.com/topics/challenger-disaster*, accessed April 29, 2014; "Failure as a Design Criteria: Human Systems Interaction - Flawed Decision Making: Challenger Space Shuttle," *www.tech.plym.ac.uk/sme/interactive_resources/tutorials/failurecases/hs1.html*, accessed April 29, 2014.

FIGURE **6.29**

GSS decision room

For group members who are in the same location, the decision room is an optimal GSS alternative. This approach can use both face-to-face and computer-mediated communication. By using networked computers and computer devices, such as project screens and printers, the meeting leader can pose questions to the group, instantly collect members' feedback, and with the help of the governing software loaded on the control station, process this feedback into meaningful information to aid in the decision-making process.



uses video conferencing and collaboration tools to bring its developers together to solve the problems of video game design. The use of this technology has dramatically speeded up the time it takes to create new games.

- The *wide area decision network* is used when the decision frequency is high and the location of group members is distant. In this case, the decision makers require frequent or constant use of the GSS approach. This GSS alternative allows people to work in **virtual workgroups**, where teams of people located around the world can work on common problems.

virtual workgroups: Teams of people located around the world working on common problems.

SUMMARY

Principle:

Good decision-making and problem-solving skills are the key to developing effective information and decision support systems.

Every organization needs effective decision making and problem solving to reach its objectives and goals. Problem solving begins with decision making. A well-known model developed by Herbert Simon divides the decision-making phase of the problem-solving process into three stages: intelligence, design, and choice.

Decision making is a component of problem solving. In addition to the intelligence, design, and choice steps of decision making, problem solving also includes implementation and monitoring. Implementation places the solution into effect. After a decision has been implemented, it is monitored and modified if necessary.

Decisions can be programmed or nonprogrammed. Programmed decisions are made using a rule, procedure, or quantitative method. Ordering more inventory when the level drops below the reorder point is an example of a programmed decision. A nonprogrammed decision deals with unusual or

exceptional situations. Determining the best training program for a new employee is an example of a nonprogrammed decision.

Structured decisions are ones where the variables that affect the decision are known and they can be measured. Unstructured decisions are ones where the variables that affect the decision cannot be measured. Semistructured decisions are ones where only some of the variables can be measured.

Decisions can use optimization, satisficing, or heuristic approaches. Optimization finds the best solution. Optimization problems often have an objective, such as maximizing profits, given production and material constraints. When a problem is too complex for optimization, satisficing is often used. Satisficing finds a good, although not necessarily the best, decision. Finally, a heuristic is a "rule of thumb" or common guideline or procedure used to find a good decision.

Principle:

The management information system (MIS) must provide the right information to the right person in the right format at the right time.

A management information system is an integrated collection of people, procedures, databases, and devices that provides managers and decision makers with information to help achieve organizational goals. An MIS can help an organization achieve its goals by providing managers with insight into the regular operations of the organization so that they can control, organize, and plan more effectively and efficiently. The primary difference between the reports generated by the TPS and ERP systems and those generated by the MIS is that MIS reports support managerial decision making at the higher levels of management.

Data that enters the MIS originates from both internal and external sources. The most significant internal sources of data for the MIS are an organization's various TPSs and ERP systems. Data warehouses and data marts also provide important input data for the MIS. External sources of data for the MIS include extranets, customers, suppliers, competitors, and stockholders.

The output of most MISs is a collection of reports that are distributed to managers. These reports include executive dashboards, scheduled reports, key-indicator reports, demand reports, exception reports, and drill-down reports. Executive dashboards present a set of key performance indicators about the state of a process at a specific point in time to enable managers to make better real-time decisions. Scheduled reports are produced periodically, such as daily, weekly, or monthly. A key-indicator report is a special type of scheduled report. Demand reports are developed to provide certain information at a manager's request. Exception reports are automatically produced when a situation is unusual or requires management action. Drill-down reports provide increasingly detailed data about situations.

More and more MIS reports are being delivered over the Internet and through mobile devices, such as cell phones.

Most MISs are organized along the functional lines of an organization. Typical functional management information systems include financial, manufacturing, marketing, human resources, and other specialized systems. Each system is composed of inputs, processing subsystems, and outputs. The primary sources of input to functional MISs include the corporate strategic plan, data from the ERP system and TPS, information from supply chain and business transactions, and external sources including the Internet and extranets. The primary outputs of these functional MISs are summary reports that assist in managerial decision making.

A geographic information system (GIS) is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, that is, data identified according to its location.

Principle:

The focus of a decision support system is on decision-making effectiveness when faced with unstructured or semistructured business problems.

A decision support system (DSS) is an organized collection of people, procedures, software, databases, and devices working to support managerial decision making. DSS characteristics include the ability to handle large amounts of data; obtain and process data from a variety of sources; provide report and presentation flexibility; support drill-down analysis; perform complex statistical analysis; offer textual and graphical orientations; support optimization, satisficing, and heuristic approaches.

DSSs provide support assistance through all phases of the problem-solving process. Different decision frequencies also require DSS support. An ad hoc DSS addresses unique, infrequent decision situations, and an institutional DSS handles routine decisions. Highly structured problems, semistructured problems, and unstructured problems can be supported by a DSS. A DSS can also support different managerial levels, including strategic, tactical, and operational managers. A common database is often the link that ties together a company's TPS, MIS, and DSS.

The components of a DSS are the database, model base, user interface or dialogue manager, and a link to external databases, the Internet, the corporate intranet, extranets, networks, and other systems. The database can use data warehouses and data marts. A data-driven DSS primarily performs qualitative analysis based on the company's databases. Data-driven DSSs tap into vast stores of information contained in the corporate database, retrieving information on inventory, sales, personnel, production, finance, accounting, and other areas. Data mining is often used in a data-driven DSS. The model base contains the models used by the decision maker, such as financial, statistical, graphical, and project-management models. A model-driven DSS primarily performs mathematical or quantitative analysis. Model management software (MMS) is often used to coordinate the use of models in a DSS. The user interface provides a dialogue management facility to assist in communications between the system and the user. Access to other computer-based systems permits the DSS to tie into other powerful systems, including the TPS or function-specific subsystems.

Principle:

A group decision support system (GSS) uses the overall approach of a DSS to improve the decision-making process of a group.

A group decision support system (GSS), also called a group support system and computerized collaborative work system, consists of most of the elements in a DSS, plus software to provide effective support in group decision-making settings. GSSs are typically easy to learn and use and can offer specific or general decision-making support. GSS software, also called groupware, is specially designed to help generate lists of decision alternatives and perform data analysis. These packages let people work on joint documents and files over a network. Text messages and the Internet are also commonly used in a GSS.

The frequency of GSS use and the location of the decision makers will influence the GSS alternative chosen. The decision room alternative supports users in a single location who meet infrequently. Local area decision networks can be used when group members are located in the same geographic area and users meet regularly. Teleconferencing is used when decision frequency is low and the location of group members is distant. A wide area network is used when the decision frequency is high and the location of group members is distant.

KEY TERMS

accounting MIS
ad hoc DSS
auditing
brainstorming
choice stage
computer-integrated manufacturing (CIM)
cost center
decision room
decision-making phase
delphi approach
demand report
design stage
dialogue manager
drill-down report
economic order quantity (EOQ)
exception report
executive dashboard
external auditing
financial audit
financial MIS
flexible manufacturing system (FMS)
geographic information system (GIS)
group consensus approach
group decision support system (GSS)
heuristics
human resource MIS
implementation stage
institutional DSS
intelligence stage
internal auditing
just-in-time (JIT) inventory
key-indicator report
marketing
marketing MIS
model base
model management software (MMS)
monitoring stage
multivoting
nominal group technique (NGT)
nonprogrammed decision
operational audit
optimization model
problem solving
profit center
programmed decision
quality control
reorder point (ROP)
revenue center
satisficing model
scheduled report
semistructured decision
structured decision
unstructured decision
virtual workgroups

CHAPTER 6: SELF-ASSESSMENT TEST

Good decision-making and problem-solving skills are the key to developing effective information and decision support systems.

1. During which stage of the problem-solving process do you identify and define potential problems as well as investigate resource and environmental constraints?
   a. initiation stage
   b. intelligence stage
   c. design stage
   d. choice stage
2. The three stages of decision making are augmented by implementation and monitoring to result in problem solving. True or False?
3. _____ decisions deal with typically one-time decisions that in many cases are difficult to quantify.
   a. Structured
   b. Unstructured
   c. Programmed
   d. Nonprogrammed
4. A decision that inventory should be ordered when inventory levels drop below the reorder point is an example of a(n) _____.
   a. semistructured decision
   b. asynchronous decision
   c. nonprogrammed decision
   d. programmed decision

5. A satisficing model is one that will find a good problem solution, although not necessarily the best problem solution. True or False?

The management information system (MIS) must provide the right information to the right person in the right format at the right time.

6. A(n) _____ presents a set of key performance indicators about the state of a process at a specific point in time to enable managers to make better real-time decisions.
   a. key-indicator report
   b. demand report
   c. exception report
   d. executive dashboard
7. The _____ defines the accounting categories of a business and is a key component of the financial MIS.
8. Financial accounting and managerial accounting are basically the same thing. True or False?
9. _____ is an independent business unit that is treated as a distinct entity enabling its revenue and expenses to be determined and its profitability to be measured.
   a. Profit center
   b. Revenue center
   c. Cost center
   d. Sales center

The focus of a decision support system is on decision-making effectiveness when faced with unstructured or semistructured business problems.

10. Decision support systems are designed solely for use by the top levels of management. True or False?
11. What component of a decision support system allows decision makers to easily access and manipulate the DSS and to use common business terms and phrases?
    a. the knowledge base
    b. the model base
    c. the user interface or dialogue manager
    d. the model management software

A group decision support system (GSS) uses the overall approach of a DSS to improve the decision-making process of a group.

12. The _____ approach is a structured, interactive, iterative decision-making method that relies on input from a panel of experts.
13. The _____ is a structured method for brainstorming that encourages contributions from everyone.
14. There are several multivoting processes that can be used to reduce the number of options to be considered. True or False?

CHAPTER 6: SELF-ASSESSMENT TEST ANSWERS

1. b
2. True
3. d
4. d
5. True
6. d
7. general ledger
8. False
9. a
10. False
11. c
12. Delphi
13. nominal group technique
14. True

REVIEW QUESTIONS

1. What is the difference between decision making and problem solving?
2. What is a satisficing model? What is an optimization model? Describe a situation where each should be used.
3. Identify and briefly describe the three stages of decision making.
4. What is the difference between a structured and an unstructured decision? Give several examples of each.
5. Give several examples of heuristics that you use in decision making.
6. Identify and briefly describe the basic kinds of reports produced by an MIS.
7. Describe the difference between a profit center, revenue center, and cost center.
8. How can a social networking site be used in a DSS?
9. What are the primary activities supported by a marketing MIS?
10. Describe the functions of a human resource MIS.
11. What is a geographic information system? Give an example of such a system.
12. How can location analysis be used in a marketing research MIS?
13. List some software tools used in group support systems.

14. Identify and briefly describe the primary components of a decision support system.
15. State the objective of a group support system (GSS) and identify three characteristics that distinguish it from a DSS.
16. Identify and briefly describe five decision-making approaches frequently used with GSS.
17. What is a decision room and when might one be used?

DISCUSSION QUESTIONS

1. Think of an important problem you had to solve during the last few months. Describe how you used the problem-solving steps discussed in this chapter to resolve the problem. Did you elect to get others involved in helping solve this problem? What sources of data did you employ to help reach a decision?
2. Identify a problem that would benefit from using data from a social networking site as input to a decision support system. What difficulties might be encountered in capturing and trying to use this data?
3. Describe the key features of a human resource MIS for a management consulting firm. What are the primary inputs and outputs? What are the subsystems?
4. Why is auditing so important in a financial MIS? Give an example of an audit that failed to disclose the true nature of the financial position of a firm. What was the result?
5. Describe two industries where a marketing MIS is critical to sales and success.
6. Pick a company and research its human resource management information system. Describe how the system works. What improvements could be made to the company's human resource MIS?
7. Under what conditions and for what types of problems would you recommend the use of a group decision support system over the use of a single user decision support system?
8. What functions do DSSs support in business organizations? How does a DSS differ from a TPS and an MIS?
9. How is decision making in a group environment different from individual decision making, and why are information systems that assist in the group environment different? What are the advantages and disadvantages of making decisions as a group?
10. You have been hired to develop group support software for your university. Describe the features you would include in your new GSS software.

PROBLEM-SOLVING EXERCISES

1. Use the Internet to identify two GSS software solutions that can be used to facilitate group decision making. Use a spreadsheet program to show a side-by-side comparison of the key features and capabilities as well as the hardware required of each software solution. Develop a set of slides using a graphics program to deliver a presentation comparing the two solutions.
2. Review the summarized consolidated statement of income for the manufacturing company whose data is shown in Table 6.5. Use graphics software to prepare a set of bar charts that shows the data for this year compared with the data for last year.
   a. This year, operating revenues increased by 1.5 percent, while operating expenses increased 1.0 percent.
   b. Other income and expenses decreased to $12,000.
   c. Interest and other charges increased to $285,000.

TABLE 6.5 Operating results for a manufacturing firm

Operating results (in millions)	
Operating Revenues	$2,924,100
Operating Expenses (including taxes)	2,483,600
Operating Income	440,500
Other Income and Expenses	13,400
Income before Interest and Other Charges	453,900
Interest and Other Charges	262,800
Net Income	191,100
Average Common Shares Outstanding	145,000
Earnings per Share	1.32

If you were a financial analyst tracking this company, what additional data might you need to perform a more complete financial analysis? Write a brief memo summarizing your data needs.

3. As the head buyer for a major supermarket chain, you are constantly being asked by manufacturers and distributors to stock their new products. Over 50 new items are introduced each week. Many times, these products are launched with national advertising campaigns and special promotional allowances to retailers. To add new products, the amount of linear shelf space allocated to existing products must be reduced or items must be eliminated altogether. Develop a simple spreadsheet DSS program that you can use to estimate the change in profits from adding or deleting an item from inventory. Your analysis should include input such as estimated weekly sales in units, the amount of linear shelf space allocated to stock an item (measured in inches), total cost per unit, and sales price per unit. Your analysis should calculate total annual profit by item and then sort the rows in descending order based on total annual profit.

TEAM ACTIVITIES

1. Use the Internet to identify three GSS software solutions that can be used to facilitate group decision making. As a group, come to a decision on which of the three software solutions is the best for use by small teams like yours. Document your decision and the process you followed to reach a decision.
2. Have your team make a group decision to identify ways to improve their grade in this course. Secretly appoint one or two members of the team to disrupt the meeting with negative group behavior. After the meeting, have your team describe how to prevent this negative group behavior. What GSS software features would you suggest to prevent the negative group behavior your team observed?
3. Have your team design a human resource MIS for a medium-sized retail store. Describe the features and characteristics of your human resource MIS. How could you achieve a competitive advantage over a similar retail store with your superior human resource MIS?

WEB EXERCISES

1. Do research on the Web to find an example of an external audit that uncovered serious problems at an organization. Briefly summarize the findings of the audits. What recommendations were made to correct those problems?
2. Use the Internet to explore applications for smartphones and tablet computers that can be used in decision making. You might be asked to develop a report or send an email message to your instructor about what you found.
3. Software, such as Microsoft Excel, is often used to find an optimal solution to maximize profits or minimize costs. Search the Internet using Yahoo!, Google, or another search engine to find other software packages that offer optimization features. Write a report describing one or two of the optimization software packages. What are some of the features of the packages?

CAREER EXERCISES

1. What decisions are critical for success in a career that interests you? What specific types of reports could help you make better decisions on the job? Give three specific examples.
2. Describe the features of a decision support system that you would want, assuming you are a brand assistant in a consumer products company in charge of the marketing for one of your company's brands.

CASE STUDIES

Case One

DSS Dashboards Spur Business Growth at Irish Life

Irish Life, founded in 1939, is Ireland's largest life insurer and provider of employee benefit solutions for both the private and public sector. In addition, the company also handles pensions for 595,000 Irish workers and is Ireland's largest investment manager.

However, Irish Life had a problem. It collected vast amounts of data. It had lots of software to help analyze all this data, but that software wasn't doing the job. Paul Egan, IT manager at Irish Life, explains that "a lot of the tools were only IT tools and only IT people could use them, but [with those tools] we could never keep up with the appetite the business had for this." Irish Life needed software that its business managers could use in their decision making without having to become technical specialists.

After looking at the available DSS packages from its incumbent supplier and other software vendors, Irish Life sought advice from consultants at the Gartner Group. The life insurance provider then chose software from Tableau Software of Seattle, Washington, and engaged Tableau partner MXI Computing to help implement that software.

Using the Tableau software, Irish Life could represent data graphically across the organization, mapping patterns and trends more clearly than it could before the company began to use it. It originally made Tableau dashboards available to about 300 users. These users were able to build their own dashboards, to publish on the Web, or distribute on mobile devices running Android or iOS software. The net result, Irish Life believes, was improved decision making due to better availability of data and better insight into the data. The Intelligence and Design stages of decision making are especially well positioned to benefit from this insight.

For example, Irish Life releases the Personal Lifestyle Strategy program for customized retirement planning within the framework of a corporate pension plan. Making the decisions that were involved in developing this program required detailed analysis of workforce data—exactly what data visualization is suited for.

"Managers can come up with their own dashboards based on the numbers they know they need. There's less work for IT in the front end: IT now only have to worry about the data warehouse, which is where we can add value. We don't have to worry about the visuals as much," added Egan. Insights from the DSS tool have already led to Irish Life moving its management team's focus in certain cases to product lines or customer accounts that needed closer attention.

The results are that Irish Life has been able to offer improved products and services. Customers can speak with better-informed financial experts or they can go online and access their own pension information and estimate what financial resources they will have in the future depending on their own pension choices. As a result, Irish Life has almost tripled its customer base since it first adopted the system.

Discussion Questions

1. Irish Life had a business software that was only accessible to the members of the IT department. Why was this a problem?
2. What steps can companies take to make sure that the users of a DSS system are able to use it effectively?

Critical Thinking Questions

1. What data do financial experts at a company like Irish Life have to analyze and present to clients? What analyses must the DSS system provide the experts so they can help customers?
2. Irish Life is now offering online tools that enable customers to access pension information themselves. What are the advantages of providing these online tools to the customers? What advantages do financial experts with access to the more sophisticated DSS tools offer above and beyond these online tools?

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Case Two

Mando: Streaming Inventory Management for Growth

Mando Corporation is South Korea's largest manufacturer of automobile steering, brake, and suspension components. Originally a division of automobile manufacturer Hyundai, it is now separate, though both are in the same *chaebol* (conglomerate). Mando supplies many other automobile firms as well, including Chinese auto makers and GM. Its 2014 annual revenue was about U.S. $7 billion. With plants in China, India, Malaysia, Turkey, Poland, and Brazil as well as South Korea and with a wide range of mechanical and electronic products, inventory management is critical to its success.

With inventory management (and more) in mind, Mando chose Oracle's E-Business Suite as an integrated ERP system to connect all its divisions. Using a single enterprise-wide database reduced errors. For example, it enabled Mando to standardize on a common numbering system, eliminating inventory-tracking errors due to part number differences when applying design changes.

As you read in this chapter, inventory management decisions use a variety of reports. Therefore, if you saw "Mando Achieves 99.9% Accuracy in Inventory Tracking," you'd probably assume that management information systems and their reports were part of the reason. You'd be right. The E-Business Suite software can produce a wide variety of reports of all types.

Tracking inventory, or knowing what you have, is only part of the answer. You have to have the *right* inventory, which is often specified in reports. Inventory management decisions depend on reports as well.

Some inventory management decisions can be programmed. When stock drops to the reorder point, an order is placed for the reorder quantity. In this instance,

management uses reports to make sure the programmed procedures are operating properly and meet the organization's needs.

Other inventory management decisions are less structured. New products have no usage history on which to base reorder points or quantities. Inventory of products being replaced must be managed to ensure proper phase-out. Management doesn't want to be left with a stock of parts that have no current use or run out of a key component before production ends. The transition from mechanical to electronic controls involves more than just replacing one part with a slightly different one. In making these inventory decisions, reports must be used along with sales forecasts and careful analysis to ensure that the right amounts of the right items are on hand.

In addition to reports, Mando used the capabilities of Oracle Business Intelligence software to create a real-time decision-making environment. Inventory information and other data are presented to senior managers through a dashboard on a daily and monthly basis. The dashboards deliver key information in an easy-to-view format and help managers determine business trends.

Park ByoungOk, Mando's CIO, is pleased with these software capabilities. He says, "The [ERP] system enabled us to standardize more than 200 processes globally, which gave senior managers an integrated, enterprise-wide view of sales, financials, inventory, and quality management." Giving managers an overview of the company is, in the final analysis, the purpose of any management information system.

Discussion Questions

1. As a manager, you must choose between two inventory management software packages. One is a stand-alone package that only manages inventory. It allows users to define their own reports without much training. The other requires a professional programmer for new reports, but it is part of an ERP system that can handle much more than inventory management. Describe how you would choose between the two packages.
2. As a manager of a Mando factory, you might be faced with making inventory decisions about new products. Describe what steps you would take to transition smoothly from mechanical to electronic control of the inventory system? Once in place, what follow-up steps would you have to take to monitor the electronic inventory system?

Critical Thinking Questions

1. Managers at Mando receive daily and monthly reports. Describe the types of reports managers need to review daily and the types they need to review monthly?
2. Explain why it would be more difficult for Mando to manage its inventory if the databases for all its factories were different and used different numbers for the same part. Give a specific example of a problem that could arise.

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Questions for Web Case

See the Web site for this book to read about the Altitude Online case for this chapter. Following are questions concerning this Web case.

Altitude Online: Information and Decision Support Systems Considerations

Discussion Questions

1. What functional areas of Altitude Online are supported by MISs?
2. How do MISs and DSSs provide a value add to Altitude Online's products?

Critical Thinking Questions

1. How do you think MISs and DSSs assist Altitude Online's top executives in guiding the direction of the company?
2. How can the quality of information systems affect Altitude Online's ability to compete in the online marketing industry?

NOTES

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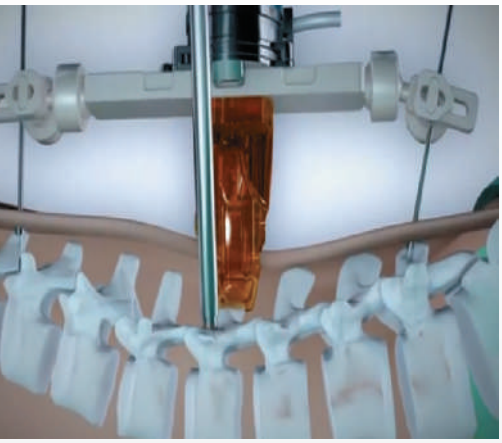
7 Knowledge Management and Specialized Information Systems

Principles	Learning Objectives
• Knowledge management allows organizations to share knowledge and experience among its workers.	• Discuss the differences between data, information, and knowledge. • Describe the role of the chief knowledge officer (CKO). • List some of the tools and techniques used in knowledge management.
• Artificial intelligence systems form a broad and diverse set of systems that can replicate human decision making for certain types of well-defined problems.	• Define the term *artificial intelligence* and state the objective of developing artificial intelligence systems. • List the characteristics of intelligent behavior and compare the performance of natural and artificial intelligence systems for each of these characteristics. • Identify the major components of the artificial intelligence field and provide one example of each type of system.
• Expert systems can enable a novice to perform at the level of an expert but must be developed and maintained very carefully.	• List the characteristics and basic components of expert systems. • Outline and briefly explain the steps for developing an expert system. • Identify the benefits associated with the use of expert systems.
• Multimedia and virtual reality systems can reshape the interface between people and information technology by offering new ways to communicate information, visualize processes, and express ideas creatively.	• Discuss the use of multimedia in a business setting. • Define the term *virtual reality* and *augmented reality* and provide three examples of these applications.
• Specialized systems can help organizations and individuals achieve their goals.	• Discuss examples of specialized systems for organizational and individual use.

Information Systems in the Global Economy
CAESARIA, ISRAEL

Revolutionizing Spinal Surgery with Robotics



http://mazorrobotics.com/renaissance/how-it-works

In Jerusalem, in Moscow, and even in Jacksonville, Florida, Mazor Robotics Renaissance™ Guidance System is revolutionizing the accuracy and improving the outcome of spinal surgery across the globe. The Renaissance Robot serves as a sidekick to surgeons, locating with precision the points of incision along the spines of patients suffering from mild spinal instabilities such as scoliosis to other complex spinal deformities.

Here's how it works. A few days prior to the operation, a CT scan of the patient's spine is done to create a 3D model of the spine. Because the spine shifts and is not in the exact same position as it was during the CT scan, technicians feed live X-rays of the spine into the robot's software as the patient lies on the operating table to obtain a real-time 3D image. The robot is mounted on the patient's back and comes to a rest at the point of incision. The surgeon then implants a screw at that location. The screw serves to connect or reposition the vertebrae to stabilize the spine. Once implanted, the robot moves to the next point of incision.

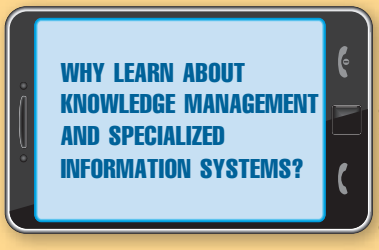
Without the aid of the Renaissance Robot, a spinal surgeon risks cutting into the spinal cord or nerve canals. As a result, some 10 percent of patients wind up with misplaced implanted screws and half of those suffer long-term neurological damage. In the first 4,000 operations conducted using the Renaissance Robot, not a single patient suffered long-term damage to the nervous system.

The guidance system has other advantages. Studies show that the average length of hospital stays is reduced by 27 percent and complication rates are reduced by 48 percent. Patients are exposed to much less than the standard X-ray radiation that is used during surgery to create static models of the spine. Finally, the guidance system can reduce the intrusiveness for many surgical procedures.

As a result, Mazor Robotics has rocketed to success, named by Fast Company as the fourth most innovative robotic company in the world. The company has offices in United States and Germany and sends employees around the world to train surgeons in the use of the Renaissance Robot. As a start-up, the company had originally planned to develop robotic solutions for hip, knee, and other surgeries, but expense forced them to narrow their focus. Now, thanks to the large infusion of capital made possible by their recent listing on the NASDAQ, the company is expanding development. It is now working on a robotic guidance system for brain surgery.

As you read this chapter, consider the following:

- How can specialized IT systems and devices provide expertise superior to that which can be obtained through human effort?
- What are the many uses for IT systems designed to collect knowledge and provide expertise?



Knowledge management and specialized information systems are used in almost every industry. As a manager, you might use a knowledge management system to obtain advice on how to approach a problem that others in your organization have already encountered. As an executive at an automotive company, you might oversee robots that attach windshields to cars or paint body panels. As a young stock trader, you might use a special system called a *neural network* to uncover patterns and make millions of dollars trading stocks and stock options. As a marketing manager for a PC manufacturer, you might use virtual reality on a Web site to show customers your latest laptop and tablet computers. As a member of the military, you might use computer simulation as a training tool to prepare you for combat. As an employee of a petroleum company, you might use an expert system to determine where to drill for oil and gas. You will see many additional examples of using these specialized information systems throughout this chapter. Learning about these systems will help you discover new ways to use information systems in your day-to-day work.

Like other aspects of an information system, the overall goal of knowledge management and the specialized systems discussed in this chapter is to help people and organizations achieve their goals. In this chapter, we explore knowledge management, artificial intelligence, and many other specialized information systems, including expert systems, robotics, vision systems, natural language processing, learning systems, neural networks, genetic algorithms, intelligent agents, multimedia, virtual reality, and augmented reality.

KNOWLEDGE MANAGEMENT SYSTEMS

Chapter 1 defines and discusses data, information, and knowledge. Recall that *data* consists of raw facts, such as an employee number, number of hours worked in a week, inventory part numbers, or sales orders. A list of the quantity available for all items in inventory is an example of data. When these facts are organized or arranged in a meaningful manner, they become information. You may recall from Chapter 1 that *information* is a collection of facts organized so that it has additional value beyond the value of the facts themselves. An exception report of inventory items that might be out of stock in a week because of high demand is an example of information. *Knowledge* is the awareness and understanding of a set of information and the ways that information can be made useful to support a specific task or reach a decision. Knowing the procedures for ordering more inventory to avoid running out is an example of knowledge. In a sense, information tells you what the current situation is (some items have low inventory levels), while knowledge tells you what action is needed to address the situation (make two important phone calls to the right people to get the needed inventory shipped overnight). See Figure 7.1.

FIGURE **7.1**

Differences between data, information, and knowledge

Data consists of raw facts, information explains the current situation, and knowledge identifies the action needed to address the situation.

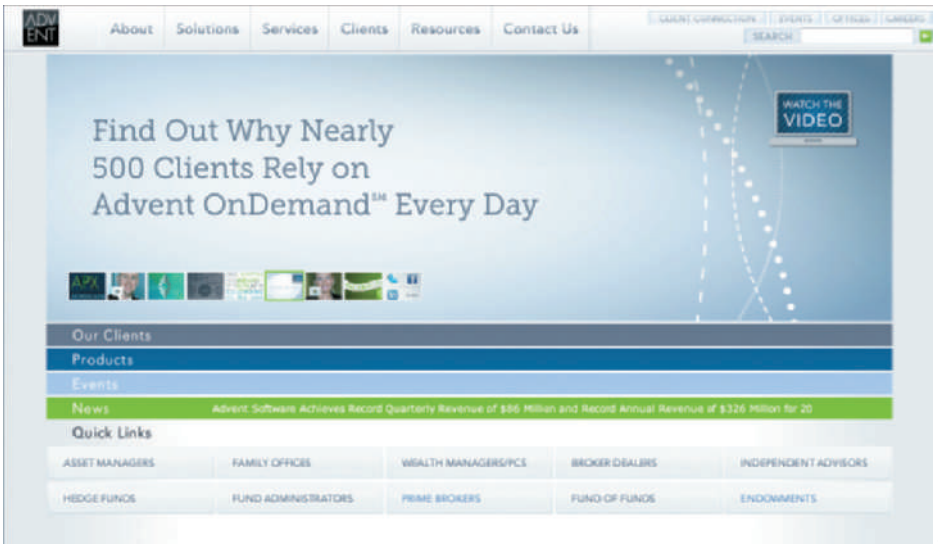
Data	There are 20 PCs in stock at the retail store.
Information	The store will run out of inventory in a week unless more is ordered today.
Knowledge	Call 800-555-2222 to order more inventory.

A *knowledge management system (KMS)* is an organized collection of people, procedures, software, databases, and devices used to create, store, share, and use the organization's knowledge and experience. KMSs cover a wide range of systems, from software that contains some KMS components to dedicated systems designed specifically to capture, store, and use knowledge.

Overview of Knowledge Management Systems

An effective KMS enables an organization to make better use of its gathered knowledge. This avoids wasted time to find valuable information and prevents "re-inventing" the wheel. The use of a KMS can reduce wasted resources, improve customer satisfaction, raise an organization's competitiveness in the marketplace, and increase the success of its planning processes. AstraZeneca, the biopharmaceutical company, implemented a KMS to index some 200 million documents so that scientists in its global R&D organization can find relevant information concerning drugs, diseases, and genes.[1]

For many organizations, KM can mean providing better customer service or providing special needs to people and groups. See Figure 7.2. Legato Support Systems (recently acquired by EMC) engages in the development, marketing, and support of storage software products and services worldwide. The firm implemented a KMS to enable customers to obtain self-service and reduce by 25 percent the number of calls that had to be handled by the support staff.



Source: www.advent.com

FIGURE **7.2**

Knowledge management software

Advent Software uses a knowledge management system to help its employees find critical investment information.

Knowledge can be of two types—explicit and tacit knowledge. *Explicit knowledge* is objective and can be measured and documented in reports, papers, and rules. For example, knowing the best road to take to minimize driving time from home to the office when a major highway is closed is explicit knowledge. It can be documented in a report or a rule, as in "If I-70 is closed, take Highway 6 to the office." *Tacit knowledge*, on the other hand, is hard to measure and document and typically is not objective or formalized. Knowing the best way to negotiate with a foreign government about nuclear disarmament or a volatile hostage situation often requires a lifetime of experience and a high level of skill. These are examples of tacit knowledge. It is difficult to write a detailed report or a set of rules that would always work in every hostage situation. Many organizations actively attempt to convert tacit knowledge to explicit knowledge to make the knowledge easier to measure, document, and share with others.

Data and Knowledge Management Workers and Communities of Practice

The personnel involved in a KMS include *knowledge workers* (a term first coined by management guru Peter Drucker),[2] people who earn their living by creating, using, and disseminating knowledge. This covers a wide range of today's workers. See Figure 7.3. "There are 615 million knowledge workers in the world but 2.1 billion workers who are not 'knowledge workers,'" according to Jim Patterson, the co-founder and CEO of Cotap, a messaging application software start-up firm.

FIGURE **7.3**

Knowledge workers

Knowledge workers are people who create, use, and disseminate knowledge and include professionals in science, engineering, business, and other areas.

chief knowledge officer (CKO): The individual who presents the organization's knowledge management vision with clarity and effectiveness, strives mightily to achieve that vision, provides executive level leadership to implement and sustain KM, and is the ultimate focal point for knowledge creation, sharing, and application.

The **chief knowledge officer (CKO)** is the individual who represents the organization's knowledge management vision with clarity and effectiveness, strives mightily to achieve that vision, provides executive level leadership to implement and sustain KM, and is the ultimate focal point for knowledge creation, sharing, and application. The CKO is responsible for the organization's KMS and typically works with other executives and vice presidents, including the chief executive officer (CEO) and chief financial officer (CFO), among others.

Each NASA center has been directed to appoint a chief knowledge officer and implement a KM program. Dr. Edward Hoffman (NASA-overall CKO) and Dr. Edward Rogers (NASA-Goddard CKO) were two of the first appointed CKOs. Dr. Rogers is a recognized NASA expert on the use of institutional learning case studies and has helped develop over 50 case studies to make mission knowledge attractive and engaging.[3]

community of practice (COP): A group of people with common interests who come together to create, store, and share knowledge of a specific topic.

Some organizations and professions use **communities of practice (COP)**, which are groups of people with common interests who come together to create, store, and share knowledge on a specific topic. A group of oceanographers investigating climate change or a team of medical researchers looking for new ways to treat lung cancer are examples of COPs. COPs often connect people who might not otherwise have an opportunity to interact, either frequently or perhaps not at all. Thus an effective COP can lead to a quantum leap in collaboration among people with common interests. COPs help individuals enhance their area of expertise by providing a forum to share information, stories, personal experiences, and solutions to common problems.

Companies in the oil and gas industry have been among the leaders in establishing COPs. Members of a COP come together to share and learn from one another on a specific topic. Two early communities of practice were exploration and production. Eventually additional communities of practice formed on such topics as health and safety, energy efficiency, and process engineering. Chevron Texaco has over 100 active communities of practice.[4]

Obtaining, Storing, Sharing, and Using Knowledge

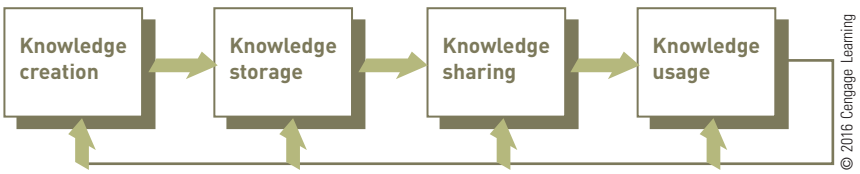
Obtaining, storing, sharing, and using knowledge is the key to any KMS. The Directorate-General for Competition is responsible for establishing and implementing a clear competition policy for the European Union. In this role, the Directorate-General must review all proposed mergers and acquisitions for potential antitrust violations. It also verifies suspected abuse of a dominant market position or illicit cartels. The Directorate-General must reach decisions quickly to minimize any adverse effects on consumers and affected competitors. Each case may involve the review of thousands of documents and contemplation of intricate legal issues. The Directorate-General implemented a KMS to help it discover all relevant information and to keep track of key information related to each case.[5]

Using a KMS often leads to additional knowledge creation, storage, sharing, and usage. Drug companies and medical researchers invest billions of dollars in creating knowledge on cures for diseases. Knowledge management systems can also diminish the reliance on paper reports and thus reduce costs and help protect the environment. Although knowledge workers can act alone, they often work in teams to create or obtain knowledge. See Figure 7.4.

FIGURE **7.4**

Knowledge management system

Obtaining, storing, sharing, and using knowledge is the key to any KMS.



After knowledge is created, it is often stored in a *knowledge repository* that includes documents, reports, files, and databases. The knowledge repository can be located both inside the organization and outside. Bio-Botanica manufactures cosmetic, personal care, and pharmaceutical products that require much regulatory data, R&D documentation, and specification data. The firm must be able to prove that it is managing all this data and associated workflow processes according to standards defined by the Federal Drug Administration and others. Bio-Botanica collects this data from numerous sources within the company and stores it in a knowledge repository managed by its KMS.

Some types of software can store and share knowledge contained in documents and reports. Adobe portable document format (PDF) files, for example, allow you to store corporate reports, tax returns, and other documents and send them to others over the Internet. The publisher and the authors of this book used PDF files to store, share, and edit each chapter. Traditional databases, data warehouses, and data marts often store the organization's knowledge. Specialized knowledge bases in expert systems, discussed later in this chapter, can also be used.

Because knowledge workers often work in groups or teams, they can use collaborative work software and group support systems to share knowledge, such as groupware, meeting software, and collaboration tools. Intranets and password-protected Internet sites also provide ways to share knowledge. Many businesses, however, use patents, copyrights, trade secrets, Internet

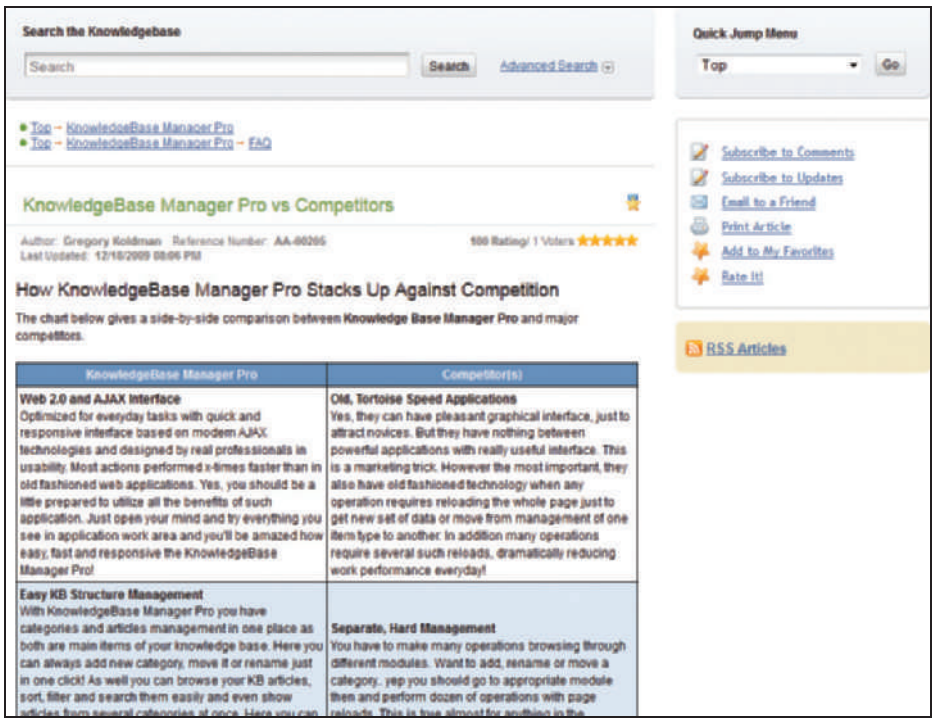
firewalls, and other measures to keep prying eyes from seeing important knowledge that is expensive and hard to create.

Using a knowledge management system begins with locating the organization's knowledge. This procedure is often done using a *knowledge map* or directory that points the knowledge worker to the needed knowledge. Medical researchers, university professors, and even textbook authors use LexisNexis to locate important knowledge. Corporations often use the Internet or corporate Web portals to help their knowledge workers find knowledge stored in documents and reports.

Technology to Support Knowledge Management

KMSs use a number of tools discussed throughout the book. In Chapter 1, for example, we explored the importance of *organizational learning* and *organizational change*. An effective KMS is based on learning new knowledge and changing procedures and approaches as a result. A manufacturing company, for example, might learn new ways to program robots on the factory floor to improve accuracy and reduce defective parts. The new knowledge will likely cause the manufacturing company to change how it programs and uses its robots. In Chapter 3, we investigated the use of *data mining* and *business intelligence*. These powerful tools can be important in capturing and using knowledge. Enterprise resource planning tools, such as SAP, include knowledge management features. In Chapter 6, we showed how *groupware* can improve group decision-making and collaboration. Groupware can also be used to help capture, store, and use knowledge. Of course, hardware, software, databases, telecommunications, and the Internet, discussed in Part 2, are important technologies used to support most knowledge management systems.

Hundreds of organizations provide specific KM products and services. See Figure 7.5. In addition, researchers at colleges and universities have developed tools and technologies to support knowledge management. American companies spend billions of dollars on knowledge management technology every year. Companies such as IBM have many knowledge management tools in a variety



Source: www.web-site-scripts.com

FIGURE **7.5**

Knowledge management technology

Knowledgebase Manager Pro is designed for helping organizations create knowledge bases.

of products, including IBM Lotus Notes (now known as IBM Connections Mail), discussed in Chapter 6. Hughes Christensen is an oil and gas-drilling tool provider whose engineers had acquired a depth and breadth of drilling expertise. The organization built a knowledge-sharing tool it dubbed "Drilling Performance Guidelines" based on IBM Domino/Notes. The tool enables experts within the firm to publish and share their knowledge and experience with others within the firm as well as outside clients. Hughes Christensen has been highly successful in attracting new clients who need advice on difficult drilling projects. One client, oil-drilling specialist BP Norge, was able to save nearly $7 million on a drilling project in Norway.[6]

Microsoft offers a number of knowledge management tools, including Digital Dashboard, which is based on the Microsoft Office suite. Digital Dashboard integrates information from a variety of sources, including personal, group, enterprise, and external information and documents. Other tools from Microsoft include Web Store Technology, which uses wireless technology to deliver knowledge to any location at any time; Access Workflow Designer, which helps database developers create effective systems to process transactions and keep work flowing through the organization; and related products.

Some smaller, lesser-known software firms provide knowledge management software tools that make it easy to build a knowledge base and make it possible for employees and customers to find the right knowledge, answers, and information that they need. Examples of such knowledge management software solutions are summarized in Table 7.1.

TABLE 7.1 Knowledge management software

Software	Vendor	Select Customers
Bloomfire	Bloomfire	Re/Max Comcast
Communifire	Axero Solutions	Electronic Music Alliance Together.in
Intelligence Bank	Intelligence Bank	Deloitte SunCorp Bank
Moxie Knowledgebase	Moxie Software	Student Loans Company Infusionsoft
Oxcyon	Oxcyon CentralPoint CMS	Tanner Health VCA Antech
Smart Support	Safe Harbor Knowledge Solutions	SunTrust Bank

OVERVIEW OF ARTIFICIAL INTELLIGENCE

At a Dartmouth College conference in 1956, John McCarthy proposed the use of the term *artificial intelligence* (*AI*) to describe computers with the ability to mimic or duplicate the functions of the human brain. A paper was presented at the conference proposing a study of AI based on the conjecture that "every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it."[7] Many AI pioneers attended this first conference; a few predicted that computers would be as "smart" as people by the 1960s. The prediction has not yet been realized, but many applications of artificial intelligence can be seen today, and research continues.

Watson, a supercomputer developed by IBM with artificial intelligence capabilities, was able to soundly defeat two prior champions of the popular

INFORMATION SYSTEMS @ WORK

Knowledge Management Improves Customer Support at Canon

Millions of U.S. consumers own Canon digital cameras, copiers, printers, binoculars, fax machines, camcorders, and calculators. Canon Information Technology Services (CITS) in Chesapeake, Virginia, fields support requests at a current rate of 200,000 calls, 50,000 emails, and 1,000 letters per month: a total of about three million contacts per year. CITS employs over 500 people to handle these contacts.

Canon's problem is that, until recently, they had no central knowledge repository. Product information was scattered over a CITS intranet, the Canon USA Web site, hard-copy manuals, and an internally developed knowledge system. CITS could not ensure that all of the content was correct and did not conflict with the manuals or another system. Customers could use only the knowledge system, which was not searchable. Support agents needed to check multiple sources of information on any product. This process was cumbersome, annoyed the agents, and wasted valuable time.

To address this problem, Canon installed Consona's Knowledge-Driven Support (KDS). KDS integrates knowledge management with case management software, a type of Customer Relationship Management software that you studied in Chapter 5.

As an example of integration, KDS supports *in-process authoring*. A representative who has just written a customer a long, complex explanation of how to solve a problem can enter that explanation directly into the knowledge base without having to re-create it or even copy and paste it. Agents don't have to take time after a call to create new knowledge when they could be improving their performance reports by taking another call. As Consona puts it, "knowledge isn't something that you do in addition to solving problems—it becomes the way you solve problems."

The results are that, during the first six months that the system was in full use, the fraction of customer questions resolved online without a phone call increased from 51 to 71 percent. This saved agent time while providing customers with better service. Another measure of the need for follow-up, email escalation rate, dropped 47 percent from the same period of the previous year. Overall customer satisfaction scores were up from 6.5 to 7.1 on a scale of 1 to 10, and customer resolution rates rose from 50 to 60 percent.

"The Consona CRM knowledge base has been a great help to our service agents and to our customers. It lets the customers get the answers to the 'easy' questions themselves, while freeing up the agents to focus on the more difficult problems," says Jay Lucado, CITS assistant director of knowledge management and delivery.

CITS also leveraged the knowledge base to improve agent training. Its new training curriculum focuses on teaching agents to find the answers in the system rather than how to fix any problem a customer might have. In addition, system-based training is remotely available, which works well with CITS's work-at-home program. Agents work from their homes four days each week and are able to complete their training remotely as well.

Discussion Questions

1. Discuss two reasons the cost/benefit ratio of a knowledge management system such as KDS goes up as the company using it gets larger. Which of these reasons apply to other applications besides knowledge management?
2. What other industries could benefit from searchable knowledge management systems that allow easy access to the content within user manuals and other documentation?

Critical Thinking Questions

1. How could making a searchable knowledge management system accessible to Canon's customers online affect CITS's call volume and customer satisfaction?
2. How would the need for a system such as KDS change if each of Canon's product lines (including cameras and printers) was sold by a different company?

SOURCES: Briggs, M., "New Consona Report Uncovers Best Practices for Easier and More Effective Knowledge Management," Consona press release, August 4, 2011, *www.prweb.com/releases/Consona/Knowledge-Management/prweb8697920.htm*; Canon ITS Web site, *www.cits.canon.com*, accessed May 19, 2014; Canon USA Web site, *www.usa.canon.com/cusa/home*, accessed February 11, 2012; Consona, Inc., Knowledge-Driven Support Web site, *crm.consona.com/software/products/knowledge-driven-support.aspx*, accessed June 4, 2014; Johnson, S., "Canon Information Technology Services, Inc./Consona Knowledge Management," *Office Product News*, October 24, 2011, *www.officeproductnews.net/case_studies/canon_information_technology_services_inc_consona_knowledge_management*.

TV game show, *Jeopardy!* See Figure 7.6. The artificial intelligence computer could process human speech, search its vast databases for possible responses, and reply in a human voice. Now a new cloud-based Watson system will be used by oncologists to fight glioblastoma, an aggressive brain cancer that kills over 13,000 people in the United States each year. The system will correlate data from the DNA associated with each patient's disease to the latest findings from medical journals, new studies, and clinical records to develop a highly personalized treatment regimen. The goal is for Watson to increase the number of patients who can benefit from care options uniquely tailored to their disease's DNA. Watson will continually learn and improve as it deals with each new patient scenario and new medical research becomes available.

CAROLINE SEIDEL/EPA/Landov

FIGURE **7.6**

IBM Watson

Watson is an AI system that can answer questions posed in natural language over a nearly unlimited range of knowledge.

Artificial Intelligence in Perspective

Computers were originally designed to perform simple mathematical operations, using fixed programmed rules and eventually operating at millions of computations per second. When it comes to performing mathematical operations quickly and accurately, computers beat humans hands down. However, computers have trouble recognizing patterns, adapting to new situations, and drawing conclusions when not provided complete information—all activities that humans can perform quite well. Artificial intelligence systems tackle these sorts of problems. **Artificial intelligence systems** include the people, procedures, hardware, software, data, and knowledge needed to develop computer systems and machines that can simulate human intelligence processes, including learning (the acquisition of information and rules for using the information), reasoning (using rules to reach conclusions), and self-correction (using the outcome from one scenario to improve its performance on future scenarios).

artificial intelligence system: The people, procedures, hardware, software, data, and knowledge needed to develop computer systems and machines that can simulate human intelligence processes, including learning (the acquisition of information and rules for using the information), reasoning (using rules to reach conclusions), and self-correction (using the outcome from one scenario to improve its performance on future scenarios).

AI is a complex and interdisciplinary field that involves several specialties including biology, computer science, linguistics, mathematics, neuroscience, philosophy, and psychology. The study of AI systems causes one to ponder philosophical issues such as the nature of the human mind and the ethics of creating objects gifted with human-like intelligence. Today artificial intelligence systems are used in many industries and applications. Researchers,

scientists, and experts on how human beings think are often involved in developing these systems.

Nature of Intelligence

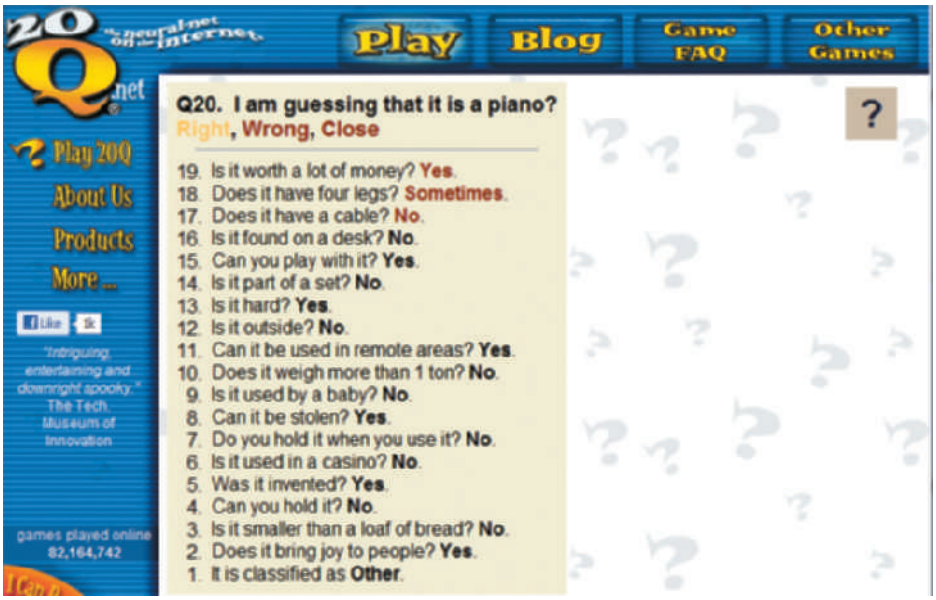
From the early AI pioneering stage, the research emphasis has been on developing machines with the ability to "learn" from experiences and apply knowledge acquired from those experiences; to handle complex situations; to solve problems when important information is missing; to determine what is important and to react quickly and correctly to a new situation; to understand visual images, process and manipulate symbols, be creative and imaginative; and to use heuristics, which together is considered **intelligent behavior**.

intelligent behavior: The ability to learn from experiences and apply knowledge acquired from those experiences; to handle complex situations; to solve problems when important information is missing; to determine what is important and to react quickly and correctly to a new situation; to understand visual images, process and manipulate symbols, be creative and imaginative; and to use heuristics.

The *Turing Test* was designed by Alan Turing, a British mathematician. It attempts to determine whether a computer can successfully impersonate a human. Human judges are connected to the computer and to another human via an instant messaging system and the only information flowing between the contestants and judges is text. The judges pose questions on any topic from the arts to zoology, even questions about personal history and social relationships. To pass the test, the computer must communicate via this medium so competently that the judges cannot tell the difference between the computer's responses and the human's responses.[8] After many years of failure by various software developers, a computer program created by a team based in Russia succeeded in passing the test in June 2014.[9] The Loebner Prize is an annual competition in artificial intelligence that awards prizes to the computer system designed to simulate an intelligent conversation that is considered by the judges to be the most human-like.[10]

Some of the specific characteristics of intelligent behavior include the ability to do the following:

- **Learn from experience and apply the knowledge acquired from experience**. Learning from past situations and events is a key component of intelligent behavior and is a natural ability of humans, who learn by trial and error. This ability, however, must be carefully programmed into a computer system. Today, researchers are developing systems that can "learn" from experience. The 20 questions (20Q) Web site, *www.20q.net* (see Figure 7.7), is an example of a system that learns.[11] The Web site is an artificial intelligence game that learns as people play.
- **Handle complex situations**. In a business setting, top-level managers and executives must handle a complex market, challenging competitors, intricate government regulations, and a demanding workforce. Even human experts make mistakes in dealing with these matters. Very careful planning and elaborate computer programming are necessary to develop systems that can handle complex situations.
- **Solve problems when important information is missing**. An integral part of decision making is dealing with uncertainty. Often, decisions must be made with little or inaccurate information because obtaining complete information is too costly or impossible. Today, AI systems can make important calculations, comparisons, and decisions even when information is missing.
- **Determine what is important**. Knowing what is truly important is the mark of a good decision maker. Developing programs and approaches to allow computer systems and machines to identify important information is not a simple task.
- **React quickly and correctly to a new situation**. A small child, for example, can look over an edge and know not to venture too close. The child



Source: www.20q.net

FIGURE **7.7**

20Q

20Q is an online game where users play the popular game, 20 Questions, against an artificial intelligence foe.

reacts quickly and correctly to a new situation. Computers, on the other hand, do not have this ability without complex programming.

- **Understand visual images**. Interpreting visual images can be extremely difficult, even for sophisticated computers. Moving through a room of chairs, tables, and other objects can be trivial for people but extremely complex for machines, robots, and computers. Such machines require an extension of understanding visual images, called a **perceptive system**. Having a perceptive system allows a machine to approximate the way a person sees, hears, and feels objects.

perceptive system: A system that approximates the way a person sees, hears, and feels objects.

- **Process and manipulate symbols**. People see, manipulate, and process symbols every day. Visual images provide a constant stream of information to our brains. By contrast, computers have difficulty handling symbolic processing and reasoning. Although computers excel at numerical calculations, they aren't as good at dealing with symbols and three-dimensional objects. Recent developments in machine-vision hardware and software, however, allow some computers to process and manipulate some symbols.
- **Be creative and imaginative**. Throughout history, some people have turned difficult situations into advantages by being creative and imaginative. For instance, when defective mints with holes in the middle arrived at a candy factory, an enterprising entrepreneur decided to market these new mints as LifeSavers instead of returning them to the manufacturer. Ice cream cones were invented at the St. Louis World's Fair when an imaginative store owner decided to wrap ice cream with a waffle from his grill for portability. Developing new products and services from an existing (perhaps negative) situation is a human characteristic. While software has been developed to enable a computer to write short stories, few computers can be imaginative or creative in this way.
- **Use heuristics**. For some decisions, people use heuristics (rules of thumb arising from experience) or even guesses. In searching for a job, you might rank the companies you are considering according to profits per employee. Today, some computer systems, given the right programs, obtain good solutions that use approximations instead of trying to search for an optimal solution, which would be technically difficult or too time consuming.

This list of traits only partially defines intelligence. Another challenge is linking a human brain to a computer.

Brain Computer Interface

Developing a link between the human brain and the computer is another exciting area that touches all aspects of artificial intelligence. Called *Brain Computer Interface* (*BCI*), the idea is to directly connect the human brain to a computer and have human thought control computer activities. One example is BrainGate, which can be used to connect a human brain to a computer. If successful, the BCI experiment could allow people to control computers and artificial arms and legs through thought alone. The objective is to give people without the ability to speak or move (called Locked-in Syndrome) the capability to communicate and move artificial limbs using advanced BCI technologies. Honda Motors has developed a BCI system that allows a person to complete certain operations, such as bending a leg, with 90 percent accuracy. See Figure 7.8. The new system uses a special helmet that can measure and transmit brain activity to a computer.

YOSHIKAZU TSUNO/AFP/Getty Images

FIGURE **7.8**

Brain-machine interface

Honda Motors has developed a brain-machine interface that measures electrical current and blood flow change in the brain and uses the data to control ASIMO, the Honda robot.

Major Branches of Artificial Intelligence

AI is a broad field that includes several specialty areas, such as expert systems, robotics, vision systems, natural language processing, learning systems, and neural networks. See Figure 7.9. Many of these areas are related; advances in one can occur simultaneously with or result in advances in others.

Expert Systems

An expert system consists of hardware and software that stores knowledge and makes inferences, enabling a novice to perform at the level of an expert. Because of their many business applications, expert systems are discussed a little later in this chapter.

Robotics

robotics: Mechanical or computer devices that perform tasks requiring a high degree of precision or that are tedious or hazardous for humans.

Robotics involves developing mechanical or computer devices that can paint cars, make precision welds, and perform other tasks that require a high

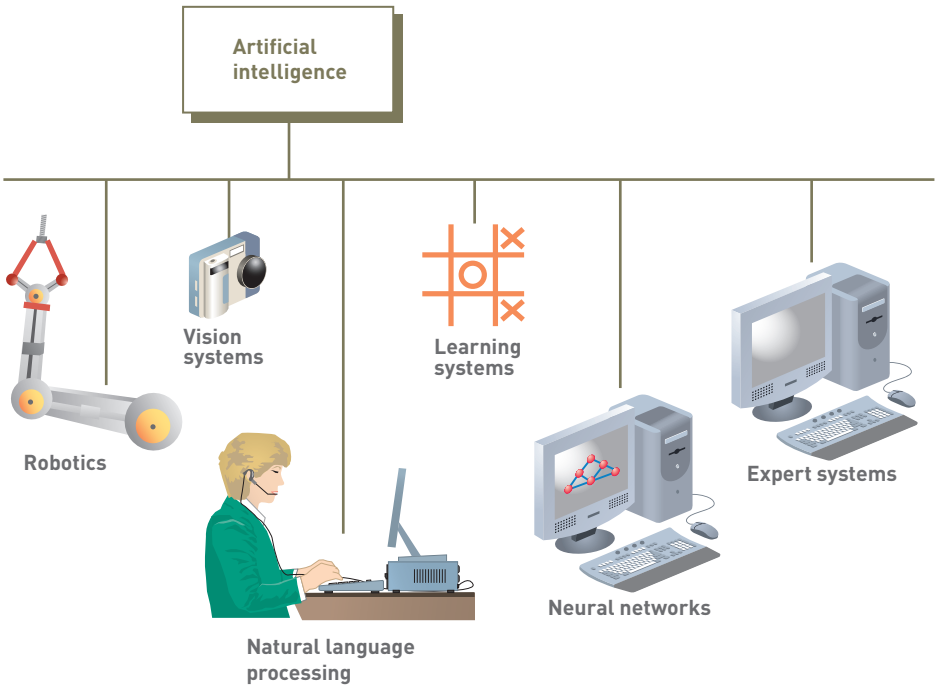


FIGURE **7.9**

Conceptual model of artificial intelligence

AI is a broad field that includes several specialty areas.

degree of precision or are tedious or hazardous for human beings. Karel Capek introduced the word "robot" in his 1921 play, *R.U.R.* (an abbreviation of Rostrum's Universal Robots). The play was about an island factory that produced artificial people called "robots" who are consigned to do drudgery work and eventually rebel and overthrow their creators, causing the extinction of human beings.[12] Organizations today do indeed use robots to perform dull, dirty, and/or dangerous jobs. They are often used to lift and move heavy pallets in warehouses, perform welding operations, and provide a way to view radioactively contaminated areas of power plants inaccessible by people.

However, the use of robots has expanded and is likely to continue to grow in the future. Robots are increasingly being used in surgical procedures from prostrate removal to open-heart surgery. See Figure 7.10. Robots can provide doctors with enhanced precision, improved dexterity, and better visualization. The U.S. Navy's Bluefin 21 robotic submarine made several trips below the Indian Ocean's surface to scan the seabed for any trace of the missing Malaysia Airlines Flight 370. iRobot (*www.irobot.com*) is a company that builds a variety of robots, including the Roomba Floorvac for vacuuming floors, the Looj for cleaning gutters, and the PackBot, an unmanned vehicle used to assist and protect soldiers.[13]

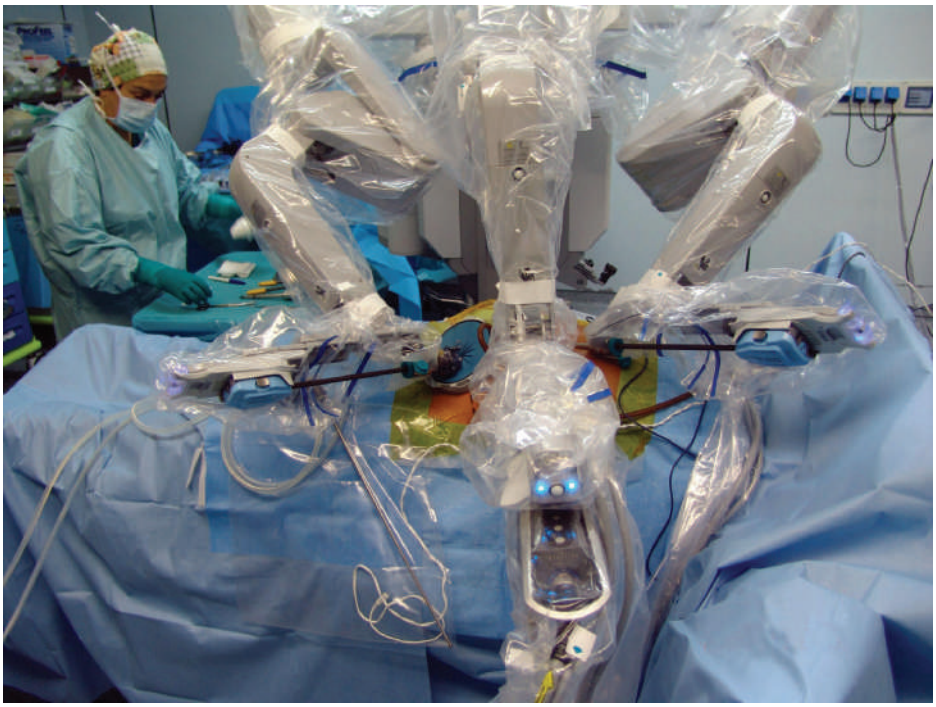
Some robots, such as the ER series by Intelitek, can be used for training or entertainment.[14] Play-i is a start-up firm that created robots Bo and Yana to help young children (ages 5+) to learn programming concepts and creative problem solving.[15] See Figure 7.11.

Some people fear that robots will increasingly take jobs from human employees. For example, Chapter 1 discussed that once governments have created the policy and developed the infrastructure needed to accommodate the use of autonomous vehicles, some or all of the almost six million truck drivers, chauffeurs, and cab drivers on the road today may find themselves without work.

vision system: The hardware and software that permit computers to capture, store, and manipulate visual images.

Vision Systems

Another area of AI involves vision systems. **Vision systems** include hardware and software that permit computers to capture, store, and process visual

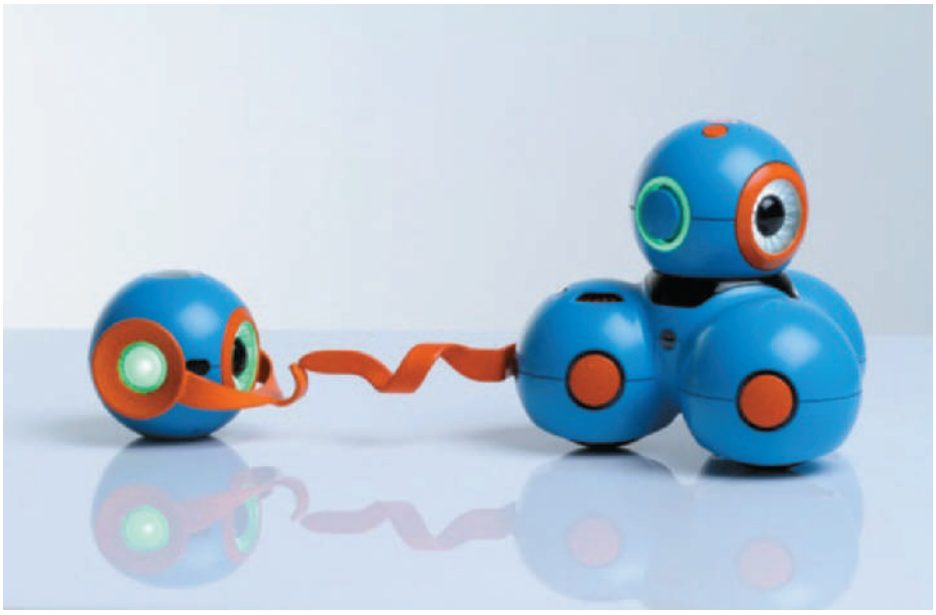


EPA/University Hospital AOUP/Landov

FIGURE **7.10**

Robotic surgery

The arms of the Da Vinci robot assist in a kidney transplant. A surgeon controls the robot remotely from a corner of the operating room.



Source: *https://www.play-i.com*

FIGURE **7.11**

Play-i educational robots Bo and Yana

Play-i creates robots to help young children learn programming concepts and develop creative problem-solving skills.

images. 3D machine vision systems are used to increase the accuracy and speed of industrial inspections of parts. Automated fruit-picking machines use a unique vacuum-gripper combined with a vision system to pick fruit. Facebook is developing a new AI vision system it calls DeepFace, which creates 3D models of the faces in photos. The technology represents a vast improvement over current facial recognition software. DeepFace can correctly tell if two photos show the same person with 97.25 percent accuracy. This nearly matches humans who are correct 97.53 percent of the time.[16]

ETHICAL & SOCIETAL ISSUES

Next Generation Identification Database

The Federal Bureau of Investigation (FBI) is developing and deploying Next Generation Identification (NGI), the largest biometric database on the planet. In 2015, the system is capable of querying up to 52 million photos and over 100 million prints, including fingerprints, palm prints, and retina scans. The system will build on and improve the FBI's Automated Fingerprint Identification System (IAFIS) services. The goals of NGI are to ensure public safety and national security, provide biometric leadership in cooperation with state and local governments, improve the efficiency of biometric data retrieval and analysis, ensure privacy and data protection, and allow smooth transitions between existing systems. One astounding new capability, for example, is a search engine that queries photographs to identify individuals based on tattoos, scars, and other marks. In addition, NGI provides advanced facial recognition technology.

The NGI has also significantly improved on IAFIS's capacity to store and share data. Enhancing the interstate photo system, cities and states are able to directly upload the photos into the system. So, for example, the New York Police Department has been scanning the irises of arrestees since 2010. Their collection is now part of NGI.

The system's faster response time will have a positive impact on the criminal justice system. The time it takes to obtain a fingerprint match for a criminal suspect has been reduced from two hours using the IAFIS system to ten minutes using NGI. Moreover, the NGI lets agents and police specify whether the search is urgent, routine, or non-urgent. Urgent requests can be met within 10 minutes, while non-urgent requests allow the system to respond within a week. NGI has also implemented a quality check automation. With IAFIS, as many as 98 percent of print matches required a manual review. With NGI, that number is reduced to 15 percent.

Privacy groups, however, are up in arms. Of the 52 million photos, only 46 million are criminal images and only an additional 215,000 come from the Repository of Individuals of Special Concern. About 4.3 million are images collected by state and local government during criminal proceedings. Privacy advocates want to know the origins of the approximately 1.5 million remaining photos. Some groups, like the Electronic Privacy Information Center (EPIC), also worry about the potential to connect the system to driver license photos and live feeds and recordings from closed circuit television (CCTV) surveillance cameras. The Department of Homeland Security has worked with state and local governments to install approximately 30 million CCTVs across the country. EPIC is also concerned that the FBI is relying on private companies to develop the system, potentially giving them access to the database.

The purpose of NGI is to allow law enforcement to decrease crime and prevent terrorist attacks. The United States cannot wage a conventional war against terrorist organizations because they are international non-governmental bodies. The collection and sharing of intelligence is vital to the prevention of terrorist attacks. The question the American public must consider then is how to balance the need to fight crime and terrorism with the protection of privacy rights.

Discussion Questions

1. Lockheed Martin, IBM, and Accenture are among those private contractors that are helping develop and implement NGI. What privacy concerns does their involvement in the project raise?

2. Some privacy advocates fear that the system will lead to the identification of "false positives"—implicating innocent civilians in criminal or terrorist activities. What steps could the FBI take to reduce the likelihood of mistaking individuals' identity?

Critical Thinking Question

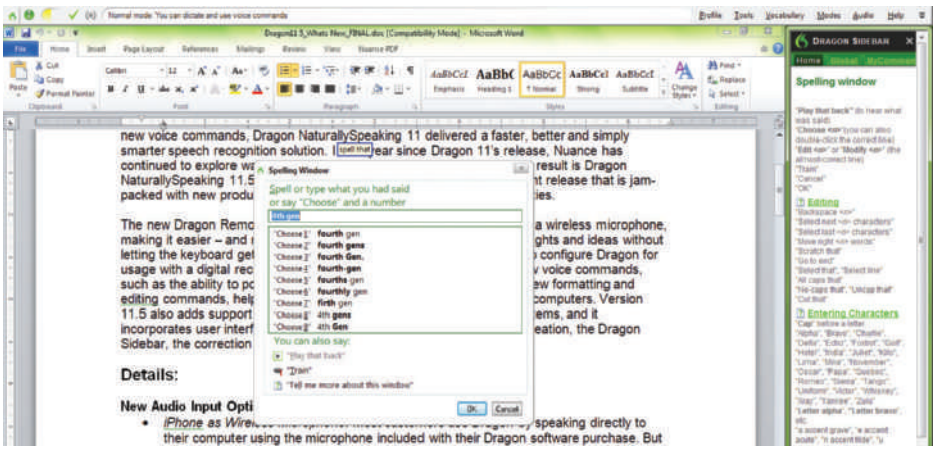
1. NGI uses facial recognition software that could allow CCTV cameras to identify people within a crowd. What privacy concerns does this usage raise?
2. What advantages would such a system have? Do the benefits outweigh costs? Why or why not?

SOURCES: "EPIC v. FBI - Next Generation Identification," Epic Web site, *http://epic.org/foia/fbi/ngi*, accessed May 20, 2014; "Next Generation Identification," FBI Web site, *www.fbi.gov/about-us/cjis/fingerprints_biometrics/ngi*, accessed May 20, 2014; Love, Dylan, "The FBI's Facial Recognition System Is A Privacy Nightmare That Collects Your Data Even If You've Never Broken The Law," *Business Insider*, April 15, 2014, *www.businessinsider.com/fbi-ngi-facial-recognition-system-2014-4#ixzz30fPWcusH*, accessed May 20, 2014.

Natural Language Processing and Voice Recognition

natural language processing: Involves the computer understanding, analyzing, manipulating, and/or generating "natural" languages such as English.

Natural language processing involves the computer understanding, analyzing, manipulating, and/or generating "natural" languages such as English. Many companies provide natural language-processing help over the phone. When you call the help phone number, you are typically given a menu of options and asked to speak your responses. Many people, however, become easily frustrated talking to a machine instead of a human. Dragon Systems' Naturally Speaking uses continuous voice recognition, or natural speech, that allows the user to speak to the computer at a normal pace without pausing between words. The spoken words are transcribed immediately onto the computer screen. See Figure 7.12.



Source: Nuance Communications, Inc.; Microsoft product screenshots used with permission from Microsoft Corporation

FIGURE **7.12**

Dragon Systems' Naturally Speaking

With the Naturally Speaking application from Dragon Systems, computer users can speak commands or text to transcribe into software such as Microsoft Word.

In some cases, voice recognition is used with natural language processing. *Voice recognition* involves converting sound waves into words. After converting sounds into words, natural language-processing systems react to the words or commands by performing a variety of tasks. Brokerage services are a perfect fit for voice recognition and natural language-processing technology

to replace the existing "press 1 to buy or sell a stock" touchpad telephone menu system. Using voice recognition to convert recordings into text is also possible. Some companies claim that voice recognition and natural language-processing software is so good that customers forget they are talking to a computer and start discussing the weather or sports scores.

Learning Systems

learning systems: A combination of software and hardware that allows a computer to change how it functions or how it reacts to situations based on feedback it receives.

Another part of AI deals with **learning systems**, a combination of software and hardware that allows a computer to change how it functions or how it reacts to situations based on feedback it receives. For example, some computerized games have learning abilities. If the computer does not win a game, it remembers not to make the same moves under the same conditions again. *Reinforcement learning* is a learning system involving sequential decisions with learning taking place between each decision. Reinforcement learning often involves sophisticated computer programming and optimization techniques, first discussed in Chapter 6. The computer makes a decision, analyzes the results, and then makes a better decision based on the analysis. The process, often called *dynamic programming*, is repeated until it is impossible to make improvements in the decision.

Learning systems software requires feedback on the results of actions or decisions. At a minimum, the feedback needs to indicate whether the results are desirable (winning a game) or undesirable (losing a game). The feedback is then used to alter what the system will do in the future.

Google combined natural language processing with learning systems in its Android smartphone operating system to reduce word errors by 25 percent.[17] With this combined technology, the voice assistant asks questions to clarify what you are looking for.

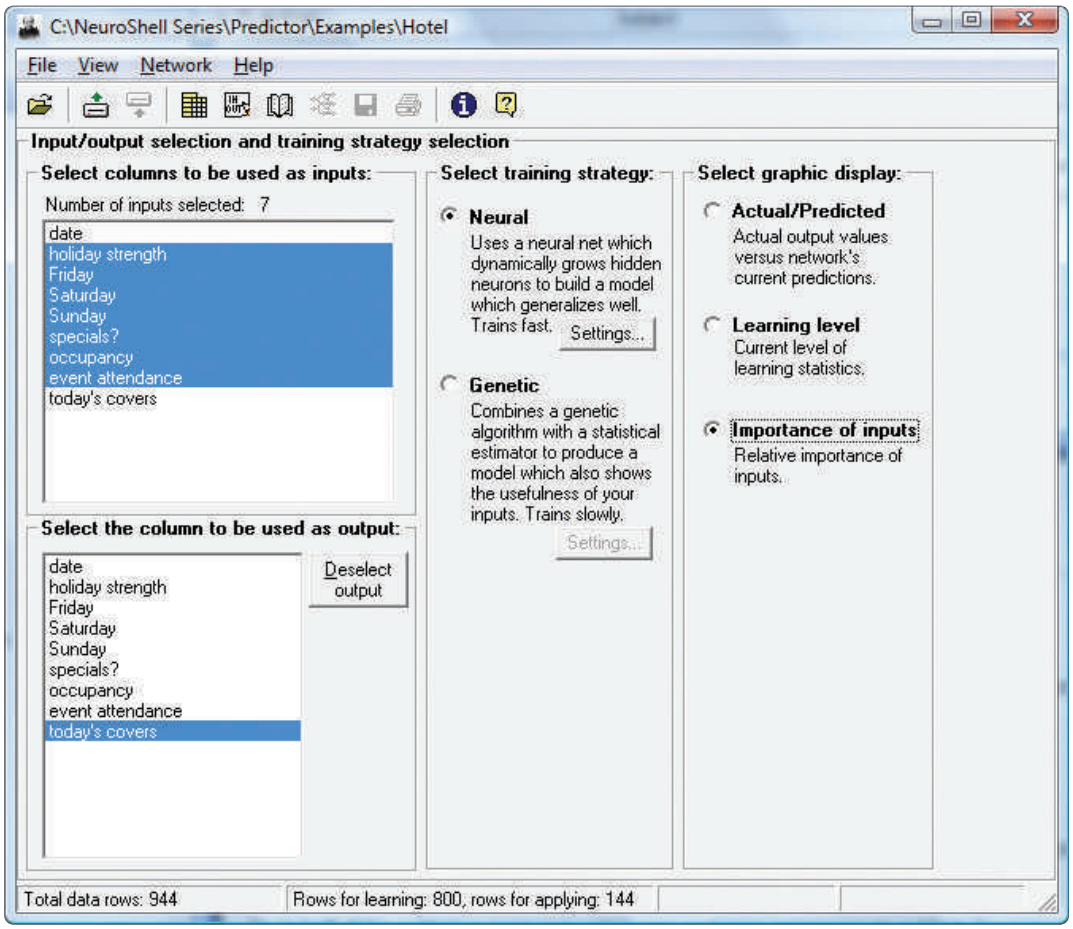
Neural Networks

neural network: A computer system that can recognize and act on patterns or trends in that it detects in large sets of data.

An increasingly important aspect of AI involves neural networks, also called neural nets. A **neural network** is a computer system that can recognize and act on patterns or trends that it detects in large sets of data. A neural network employs massively parallel processors in an architecture that is based on the human brain's own meshlike structure. As a result, neural networks can process many pieces of data at the same time and learn to recognize patterns.

AI Trilogy, available from the Ward Systems Group (*www.wardsystems.com*), is a neural network software program that can run on a standard PC. The software can make predictions with NeuroShell Predictor and classify information with NeuroShell Classifier. See Figure 7.13. The software package also contains GeneHunter, which uses a special type of algorithm called a genetic algorithm to get the best result from the neural network system. (Genetic algorithms are discussed next.) Some pattern recognition software uses neural networks to make credit lending decisions by predicting the likelihood a new borrower will pay back a loan. Neural networks are also used to identify bank or credit card transactions likely to be fraudulent. Large call centers use neural networks to create staffing strategies by predicting call volumes.

Dr. José R. Iglesias-Rozas at the Katharinenhospital in Stuttgart, Germany, is a leader in researching the use of neural networks to diagnose the degree of malignancy of tumors. In his early research, microscopic sections of 786 different human brain tumors were collected. A neural network tool called NeuralTools was then used to predict the degree of malignancy based on the presence of 10 histological characteristics. The neural network accurately predicted over 95 percent of the sample cases. Dr. Iglesias-Rozas plans to expand his research to analyze over 30 years of data from more than 8,000 patients with different brain tumors.[18]



Source: Ward Systems Group, Inc.

FIGURE **7.13**

Neural network software

NeuroShell Predictor uses recognized forecasting methods to look for future trends in data.

Other Artificial Intelligence Applications

genetic algorithm: An approach to solving problems based on the theory of evolution and the survival of the fittest as a problem-solving strategy.

A few other artificial intelligence applications have been developed in addition to those just discussed. A **genetic algorithm** is an approach to solving problems based on the theory of evolution that uses the survival of the fittest concept as a problem-solving strategy. The genetic algorithm uses a fitness function that quantitatively evaluates a set of initial candidate solutions. The highest scoring candidate solutions are allowed to "reproduce" with random changes introduced to create new candidate solutions. These digital offspring are subjected to a second round of fitness evaluation. Again, the most promising candidate solutions are selected and used to create a new generation with random changes, and the process repeats for hundreds or even thousands of rounds. The expectation is that the average fitness of the population will increase each round, and that eventually very good solutions to the problem will be discovered.

Genetic algorithms have been used to solve large, complex scheduling problems such as scheduling airline crews to meet flight requirements while minimizing total costs and not violating federal guidelines on maximum crew flight hours and minimum hours of rest. Genetic algorithms have also been used to design mirrors to funnel sunlight to a solar collection and radio antenna designed to pick up signals from space.

intelligent agent: Programs and a knowledge base used to perform a specific task for a person, a process, or another program; also called an *intelligent robot* or *bot*.

An **intelligent agent** (also called an *intelligent robot* or *bot*) consists of programs and a knowledge base used to perform a specific task for a person,

a process, or another program. Like a sports agent who searches for the best endorsement deals for a top athlete, an intelligent agent often searches to find the best price, schedule, or solution to a problem. The programs used by an intelligent agent can search large amounts of data as the knowledge base refines the search or accommodates user preferences. Often used to search the vast resources of the Internet, intelligent agents can help people find information on any topic, such as the best price for a new digital camera or used car.

OVERVIEW OF EXPERT SYSTEMS

As mentioned earlier, an expert system enables a novice to perform at the level of a human expert in a particular field. Like human experts, computerized expert systems use heuristics, or rules of thumb, to arrive at conclusions or make suggestions. Since expert systems can be difficult, expensive, and time consuming to develop, they should be developed when there is a high potential payoff or when they significantly reduce downside risk and the organization wants to capture and preserve irreplaceable human expertise.

Colossus is an expert system employed by 25 percent of the top 100 U.S. insurers to assist their claims handlers to accurately and consistently handle personal injury claims. The claims handler is the key individual you deal with should you have an accident. The claims handler investigates, assesses, and negotiates your claim, based on personal knowledge and experience with many previous claims to achieve a fair settlement. As the claims handler enters details about your injury, Colossus steers the data entry process with a series of questions determined by defined business rules to ensure accurate and complete capture of all pertinent data. Once all claim details have been entered, Colossus evaluates your claim based on relevant medical treatment information and suggests to the claims handler a range of settlement amounts suitable to the injury and circumstances. The claims handler uses the suggested amounts to negotiate with you the amount to be paid. Because so many insurers use the same system, the variance in payouts on similar bodily injury claims is reduced and customers are treated more consistently.[19]

Components of Expert Systems

An expert system consists of a collection of integrated and related components, including a knowledge base, an inference engine, an explanation facility, a knowledge base acquisition facility, and a user interface. A diagram of a typical expert system is shown in Figure 7.14. In this figure, the user interacts with the interface, which interacts with the inference engine. The inference engine interacts with the other expert system components. These components must work together to provide expertise. This figure also shows the inference engine coordinating the flow of knowledge to other components of the expert system. Note that knowledge can flow in different ways, depending on what the expert system is doing and on the specific expert system involved.

Knowledge Base

The knowledge base stores all relevant information, data, rules, cases, and relationships that the expert system uses. As shown in Figure 7.15, a knowledge base is a natural extension of a database (presented in Chapter 3) and an information and decision support system (presented in Chapter 6). A knowledge base must be developed for each unique application. For example, a medical expert system contains facts about diseases and symptoms. Rules and cases are frequently used to create a knowledge base.

rule: A conditional statement that links conditions to actions or outcomes.

IF-THEN statement: A rule that suggests certain conclusions.

A **rule** is a conditional statement that links conditions to actions or outcomes. In many instances, these rules are stored as **IF-THEN statements**,

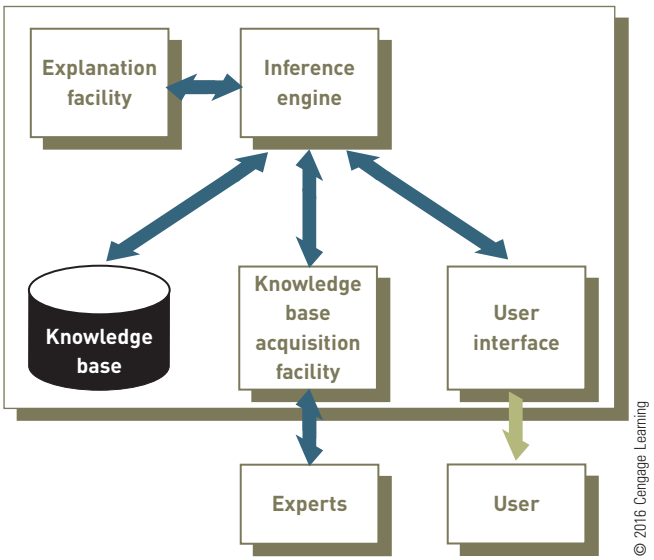


FIGURE **7.14**

Components of an expert system

An expert system includes a knowledge base, an inference engine, an explanation facility, a knowledge base acquisition facility, and a user interface.

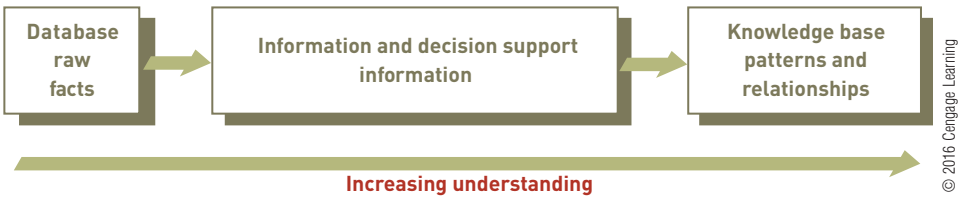


FIGURE **7.15**

Relationships between data, information, and knowledge

A knowledge base stores all relevant information, data, rules, cases, and relationships that an expert system uses.

which are rules that suggest certain conclusions. The American Express Authorizer's Assistant rules-based expert system was developed in 1988 and is still in use today. It is used to process credit requests, deciding whether to authorize or reject, and involves some 35,000 rules.[20] Figure 7.16 shows how to use expert system rules in determining whether a person should receive a mortgage loan from a bank. These rules can be placed in almost any standard programming language (discussed in Chapter 2) using IF-THEN statements or into special expert systems shells and products, discussed later in the chapter. In general, as the number of rules that an expert system knows increases, the precision of the expert system also increases.

An expert system can also use cases in developing a solution to a current problem or situation. Each case typically contains a description of the problem, plus a solution and/or the outcome. The case-based solution process involves (1) finding cases stored in the knowledge base that are similar to the problem or situation at hand, (2) reusing the case in an attempt to solve the problem at hand, (3) revising the proposed solution if necessary, and (4) retaining the new solution as part of a new case. A washing machine repair man who fixes a washer recalling another washer that presented similar symptoms is using case-based reasoning. So is the lawyer who advocates a particular outcome in a trial based on legal precedents. A company might use a case-based expert system to determine the best location for a new service facility in the state of New Mexico. The expert system might identify two previous cases involving the location of a service facility where labor and transportation costs were important—one in the state of Colorado and the other in the state of Nevada. The expert system can modify the solution to these two cases to determine the best location for a new facility in New Mexico.

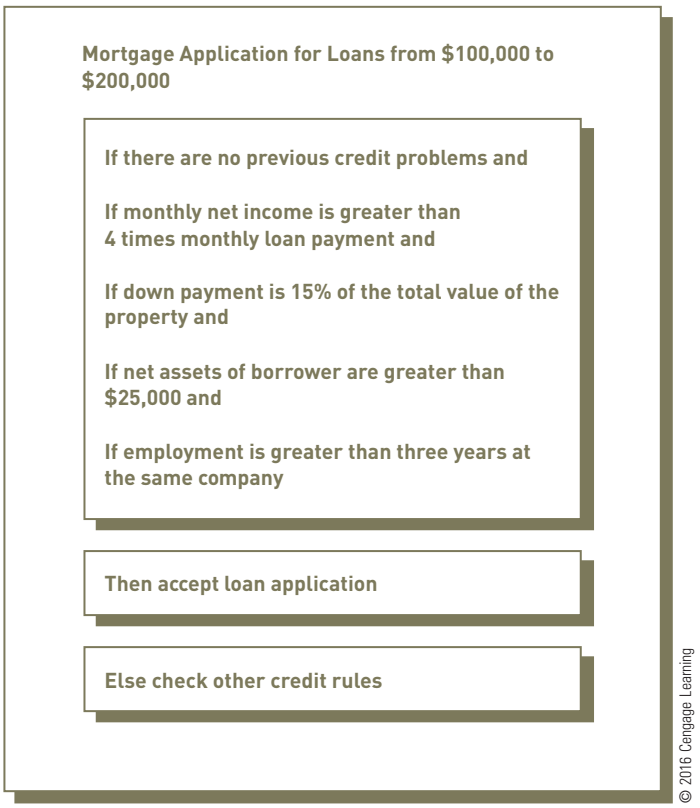


FIGURE **7.16**

Rules for a credit application

Expert system rules can determine whether a person should receive a mortgage loan from a bank.

Inference Engine

inference engine: Part of the expert system that seeks information and relationships from the knowledge base and provides answers, predictions, and suggestions similar to the way a human expert would.

The overall purpose of an **inference engine** is to seek information and relationships from the knowledge base and to provide answers, predictions, and suggestions similar to the way a human expert would. In other words, the inference engine is the component that delivers the expert advice. Consider the expert system that forecasts future sales for a product. One approach is to start with a fact such as "The demand for the product last month was 20,000 units." The expert system searches for rules that contain a reference to product demand. For example, "IF product demand is over 15,000 units, THEN check the demand for competing products." As a result of this process, the expert system might use information on the demand for competitive products. Next, after searching additional rules, the expert system might use information on personal income or national inflation rates. This process continues until the expert system can reach a conclusion using the data supplied by the user and the rules that apply in the knowledge base.

Explanation Facility

explanation facility: Component of an expert system that allows a user or decision maker to understand how the expert system arrived at certain conclusions or results.

An important part of an expert system is the **explanation facility**, which allows a user or decision maker to understand how the expert system arrived at certain conclusions or results. A medical expert system, for example, might reach the conclusion that a patient has a defective heart valve given certain symptoms and the results of tests on the patient. The explanation facility allows a doctor to find out the logic or rationale of the diagnosis made by the expert system. The expert system, using the explanation facility, can indicate all the facts and rules that were used in reaching the conclusion, which the doctors can look at to determine whether the expert system is processing the data and information correctly and logically.

Knowledge Acquisition Facility

A difficult task in developing an expert system is the process of creating and updating the knowledge base. In the past, when more traditional programming languages were used, developing a knowledge base was tedious and time consuming. Each fact, relationship, and rule had to be programmed into the knowledge base. In most cases, an experienced programmer had to create and update the knowledge base.

Today, specialized software allows users and decision makers to create and modify their own knowledge bases through the knowledge acquisition facility, as shown in Figure 7.17. The purpose of the **knowledge acquisition facility** is to provide a convenient and efficient means of capturing and storing all components of the knowledge base. Knowledge acquisition software can present users and decision makers with easy-to-use menus. After entering the appropriate attributes, the knowledge acquisition facility correctly stores information and relationships in the knowledge base, making the knowledge base easier and less expensive to set up and maintain.

knowledge acquisition facility: Part of the expert system that provides a convenient and efficient means of capturing and storing all the components of the knowledge base.

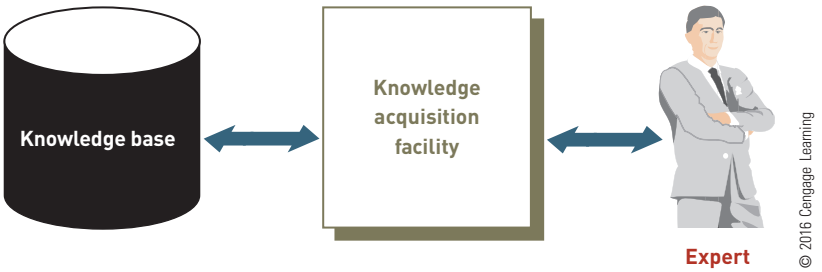


FIGURE **7.17**
Knowledge acquisition facility
The knowledge acquisition facility acts as an interface between experts and the knowledge base.

User Interface

The main purpose of the user interface is to make an expert system easier for users and decision makers to develop and use. At one time, skilled computer personnel created and operated most expert systems; today, the user interface permits decision makers to develop and use their own expert systems. A typical user interface between a user and the expert system for the credit application shown in Figure 7.16 follows:

EXPERT SYSTEM: Are there any previous credit problems?

USER: No.

EXPERT SYSTEM: Is the applicant's net income greater than four times the monthly loan payment?

USER: Yes.

EXPERT SYSTEM: Is the down payment greater than 15 percent of the property value?

USER: Yes.

EXPERT SYSTEM: Are the net assets of the borrower greater than $25,000?

USER: Yes.

EXPERT SYSTEM: Has the borrower worked more than three years at the same company?

USER: Yes.

EXPERT SYSTEM: Accept the loan application.

Participants in Developing and Using Expert Systems

Typically, several people are involved in developing and using an expert system. See Figure 7.18.

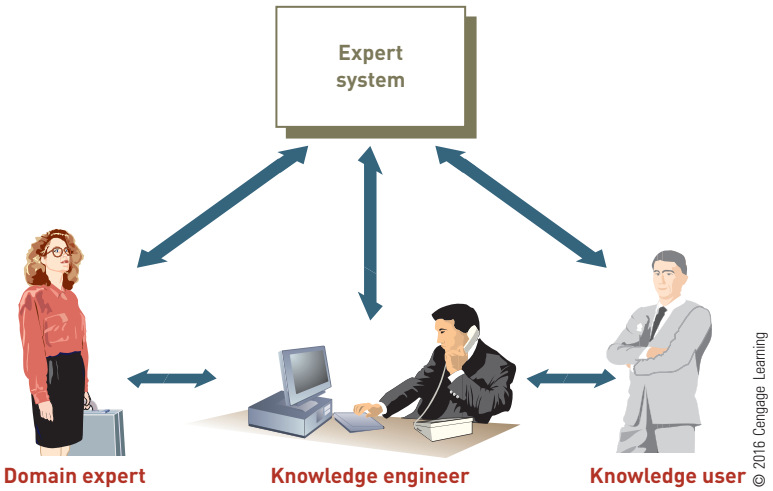


FIGURE **7.18**

Participants in expert systems development and use

A domain expert, knowledge engineer, and knowledge user work with an expert system.

domain expert: The person or group with the expertise or knowledge the expert system is trying to capture (domain).

knowledge engineer: A person who has training or experience in the design, development, implementation, and maintenance of an expert system.

knowledge user: The person or group who uses and benefits from the expert system.

The **domain expert** is the person or group with the expertise or knowledge the expert system is trying to capture (domain). In most cases, the domain expert is a group of human experts. Research has shown that good domain experts can increase the overall quality of an expert system. A **knowledge engineer** is a person who has training or experience in the design, development, implementation, and maintenance of an expert system, including training or experience with expert system shells. Knowledge engineers can help transfer the knowledge from the expert system to the knowledge user. The **knowledge user** is the person or group who uses and benefits from the expert system. Knowledge users do not need any previous training in computers or expert systems.

Expert Systems Development Tools and Techniques

Theoretically, expert systems can be developed from any programming language. Since the introduction of computer systems, programming languages have become easier to use, more powerful, and better able to handle specialized requirements. In the early days of expert systems development, traditional high-level languages, including Pascal, FORTRAN, and COBOL, were used. LISP was one of the first special languages developed and used for artificial intelligence applications, and PROLOG was also developed for AI applications. Since the 1990s, however, other expert system products (such as shells) have become available that remove the burden of programming, allowing nonprogrammers to develop and benefit from the use of expert systems.

Pharmaceutical, biotechnology, medical device, and contract research organizations use Oracle Clinical software to conduct their clinical trials. The software enables such organizations to better manage their critical clinical trial activities by providing a single application for management of all clinical trial data in a single system, thus improving data accuracy and data visibility.[21] iHelp is an interactive and configurable user guide that comes with Siebel Clinical. iHelp employs expert system technology to walk users through tasks step by step while they are using the system.[22]

Expert System Shells and Products

An *expert system shell* is a suite of software that allows construction of a knowledge base and interaction with this knowledge base through use of an inference engine. Expert system shells are available for both personal computers and mainframe systems, with some shells being inexpensive, costing less than $500. In addition, off-the-shelf expert system shells are complete and

ready to run. The user enters the appropriate data or parameters, and the expert system provides output to the problem or situation. Table 7.2 lists a few expert system products.

TABLE 7.2 Popular expert system products

Name of Product	Application and Capabilities
Clips	A tool for building expert systems on PCs.
Cogito	Software by Expert System Semantic Intelligence helps an organization extract knowledge from text in email messages, articles, Web sites, documents, and other unstructured information.
Exsys Corvid	An expert system tool that simulates a conversation with a human expert from Exsys (*www.exsys.com*).
ESTA (Expert System Shell for Text Animation)	An expert system shell that provides all necessary components except the knowledge base.
Imprint Business Systems	An expert system that helps printing and packaging companies manage their businesses.
Lantek Expert System	Software that helps metal fabricators reduce waste and increase profits.
OpenExpert	An expert system tool mainly for developing legal expert systems.
Prolog Expert System	Free software for building an expert system knowledge base.

MULTIMEDIA AND VIRTUAL REALITY

The use of multimedia and virtual reality has helped many companies achieve a competitive advantage and increase profits. The approach and technology used in multimedia is often the foundation of virtual reality systems, discussed later in this section. While these specialized information systems are not used by all organizations, they can play a key role for many. We begin with a discussion of multimedia.

Overview of Multimedia

multimedia: Text, graphics, video, animation, audio, and other media that can be used to help an organization efficiently and effectively achieve its goals.

Multimedia is text, graphics, video, animation, audio, and other media that can be used to help an organization efficiently and effectively achieve its goals. Multimedia can be used to create stunning brochures, presentations, reports, and documents. Many companies use multimedia approaches to develop exciting cartoons and video games to help advertise products and services. For example, insurance company Geico uses animation in some of its TV ads. Animation Internet sites, such as Xtranormal and GoAnimate, can help individuals and corporations develop these types of animations. Although not all organizations use the full capabilities of multimedia, most use text and graphics capabilities.

Text and Graphics

All large organizations and most small and medium-sized ones use text and graphics to develop reports, financial statements, advertising pieces, and other documents used internally and externally. Internally, organizations use text and graphics to communicate policies, guidelines, and much more to managers and employees. Externally, they use text and graphics to communicate to suppliers, customers, federal and state groups, and a variety of other stakeholders. Text can have different sizes, fonts, and colors, and graphics can include photographs, illustrations, drawings, a variety of charts, and

other still images. Graphic images can be stored in a variety of formats, including JPEG (Joint Photographic Experts Group format) and GIF (Graphics Interchange Format).

While standard word-processing programs are an inexpensive and simple way to develop documents and reports that require text and graphics, most organizations use specialized software. See Figure 7.19. Adobe Illustrator, for example, can be used to create attractive and informative charts, illustrations, and brochures. The software can also be used to develop digital art, reference manuals, profit and loss statements, and a variety of reports required by state and federal governments. Adobe Photoshop is a sophisticated and popular software package that can be used to edit photographs and other visual images. Once created, these documents and reports can be saved in an Adobe PDF file and sent over the Internet or saved on a CD or similar storage device.

© Yes Man/Shutterstock.com

FIGURE **7.19**

Digital graphics

Businesses create graphics such as charts, illustrations, and brochures using software such as Adobe Photoshop or Adobe Illustrator.

Microsoft Silverlight is a powerful development tool for creating engaging, interactive user experiences for Web and mobile applications. easyJet is one of Europe's leading low cost airlines and operates over 600 routes across more than 30 countries with a fleet of more than 200 Airbus aircraft.[23] It uses the Internet as its primary ticket distribution channel. easyJet used Microsoft Silverlight to design its travel Web site in an attempt to offer customers the most intuitive site they have ever experienced. The company hopes that this unique Web site will draw large numbers of new customers, and greatly increase the number of reservations with easyJet.[24]

PowerPoint, also by Microsoft, can be used to develop a presentation that is displayed on a large viewing screen with sound and animation. Other graphics programs include Paint and PhotoDraw by Microsoft and CorelDraw by Corel Corporation.

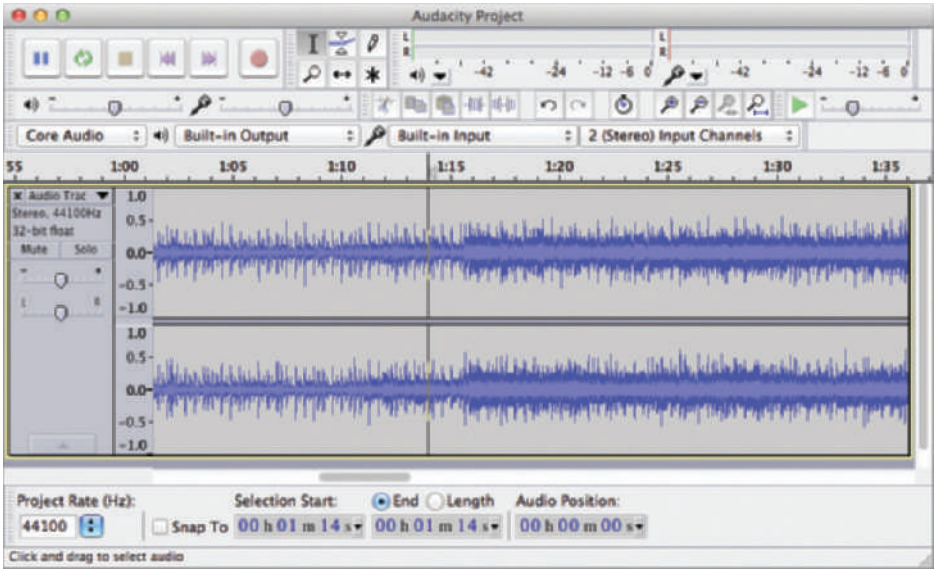
Many graphics programs can also create 3D images. James Cameron's movie *Avatar* used sophisticated computers and 3D imaging to create one of the most profitable movies in history. Once used primarily in movies, 3D technology can be employed by companies to design products, such as motorcycles, jet engines, and bridges. Autodesk, for example, makes exciting 3D

software that companies can use to design everything from flat fruit-packing machines for Sunkist[25] to large skyscrapers and other buildings for architectural firms. The technology used to produce 3D movies will also be available with some TV programs. Nintendo developed the Nintendo 3DS, one of the first portable gaming devices that displays images in 3D.

Audio

Audio includes music, human voices, recorded sounds, and a variety of computer-generated sounds. It can be stored in a variety of file formats, including MP3 (Motion Picture Experts Group Audio Layer 3), WAV (wave format), and MIDI (Musical Instrument Digital Interface). When audio files are played while they are being downloaded from the Internet, it's called *streaming audio*.

Input to audio software includes audio recording devices: microphones, imported music or sound from CDs or audio files, MIDI instruments that can create music and sounds directly, and other audio sources. Once stored, audio files can be edited and augmented using audio software, including Apple QuickTime, Microsoft Sound Recorder, Adobe Audition, and SourceForge Audacity. See Figure 7.20. Once edited, audio files can also be used to enhance presentations, create music, broadcast satellite radio signals, develop audio books, record podcasts for iPods and other audio players, provide realism to movies, and enhance video and animation (discussed next).



Source: Audacity

FIGURE **7.20**

Audio-editing software

Audacity provides tools for editing and producing audio files in a variety of formats.

Video and Animation

The moving images of video and animation are typically created by rapidly displaying one still image after another. Video and animation can be stored in AVI (Audio Video Interleave) files used with many Microsoft applications, MPEG (Motion Picture Experts Group format) files, and MOV (QuickTime format) files used with many Apple applications. When video files are played while they are being downloaded from the Internet, it's called *streaming video*. For example, Netflix, which allows people to stream movies and TV programs to their PC, is becoming a popular alternative to renting DVDs at a video store. On the Internet, Java applets (small downloadable programs) and animated GIF files can be used to animate or create "moving" images.

A number of video and animation software products can be used to create and edit video and animation files. Many video and animation programs can

create realistic 3D moving images. Adobe's Premiere and After Effects and Apple's Final Cut Pro can be used to edit video images taken from cameras and other sources. Final Cut Pro, for example, has been used to edit and produce full-length motion pictures shown in movie theaters. Adobe Flash and LiveMotion can be used to add motion and animation to Web pages.

Video and animation have many business uses. Companies that develop computer-based or Internet training materials often use video and audio software. An information kiosk at an airport or shopping mall can use animation to help customers check-in for a flight or to get information.

Visual effects involve the integration of live action footage and generated imagery to create settings that look completely lifelike, but would be dangerous or extremely expensive to capture on film. RenderMan is Pixar's technical specification for a standard communications interface between 3D computer graphics programs and rendering programs. (Rendering is the final step in the animation process and provides the final appearance to the animation with visual effects such as shading, texture-mapping, shadows, reflections, and motion blurs). RenderMan software is used everywhere to create outstanding graphics for feature films and broadcast television. Indeed, it has been used on every Visual Effects Academy Award Winner of the past 15 years.[26] See Figure 7.21.

AP Images/Disney/Pixar

FIGURE **7.21**

Creating animation for Pixar

Pixar uses sophisticated proprietary animation software called RenderMan to create cutting-edge 3D movies such as *Brave*.

File Conversion and Compression

Most multimedia applications are created, edited, and distributed in a digital file format, such as the ones discussed earlier. Older inputs to these applications, however, can be in an analog format from old home movies, magnetic tapes, vinyl records, or similar sources. In addition, some older digital formats are no longer popular or used. In these cases, the analog and older digital formats must be converted into a newer digital format before they can be edited and processed by today's multimedia software. This conversion can be done with a program or specialized hardware. Some of the multimedia software discussed earlier, such as Adobe Premium, Adobe Audition, and many others, have this analog-to-digital conversion capability. Standalone software and

specialized hardware can also be used. Grass Valley, for example, is a hardware device that can be used to convert analog video to digital video or digital video to analog video. With this device, you can convert old VHS tapes to digital video files or digital video files to an analog format.

Because multimedia files can be large, it's sometimes necessary to compress files to make them easier to download from the Internet or send as email attachments. Many of the multimedia software programs discussed earlier can be used to compress multimedia files. In addition, standalone file conversion programs, such as WinZip, can be used to compress many file formats.

Designing a Multimedia Application

Designing multimedia applications requires careful thought and a systematic approach. The overall approach to modifying any existing application or developing a new one is discussed in the next chapters on systems development. However, developing a multimedia application involves additional considerations. Multimedia applications can be printed on beautiful brochures, placed into attractive corporate reports, uploaded to the Internet, or displayed on large screens for viewing. Because these applications are typically more expensive than preparing documents and files in a word-processing program, it is important to spend time designing the best possible multimedia application. Designing a multimedia application requires that the end use of the document or file be carefully considered. For example, some text styles and fonts are designed for Internet display. Because different computers and Web browsers display information differently, it is a good idea to select styles, fonts, and presentations based on computers and browsers that are likely to display the multimedia application. Because large files can take much longer to load into a Web page, smaller files are usually preferred for Web-based multimedia applications.

Overview of Virtual Reality

The term *virtual reality* was initially coined in 1989 by Jaron Lanier, founder of VPL Research. Originally, the term referred to *immersive virtual reality* in which the user becomes fully immersed in an artificial, 3D world that is completely generated by a computer. Through immersion, the user can gain a deeper understanding of the virtual world's behavior and functionality. The Media Grid at Boston College supports a wide range of virtual reality-based applications such as immersive education; real-time visualization of complex data (e.g., engineering, medical, weather); telemedicine (e.g., drug design, medical imaging, remote surgery); immersive multiplayer games; and vehicle and aircraft design and simulation.[27]

virtual reality system: A system that enables one or more users to move and react in a computer-simulated environment.

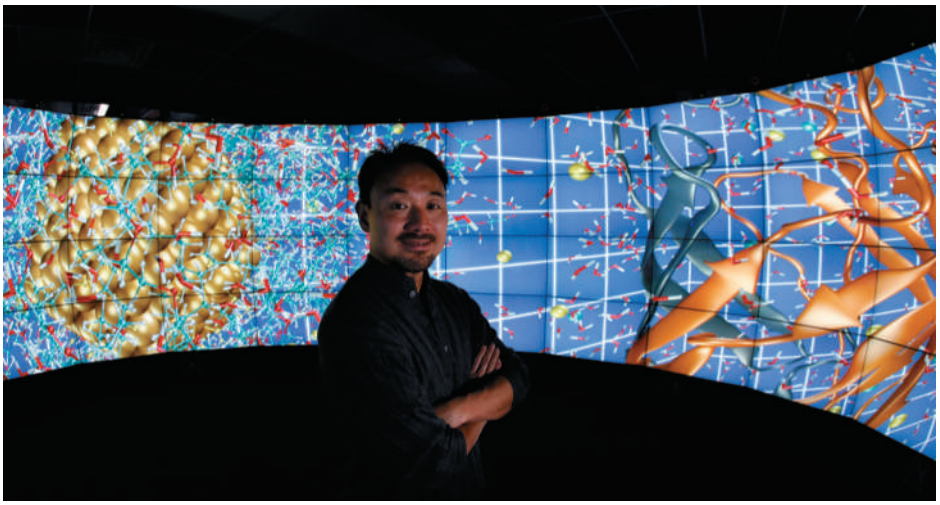
A **virtual reality system** enables one or more users to move and react in a computer-simulated environment. Virtual reality simulations require special interface devices that transmit the sights, sounds, and sensations of the simulated world to the user. These devices can also record and send the speech and movements of the participants to the simulation program, enabling users to sense and manipulate virtual objects much as they would real objects. This natural style of interaction gives the participants the feeling that they are immersed in the simulated world. For example, an auto manufacturer can use virtual reality to help it simulate and design factories.

In justifying Facebook's $2 billion acquisition of virtual reality company Oculus VR, Mark Zuckerberg said that "while mobile is the key platform for today, virtual reality will be one of the major platforms for tomorrow. Imagine enjoying a courtside seat at a game, studying in a classroom of students and teachers all over the world or consulting with a doctor face-to-face, just by putting on goggles in your home."[28]

Interface Devices

To see in a virtual world, the user often wears a head-mounted display (HMD) with screens directed at each eye. The HMD also contains a position tracker to monitor the location of the user's head and the direction in which the user is looking. Employing this information, a computer generates images of the virtual world—a slightly different view for each eye—to match the direction in which the user is looking and displays these images on the HMD. Many companies sell or rent virtual reality interface devices, including Virtual Realities (*www.vrealities.com*), Amusitronix (*www.amusitronix.com*), and I-O Display Systems (*www.i-glassesstore.com*), among others.

The Electronic Visualization Laboratory (EVL) at the University of Illinois at Chicago introduced a room constructed of large screens on three walls and a floor on which the graphics are projected. The CAVE, as this room is called, provides the illusion of immersion by projecting stereo images on the walls and floor of a room-sized cube (*www.evl.uic.edu*). Several persons wearing lightweight stereo glasses can enter and walk freely inside the CAVE. A head-tracking system continuously adjusts the stereo projection to the current position of the leading viewer. The most recent version of the CAVE is called CAVE2, and features realistic high-resolution graphics that respond to user interactions. See Figure 7.22.



AP Images/Charles Rex Arbogast

FIGURE **7.22**

Large-scale virtual reality environment

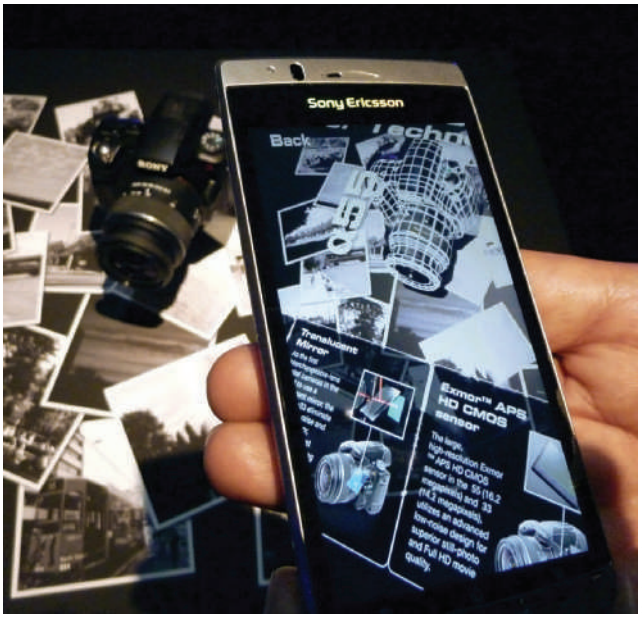
The CAVE2 virtual reality system has 72 stereoscopic LCD panels encircling the viewer 320 degrees and creates a 3D environment that can simulate the bridge of the starship U.S.S. Enterprise, a flyover of the planet Mars, or a journey through the blood vessels of the brain.

Users hear sounds in the virtual world through earphones, with information reported by the position tracker also being used to update audio signals. When a sound source in virtual space is not directly in front of or behind the user, the computer transmits sounds to arrive at one ear a little earlier or later than at the other and to be a little louder or softer and slightly different in pitch.

The *haptic* interface, which relays the sense of touch and other physical sensations in the virtual world, is the least developed and perhaps the most challenging to create. One virtual reality company has developed a haptic interface device that can be placed on a person's fingertips to give an accurate feel for game players, surgeons, and others. Currently, with the use of a glove and position tracker, the computer locates the user's hand and measures finger movements. The user can reach into the virtual world and handle objects; still, it is difficult to generate the sensations of a person tapping a hard surface, picking up an object, or running a finger across a textured surface. Touch sensations also have to be synchronized with the sights and sounds users experience. Today, some virtual reality developers are even trying to incorporate taste and smell into virtual reality applications.

Forms of Virtual Reality

Aside from immersive virtual reality, virtual reality can also refer to applications that are not fully immersive, such as mouse-controlled navigation through a 3D environment on a graphics monitor, stereo viewing from the monitor via stereo glasses, and stereo projection systems. *Augmented reality,* a newer form of virtual reality, has the potential to superimpose digital data over real photos or images. See Figure 7.23. Augmented reality is being used in a variety of settings. Some luxury car manufacturers, for example, display dashboard information, such as speed and remaining fuel, on windshields. The application is used in some military aircraft and is often called heads-up display. First down yellow lines displayed on TV screens during football games is another example of augmented reality, where computer-generated yellow lines are superimposed onto real images of a football field. GPS maps can be combined with real pictures of stores and streets to help you locate your position or find your way to a new destination. Using augmented reality, you can point a smartphone camera at a historic landmark, such as a castle, museum, or other building, and have information about the landmark appear on your screen, including a brief description of the landmark, admission price, and hours of operation. Although still in its early phases of implementation, augmented reality has the potential to become an important feature of tomorrow's smartphones and similar mobile devices.



Kyodo/Landov

FIGURE **7.23**

Augmented reality

Augmented reality technology shows additional information when it captures images through a camera on devices such as a smartphone.

Virtual Reality Applications

You can find thousands of applications of virtual reality, with more being developed as the cost of hardware and software declines and as people's imaginations are opened to the potential of virtual reality. Virtual reality applications are being used in medicine, education and training, business, and entertainment, among other fields.

Medicine

Virtual reality has been successful in treating children with autism by helping them pick up on social cues, refine their motor skills, and learn real life lessons such as looking both ways before crossing the street. It seems that children with autism interact well with technology because of its predictability,

LIPO CHING/MCT/Landov

FIGURE **7.24**

Treating children with autism

The Model Me Going Places app helps autistic children learn appropriate behaviors in various settings, such as a barber shop.

controllability, and incredible patience. See Figure 7.24. Virtual reality has also been used to help train medical students with simulations for many forms of surgery from brain surgery to delivery of a baby.[29]

Education and Training

Virtual environments are used in education to bring exciting new resources into the classroom. Thousands of administrators, faculty, researchers, staff, and students are members of the Immersive Education Initiative, a nonprofit international partnership of colleges, companies, research institutes, and universities working together to define and develop open standards, best practices, platforms, and communities of support for virtual reality and game-based learning and training systems. The following is the current curriculum of fully immersive courses offered through the Woods College of Advancing Studies at Boston College:[30]

- MT 35101 Discovering Computer Graphics
- MT 35801 Video Games and Virtual Reality
- MT 38101 Independent Study in Immersive Education and Virtual Reality
- MT 34101 Web 2.0: New Era of Web Technology
- MT 34801 Information Systems: Applications Overview
- MT 34901 Information Systems: Collaborative Computing

Virtual technology has also been used to train members of the military. To help with aircraft maintenance, a virtual reality system has been developed to simulate an aircraft and give a user a sense of touch, while computer graphics provide a sense of sight and sound. The user sees, touches, and manipulates the various parts of the virtual aircraft during training. Also, the Pentagon is using a virtual reality training lab to prepare for a military crisis. The virtual reality system simulates various war scenarios.

Business and Commerce

Virtual reality is being used in business for many purposes—to provide virtual tours of plants and buildings, enable 360-degree viewing of a product or machine, and train employees. Ford uses virtual reality technology to refine

its auto designs. Elizabeth Baron, virtual reality and advanced visualization technical specialist at the company states: "We want to be able to see the cars and our designs, and experience them before we have actually produced them." Perhaps 30 to 40 people from the design and engineering departments might participate in a portion of a typical virtual reality session lasting up to a few hours. Workers are able to scrutinize the interior and exterior of a car design. If they wish, they can even dissect a particular component, say the side mirror or front bumper, and see exactly how it is designed. This is possible because the virtual reality technology is tied directly into Ford's Autodesk computer aided design (CAD) system.[31]

Pepsi Max used augmented virtual reality to turn a London bus shelter into a fake window through which flying saucers, a giant sea monster, a tiger, and other improbable subjects appeared to be moving down the street. Waiting bus riders were fascinated by what they saw and watched the action unfold all the way to the final scene, which showed the Pepsi logo and the words, "Pepsi Max maximum taste, no sugar UNBELIEVABLE."[32]

Microsoft is developing a virtual reality headset for enterprise workers to interact with office productivity software.[33] With this headset and associated software, users can see Microsoft Excel PivotTables that actually pivot in 3D, send weekly status reports that appear in a fully immersive environment, and generate PowerPoint presentations that support full positional head tracking and provide a 3D stereo sound sensation for the listener. Virtual reality headsets such as those by Oculus Rift can be used to walk through the simulated environment. See Figure 7.25.

figurediqital.com/Rex Features

FIGURE **7.25**

Virtual reality headset

A British creative agency developed an immersive walkthrough of a grocery store using the Oculus Rift VR headset to enhance online shopping.

OTHER SPECIALIZED SYSTEMS

In addition to artificial intelligence, expert systems, and virtual reality, other interesting specialized systems have appeared including assistive technology systems, game theory, and informatics. These will now be discussed.

Assistive Technology Systems

Assistive technology systems: A wide range of assistive, adaptive, and rehabilitative devices to help people with disabilities perform tasks that they were formerly unable to accomplish or had great difficulty accomplishing.

Assistive technology systems includes a wide range of assistive, adaptive, and rehabilitative devices to help people with disabilities perform tasks that they were formerly unable to accomplish or had great difficulty accomplishing.

Many assistive technology products are designed to enhance the human-computer interface. Electronic pointing devices are available that enable users to control the pointer on the screen without the use of hands using ultrasound, infrared beams, eye movements, and even nerve signals and brain waves. Sip-and-puff systems are activated by inhaling or exhaling. Braille embossers can translate text into embossed Braille output. Screen readers can be used to speak everything displayed on the computer screen including text, graphics, control buttons, and menus. Speech recognition software enables users to give commands and enter data using their voices rather than a mouse or keyboard. Text-to-speech synthesizers can "speak" all data entered to the computer to allow users who are visually impaired or who have learning difficulties to hear what they are typing.[34] Stephen Hawking is an English theoretical physicist and cosmologist considered by many to be the most intelligent man alive today. Hawking is almost entirely paralyzed and uses assistive technology systems to communicate his thoughts and to interact with computers. See Figure 7.26.

EVERT ELZINGA/EPA/LANDOV

FIGURE **7.26**

Stephen Hawking

Stephen Hawking employs a number of assistive technology systems to support his activities.

Personal assistive listening devices help people understand speech in difficult situations. They separate the speech that a person wants to hear from background noise by improving what is known as the "speech to noise ratio." While there are several different solutions, each personal assistive learning device has at least three components: a microphone, a transmission technology, and a device for receiving the signal and bringing the sound to the ear. Depending on the technology, you just need a headset to connect to the device.[35]

Personal emergency response systems use electronic sensors connected to an alarm system to help maintain security, independence, and peace of mind for anyone who is living alone, at risk for falls, or recuperating from an illness or surgery. These systems include fall detectors, heart monitors, and unlit gas sensors. When an alert is triggered, a message is sent to a caregiver or contact center who can respond appropriately.

game theory: A mathematical theory for developing strategies that maximize gains and minimize losses while adhering to a given set of rules and constraints.

Game Theory

Game theory is a mathematical theory for developing strategies that maximize gains and minimize losses while adhering to a given set of rules and

constraints. Game theory is frequently applied to solve various decision-making problems where two or more participants are faced with choices of action, by which each may gain or lose, depending on what others choose to do or not to do. Thus the final outcome of a game is determined jointly by the strategies chosen by all participants. Such decisions involve a degree of uncertainty because no participant knows for sure what course of action the other participants will take. In zero-sum games, the fortunes of the players are inversely related so that one participant's gain is the other participant's loss. In non-zero-sum games, it wise for the participants to cooperate so that the action taken by one participant may benefit both participants. Two-person zero-sum games are used by military strategists. Many-person non-zero-sum games are used in many business decision-making settings. Game theory Explorer and Gambit are collections of software tools for building, analyzing, and exploring game models.[36]

In the TV game show *Jeopardy!*, contestants typically select a single category and progressively move down from the top question (easiest and lowest dollar value) to the bottom (hardest and highest dollar value). This provides the contestants and viewers with an easy-to-understand escalation of difficulty. But recently one player developed a much different strategy employing the fundamentals of game theory. This player seeks out the hidden Daily Double questions, which are usually the three highest-paying and most difficult questions in the categories. Thus rather than selecting a single category and increasing the degree of difficulty, he begins with the two most difficult questions in the category. Once the two most difficult questions have been taken off the board in one category, he skips to another category in search of the Daily Doubles. This strategy has proven to be highly successful.[37]

The United States Coast Guard employs a game theory system called PROTECT (Port Resiliency for Operational/Tactical Enforcement to Combat Terrorism) to randomize patrols while still achieving a very high level of security that provides maximum deterrence. There are insufficient resources to provide full security coverage around the clock at all high-value potential targets in the 361 shipping ports in the United States. This means that enemies can observe patrol and monitor activities and take actions in an attempt to avoid patrols. PROTECT generates patrol and monitoring schedules that take into account the importance of different targets at each port, and the enemy's likely surveillance and anticipated reaction to those patrols.[38]

Informatics

informatics: The combination of information technology with traditional disciplines such as medicine or science while considering the impact on individuals, organizations, and society.

Informatics is the combination of information technology with traditional disciplines such as medicine or science while considering the impact on individuals, organizations, and society. Informatics places a strong emphasis on the interaction between humans and technology with the goal of engineering information systems that provide users with the best possible user experience. Indeed, informatics represents the intersection of people, information, and technology. See Figure 7.27. The field of informatics has great breadth and encompasses many individual specializations such as biomedical, health, nursing, medical, and pharmacy informatics. Those who study informatics learn how to build new computing tools and applications. They gain an understanding of how people interact with information technology and how information technology shapes our relationships, our organizations, and our world.

Biomedical informatics (or bioinformatics) develops, studies, and applies theories, methods, and processes for the generation, storage, retrieval, use, and sharing of biomedical data, information, and knowledge. Bioinformatics has been used to help map the human genome and conduct research on biological organisms. Using sophisticated databases and artificial intelligence, bioinformatics helps unlock the secrets of the human genome, which could

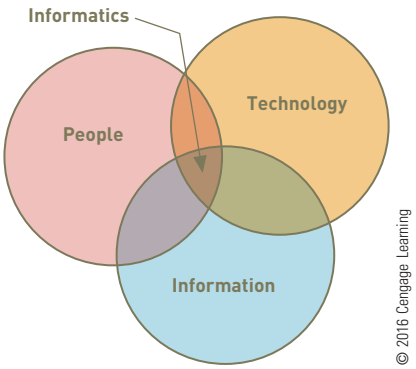


FIGURE **7.27**

Informatics

Informatics represents the intersection of people, information, and technology.

eventually prevent diseases and save lives. Some universities have courses on bioinformatics and offer bioinformatics certification.

Health informatics is the science of how to use data, information, and technology to improve human health and the delivery of health care services. Health informatics applies principles of computer and information science to the advancement of patient care, life sciences research, health professional education, and public health. Journals, such as Healthcare Informatics, report current research on applying computer systems and technology to reduce medical errors and improve health care.

New Jersey hospitals participating in a nationwide quality and patient safety program prevented 9,206 adverse events for patients and reduced related healthcare costs by over $100 million in 2013. Data collection played a key role in identifying 13 hospital-acquired conditions to be targeted by this quality improvement process.[39]

SUMMARY

Principle:

Knowledge management allows organizations to share knowledge and experience among its workers.

Knowledge is an awareness and understanding of a set of information and the ways that information can be made useful to support a specific task or reach a decision. A knowledge management system (KMS) is an organized collection of people, procedures, software, databases, and devices used to create, store, share, and use the organization's knowledge and experience. Explicit knowledge is objective and can be measured and documented in reports, papers, and rules. Tacit knowledge is hard to measure and document and is typically not objective or formalized.

Knowledge workers are people who create, use, and disseminate knowledge and include a wide range of workers. The chief knowledge officer (CKO) is the individual who represents the organization's knowledge management vision with clarity and effectiveness, strives mightily to achieve that vision, provides executive-level leadership to implement and sustain KM, and is the ultimate focal point for knowledge creation, sharing and application. Some organizations and professions use communities of practice (COP), which are groups of people with common interests who come together to create, store, and share knowledge on a specific topic.

Obtaining, storing, sharing, and using knowledge is the key to any KMS, with the employment of a KMS often leading to additional knowledge creation, storage, sharing, and usage. Many tools and techniques can be used to create, store, and use knowledge. These tools and techniques are available from IBM, Microsoft, and other companies and organizations.

Principle:

Artificial intelligence systems form a broad and diverse set of systems that can replicate human decision making for certain types of well-defined problems.

The term artificial intelligence is used to describe computers with the ability to mimic or duplicate the functions of the human brain. The objective of building AI systems is not to replace human decision making but to replicate it for certain types of well-defined problems.

Intelligent behavior encompasses several characteristics, including the abilities to learn from experience and apply this knowledge to new experiences, handle complex situations and solve problems for which pieces of information might be missing, determine relevant information in a given situation, think in a logical and rational manner and give a quick and correct response, and understand visual images and process symbols. Computers are better than people at transferring information, making a series of calculations rapidly and accurately, and making complex calculations, but human beings are better than computers at all other attributes of intelligence.

Artificial intelligence is a broad field that includes several key components, such as expert systems, robotics, vision systems, natural language processing, learning systems, and neural networks. An expert system consists of the hardware and software used to produce systems that behave as a human expert would in a specialized field or area (e.g., credit analysis). Robotics uses mechanical or computer devices to perform tasks that require a high degree of precision or are tedious or hazardous for humans (e.g., stacking cartons on a pallet). Robots are increasingly being used in surgical procedures. Vision systems include hardware and software that permit computers to capture, store, and manipulate images and pictures (e.g., face-recognition software). Natural language processing allows the computer to understand and react to statements and commands made in a "natural" language, such as English. Learning systems use a combination of software and hardware to allow a computer to change how it functions or reacts to situations based on feedback it receives (e.g., a computerized chess game). A neural network is a computer system that can recognize and act on patterns or trends that it detects in large sets of data. A genetic algorithm is an approach to solving problems based on the theory of evolution and the concept of survival of the fittest. Intelligent agents consist of programs and a knowledge base used to perform a specific task for a person, a process, or another program.

Principle:

Expert systems can enable a novice to perform at the level of an expert but must be developed and maintained very carefully.

An expert system consists of a collection of integrated and related components, including a knowledge base, an inference engine, an explanation facility, a knowledge acquisition facility, and a user interface. The knowledge base is an extension of a database, discussed in Chapter 3, and an information and decision support system, discussed in Chapter 6. It contains all the relevant data, rules, and relationships used in the expert system. The rules are often composed of IF-THEN statements, which are used for drawing conclusions.

The inference engine processes the rules, data, and relationships stored in the knowledge base to provide answers, predictions, and suggestions similar to the way a human expert would. The explanation facility of an expert system allows the user to understand what rules were used in arriving at a decision. The knowledge acquisition facility helps the user add or update

knowledge in the knowledge base. The user interface makes it easier to develop and use the expert system.

The people involved in the development of an expert system include the domain expert, the knowledge engineer, and the knowledge users. The domain expert is the person or group who has the expertise or knowledge being captured for the system. The knowledge engineer is the developer whose job is to extract the expertise from the domain expert. The knowledge user is the person who benefits from the use of the developed system.

Expert systems can be implemented in several ways. Traditionally, high-level languages, including Pascal, FORTRAN, and COBOL, were used. LISP and PROLOG are two languages specifically developed for creating expert systems from scratch. A faster and less expensive way to acquire an expert system is to purchase an expert system shell or existing package. The shell program is a collection of software packages and tools used to design, develop, implement, and maintain expert systems.

Principle:

Multimedia and virtual reality systems can reshape the interface between people and information technology by offering new ways to communicate information, visualize processes, and express ideas creatively.

Multimedia is text, graphics, video, animation, audio, and other media that can be used to help an organization efficiently and effectively achieve its goals. Multimedia can be used to create stunning brochures, presentations, reports, and documents. Although not all organizations use the full capabilities of multimedia, most use text and graphics capabilities. Other applications of multimedia include audio, video, and animation. File compression and conversion are often needed in multimedia applications to import or export analog files and to reduce file size when storing multimedia files and sending them to others. Designing a multimedia application requires careful thought to get the best results and achieve corporate goals.

A virtual reality system enables one or more users to move and react in a computer-simulated environment. Virtual reality simulations require special interface devices that transmit the sights, sounds, and sensations of the simulated world to the user. These devices can also record and send the speech and movements of the participants to the simulation program. Thus, users can sense and manipulate virtual objects much as they would real objects. This natural style of interaction gives the participants the feeling that they are immersed in the simulated world.

Virtual reality can also refer to applications that are not fully immersive, such as mouse-controlled navigation through a three-dimensional environment on a graphics monitor, stereo viewing from the monitor via stereo glasses, and stereo projection systems. Some virtual reality applications allow views of real environments with superimposed virtual objects. Augmented reality, a newer form of virtual reality, can superimpose digital data over real photos or images. Virtual reality applications are found in medicine, education and training, real estate and tourism, and entertainment.

Principle:

Specialized systems can help organizations and individuals achieve their goals.

A number of specialized systems have recently appeared to assist organizations and individuals in new and exciting ways. Assistive technology systems include a wide range of assistive, adaptive, and rehabilitative devices to help people with disabilities perform tasks that they were formerly unable to

accomplish or had great difficulty accomplishing. Game theory is a mathematical theory that helps to develop strategies for maximizing gains and minimizing losses while adhering to a given set of rules and constraints. Informatics is the combination of information technology with traditional disciplines such as medicine or science while considering the impact on individuals, organizations, and society. It represents the intersection of people, information, and technology.

KEY TERMS

artificial intelligence system
assistive technology system
chief knowledge officer (CKO)
community of practice (COP)
domain expert
explanation facility
game theory
genetic algorithm
IF-THEN statement
inference engine
informatics
intelligent agent
intelligent behavior
knowledge acquisition facility
knowledge engineer
knowledge user
learning systems
multimedia
natural language processing
neural network
perceptive system
robotics
rule
virtual reality system
vision system

CHAPTER 7: SELF-ASSESSMENT TEST

Knowledge management allows organizations to share knowledge and experience among its workers.

1. _____ knowledge is hard to measure and document and typically is not objective or formalized.
2. What type of person creates, uses, and disseminates knowledge?
   a. information worker
   b. knowledge worker
   c. domain expert
   d. knowledge engineer
3. Representing the organization's knowledge management vision is a key role for the _____ of an organization.
   a. CEO
   b. CKO
   c. CFO
   d. CTO
4. The number of knowledge workers in the world far outnumber the number of non-knowledge workers. True or False?

Artificial intelligence systems form a broad and diverse set of systems that can replicate human decision making for certain types of well-defined problems.

5. The Turing Test attempts to determine whether a computer can defeat a human at games that require logic and reasoning such as chess or checkers. True or False?
6. _____ are rules of thumb arising from experience or even guesses.
7. _____ is *not* an important characteristic of intelligent behavior.
   a. The ability to receive input from sensors
   b. The ability to learn from experience
   c. The ability to determine what is important
   d. The ability to react quickly and correctly to a new situation
8. A(n) _____ system approximates the way a person sees, hears, and feels objects.
9. Researchers are exploring the possibility of directly connecting the brain to a computer and have human thought control computer activities. True or False?

10. A(n) _____ is a computer system that can recognize and act on patterns or trends in data.

Expert systems can enable a novice to perform at the level of an expert but must be developed and maintained very carefully.

11. Rules and cases are often used to build the knowledge base for an expert system. True or False?
12. A(n) _____ is a collection of software packages and tools used to develop expert systems that can be implemented on most popular PC platforms to reduce the time and costs required to develop an expert system.
13. The overall purpose of a(n) _____ is to seek information and relationships from the knowledge base and to provide answers, predications, and suggestions similar to the way a human expert would.
    a. domain expert
    b. explanation facility
    c. knowledge acquisition facility
    d. inference engine
14. What stores all relevant information, data, rules, cases, and relationships used by the expert system?
    a. the explanation facility
    b. the knowledge base
    c. the inference engine
    d. the acquisition facility
15. The _____ is the person with the expertise or knowledge that the expert system is trying to capture.
16. Which component of an expert system enables the user or decision maker to understand how the system arrived at a certain conclusion or result?
    a. the domain expert
    b. the inference engine
    c. the explanation facility
    d. the knowledge base
17. The purpose of the _____ is to provide a convenient and efficient means of capturing and storing all components of the knowledge base.
18. A(n) _____ is a person who has training and experience in the design, implementation, and maintenance of an expert system.
    a. chief knowledge officer
    b. domain expert
    c. knowledge engineer
    d. knowledge user

Multimedia and virtual reality systems can reshape the interface between people and information technology by offering new ways to communicate information, visualize processes, and express ideas creatively.

19. _____ has the potential to superimpose digital data over real photos or images.
20. _____ is a file format frequently used to store graphic images.
    a. GIF, JPEG
    b. MP3, WAV, MIDI
    c. AVI, MPEG, MOV
    d. DOC, DOCX
21. What type of virtual reality is used to make human beings feel as though they are in a 3D setting, such as a building, an archaeological excavation site, the human anatomy, a sculpture, or a crime scene reconstruction?
    a. cloud
    b. relative
    c. immersive
    d. visual

Specialized systems can help organizations and individuals achieve their goals.

22. _____ includes a wide range of devices that help people with disabilities to perform tasks that they were formerly unable to accomplish or had great difficulty accomplishing.
23. _____ involves the use of information systems to develop competitive strategies for people, organizations, or even countries.

CHAPTER 7: SELF-ASSESSMENT TEST ANSWERS

1. tacit
2. b
3. b
4. False
5. False
6. heuristics
7. a
8. perceptive
9. True
10. neural network
11. True
12. expert system shell
13. d
14. b
15. domain expert
16. c
17. knowledge acquisition facility
18. c
19. augmented reality
20. a
21. c
22. Assistive technology systems
23. Game theory

REVIEW QUESTIONS

1. Briefly explain the difference between data, information, and knowledge.
2. Briefly explain the difference between explicit and tacit knowledge. Give an example of each.
3. What is the role of the chief knowledge officer?
4. What is a community of practice? Give an example of a COP. What are some of the advantages of participating in a COP?
5. What is a knowledge repository?
6. What is the Turing Test?
7. How would you define artificial intelligence?
8. Identify several specific characteristics of intelligent behavior.
9. Identify six major branches of artificial intelligence.
10. What is a genetic algorithm? Give an example of the use of a genetic algorithm.
11. Identify and briefly describe the five components of an expert system.
12. Identify and briefly describe two approaches for defining a knowledge base.
13. What is a domain expert? What role do they have in the development of an expert system?
14. What is a knowledge engineer?
15. What is an expert system shell?
16. Identify and briefly describe five forms of media that can be used to help an organization achieve its goals.
17. What is a virtual reality system? Identify four areas of virtual reality application.
18. What is an assistive technology system?
19. What is game theory? Identify two applications of game theory.
20. What is informatics?

DISCUSSION QUESTIONS

1. What are the requirements for a computer to exhibit human-level intelligence? How long will it be before we have the technology to design such computers? Do you think we should push to accelerate such a development? Why or why not?
2. You work on the customer software support desk of a large software manufacturing firm as an entry-level manager. The software support specialists need both explicit and tacit knowledge. Describe the types of explicit and tacit knowledge that would be useful to such workers. How would you capture each type of knowledge?
3. Many of us use heuristics each day in completing ordinary activities such as planning our meals, executing our workout routine, or determining what route to drive to school or work. Imagine that you are developing the rules for an expert system to help you in a specific activity. What rules or heuristics would you include?
4. How could you use a community of practice to help you in your work or studies? How would you go about identifying who to invite to join the COP?
5. What are some of the tasks at which robots excel? Which human tasks are difficult for robots to master? What fields of AI are required to develop a truly perceptive robot?
6. Describe how natural language processing could be used in a medical office setting.
7. Discuss the similarities and differences between learning systems and neural systems. Give an example of how each technology might be used.
8. What is the relationship between a database and a knowledge base?
9. Describe how game theory might be used in a business setting.
10. Describe how augmented reality can be used in a classroom. How could it be used in a work setting?
11. Describe how assistive living systems might benefit the residents of a nursing home.

PROBLEM-SOLVING EXERCISES

1. You are investigating the use of an automated fruit-picking machine to reduce the labor costs on your 600-acre Valencia orange grove that yields about 240,000 pounds of fruit (roughly 80,000 oranges) per season. You currently employ a crew of 10 migrant workers to hand-pick the fruit over a three-day period and pay them $8/hour. The fruit-picking machine costs $25,000 and requires two people to operate it. It is capable of picking oranges right off the tree at the rate of one orange per 10 seconds. The machine is quite sophisticated and employs a vacuum-gripper combined with a vision system to pluck ripe fruit from a tree. Does it make economic sense to purchase the automated fruit-picking machine?
2. Consider an expert system to suggest what clothes you should wear based on the previous night's weather forecast. Use a word-processing

program to list and describe the IF-THEN rules or cases that you would use.
3. Use a graphics program, such as PowerPoint, to develop a brochure for a small restaurant. Contrast your brochure to one that could have been developed using a specialized multimedia application used to develop brochures. Write a report using a word-processing application on the advantages of a multimedia application compared to a graphics program.

TEAM ACTIVITIES

1. Do research with your team to identify several instances where robots are taking jobs away from human employees. Does your team believe that the government should encourage or discourage the increasing use of robots? Why? Write a one-page summary of your findings and opinions.
2. Work with your team to design an expert system to predict how many years it will take a typical student to graduate from your college or university. Some factors to consider include the major the student selects, the student's SAT score, the number of courses taken each semester, and the number of parties or social activities the student attends each month. Identify six other factors that should be considered. Develop six IF-THEN rules or cases to be used in the expert system.
3. Have your team members explore the use of assistive technology systems by recent war veterans. Write a short paper summarizing your findings and the advantages and disadvantages of these type systems.

WEB EXERCISES

1. Use the Internet to identify several applications of neural networks. Write a brief summary of these applications.
2. Do research to find information about the acceptance (or lack thereof) of natural language processing systems. In your opinion, have these systems gained broad acceptance?
3. Use the Internet to find information about current applications of expert systems. Write a report about what you found.

CAREER EXERCISES

1. Develop three rules of thumb that individuals can use to select a career that is right for them. Develop three rules individuals can use to identify a career that is *not* right for them.
2. Imagine that you are forming a community of practice to deal with the issues of how to select a career. Identify people from your experience and others you may know of who you would like to include as members. Identify three key topics you would like the community to deal with.

CASE STUDIES

Case One

Knowledge Management Facilitates Energy Innovation

Repsol is a Spanish oil and gas company with 2013 revenues of over U.S. $76 billion. Repsol's business ranges from exploration, refining, and chemical manufacturing to retail marketing at over 7,000 service stations.

Repsol recognizes that "the key assets in an R&D organization like Repsol are the researchers and technologists, who have the training, experience, knowledge, creativity, and motivation: the necessary ingredients for discovering, improving, and assimilating new technologies." Without such *knowledge workers*, every stage in Repsol's value chain would dry up.

The value of such people is in what they know. China's Hilong Group, a supplier to the energy industry, lists many examples: geologists and geophysicists who use their knowledge to determine what rocks are beneath the earth's surface that can contain oil or gas, drilling engineers who plan well locations for efficient oil extraction, platform designers who must reduce costs to improve the efficiency of drilling platforms, and others. All of these people are in professions that call for specialized knowledge. Ideally, that knowledge should be available to anyone in the company who needs it.

Consider oil exploration, one of Repsol's core objectives. Geologists set off vibrations at one point and record them at another. They measure how strong the vibrations are at the receiving end, how long it takes the vibrations to get there,

and how strength and delay vary with vibration frequency. From those measurements, the geologists infer how much oil is beneath the surface and how hard extracting it will be. Oil companies use their conclusions to decide how much to bid for the rights to drill in an area. Companies that understand these measurements well can make reasonable predictions of how much oil will come from an area, will create accurate bids, and will be profitable. Companies that do not understand the measurements will bid too much for a barren oil field and lose money, or they will not bid enough for a rich field and be outbid by others who figure out its true value.

Knowing how to interpret these measurements—or how to do specialized work in any other field—comes from years of study and experience. Even the best expert has knowledge gaps: the expert might not know a fact or process, for example, while someone else at the company probably does. That's where knowledge management (KM) comes in. With a KM system, experts throughout the company can tap into what their colleagues know, no matter where they or those colleagues happen to be.

Before 2011, knowledge management at Repsol was haphazard; it depended on each person's knowing who else might know something plus a few localized knowledge repositories. In 2011, Repsol chose IDOL and Virage software from Autonomy (Cambridge, U.K.) to underpin its corporate knowledge management efforts. The company explains that "Autonomy's enterprise search enable[s] Repsol employees to search across different departments and operating systems, geographic locations and languages, to find timely, relevant information, regardless of data type or format. [It can] deliver personalized information through Agents, which understand users' interests and monitor business-critical information to provide automated alerts [to help] Repsol work more efficiently and quickly identify market trends, risks, or opportunities."

Repsol's new KM system and innovative approach to technology has helped fuel its success. Over the past five years, Repsol has made over 40 oil discoveries, including eight of the biggest in the world. It has used its revenue to prepare for the future, investing heavily in research and development not only in oil and gas, but in new energy and sustainability.

Discussion Questions

1. What types of knowledge did Repsol employees need to access?
2. What sort of knowledge do people use in your chosen career field? How can a knowledge management system help your employer make full use of everyone's knowledge?

Critical Thinking Questions

1. How do knowledge management systems, such as the one Repsol uses, differ from other types of information systems you have read about in this book?
2. Repsol has operations located in 50 different countries. How can KM systems help overcome language and other barriers that complicate the interchange of knowledge?

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Case Two

Vision Technologies Automate Urban Inspections

More than 4 million miles (6.5 million km) of roads cross the United States, with millions more in other countries. Proper maintenance is essential to ensure the safety of the users of these roads. Frequent repaving to completely prevent problems is too expensive, but word of mouth, resident complaints, and spot checks are not a dependable basis for planning repair work. As a result, systematic inspection of all roads is necessary—but that's expensive, too. To make things worse, systematic inspection needs to be done on a regular basis with the changes tracked and analyzed over time to predict when road repair will be necessary and to schedule the work in advance. Cash-strapped city and regional governments, therefore, need an inexpensive way to manage ongoing road maintenance and repair.

Fortunately, vision systems are coming to the rescue. City, town, and regional governments use vision systems to help municipalities maintain their share of the world's roadways. Allied Vision Technologies (AVT) is a leading manufacturer of high-performance vision cameras. According to AVT's Web site, vision systems can "collect field data and assess the condition of all roadway and pavement features such as longitudinal cracks, transverse cracks, alligator cracks, edge cracks, potholes, and rutting. Image-based systems offer a less labor-intensive and more reliable solution than traditional manual surveys, and allow the data to be stored for future referencing."

A system developed by AVT and used in the state of Florida incorporates two cameras from AVT and software from NorPix Inc. The cameras, mounted on the roof of a vehicle with one facing forward and one to the rear, capture images of the roadway every 5 to 10 feet (1.5 to 3 meters) as the vehicle drives over it, for a total of up to 180,000 images per day. GPS data is linked to the images to reference them to their actual locations. Images are geometrically flattened to eliminate perspective distortion from the angle of the photograph, superimposed on a map for analysis, and compared with images of the same location from previous years to determine the rate of change. The AVT system still

relies on people for the final data interpretation, though its image-processing capability simplifies their task.

Other vision systems can analyze the pavement as well. Pavemetrics Systems of Québec, Canada, offers systems that use lasers and high-speed cameras with custom optics to detect cracks, ruts, and surface deterioration, at speeds of over 60 mph (100 km/hr), day or night, on all types of road surfaces. Pavemetrics systems classify cracks into three categories and evaluate their severity. The systems can also measure and report on the condition of lane markings.

The use of vision systems in pavement inspection is expected to become much more widespread in next few years. However, pavement inspection imposes unique challenges on vision systems. Inspection must take place quickly so that the inspecting vehicle won't obstruct traffic. The system must be able to tell the difference between a crack and other surface imperfections such as oil stains under conditions of low contrast. All in all, vision systems in pavement inspection have a tall order, but filling it saves government agencies a great deal of money by making road repairs at the right time—not too early, not too late—and on a planned rather than an emergency basis.

Vision systems are evolving rapidly. Improvements to the underlying hardware and software technologies, combined with research into the use of those components in a variety of vision-based applications, contribute to better acquisition, storage, and analysis of images.

Discussion Questions

1. What other routine inspections do city, state, and national governments perform? How could vision technologies, combined with knowledge management systems, improve efficiency?
2. How could vision systems, combined with knowledge management systems improve government accountability and help citizens keep track of government performance?

Critical Thinking Questions

1. You work for a city highway department. Your job is to drive over its roads, noting their condition to determine which must be repaired, which must be monitored, and which can be left alone for a while. Your mayor suggests that the city should buy a vision system and asks for your opinion. Options include (a) no new system, (b) a system such as the AVT system mentioned earlier, and (c) at higher cost, a system such as the Pavemetrics system. Write a memo to the mayor making and justifying your recommendation.
2. A van equipped with a pavement inspection system costs about as much as a full-time highway department employee for a year. The highway department employee can use a car that the department already has. In addition, there are ongoing costs for using and maintaining the inspection system. Compare, as best you can from the available information, the costs of a pavement inspection system with its possible benefits.

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Questions for Web Case

See the Web site for this book to read about the Altitude Online case for this chapter. Following are questions concerning this Web case.

Altitude Online: Knowledge Management and Specialized Information Systems

Discussion Questions

1. Why do you think it is a good idea for Altitude Online to maintain records of all advertising projects?
2. How can social networks and blogs serve as knowledge management systems?

Critical Thinking Questions

1. What challenges lie in filling a wiki with information provided by employees?
2. What other tools could Altitude Online use to capture employee knowledge, build community, and reward productive employees?

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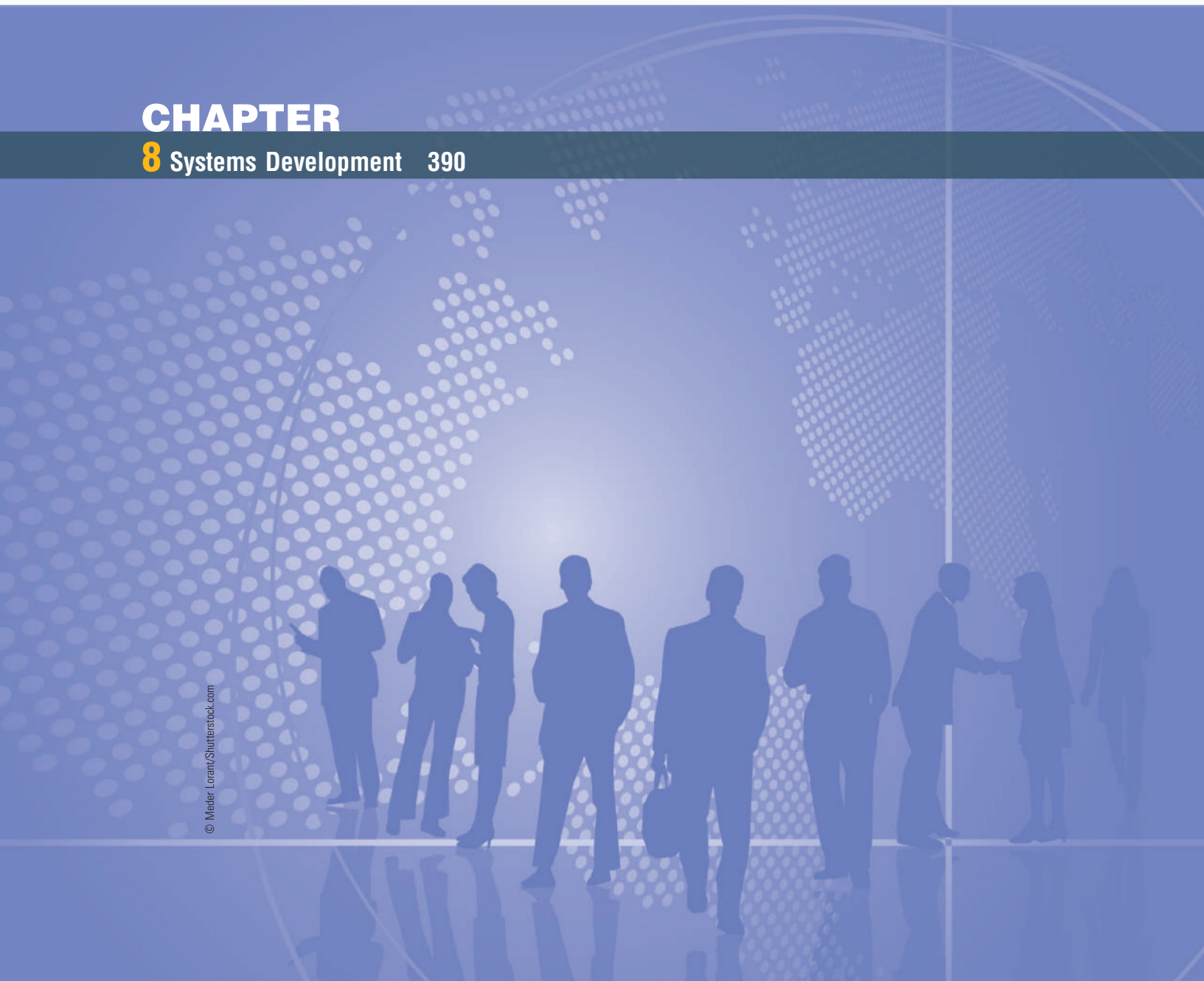
Systems Development

CHAPTER



8 Systems Development

Principles	Learning Objectives
• Effective systems development requires a team effort from stakeholders, users, managers, systems development specialists, and various support personnel, and it starts with building an information systems plan.	• Identify the key participants in the systems development process and discuss their roles in ensuring project success. • Discuss the importance of information systems planning and outline the steps of this process.
• The traditional systems development process is a sequential multistage process where work on the next stage cannot begin until the results of the previous stage are reviewed and approved or modified as necessary.	• Outline and state the purpose of each phase of the traditional systems development process. • Identify the advantages and disadvantages of the traditional systems development process. • Discuss the importance of the make-versus-buy decision and outline a process for performing this activity.
• A number of powerful techniques are frequently used by software development teams.	• Identify and briefly discuss the purpose of some of the tools and techniques used in the system development process.
• The systems development team must select the appropriate systems development approach to match the needs of the project.	• Identify the key features of alternative system development life cycles including the prototype, Agile, object-oriented, mobile, and user development process. • Identify the advantages and disadvantages of the prototyping and Agile system development processes.
• The systems development team must take special measures to ensure project success.	• Identify six common reasons why information systems project fail. • Briefly discuss measures necessary to avoid these causes of project failure.

Information Systems in the Global Economy

DIGITAL DELTA, THE NETHERLANDS

Holding Back the Flood Waters

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In the Netherlands, 55 percent of the population lives in areas prone to large-scale flooding. Much of the country—20 percent—is located below sea level and a total of 50 percent of its land mass is no more than 1 meter above sea level. Today, the government spends approximately $9.5 billion annually on water management. With rising sea levels, extended droughts, heavier rains, and less water pouring in from rivers, the Netherlands faces future challenges that are predicted to increase its already hefty water budget by as much as $3 billion per year.

Many private companies, educational institutions, and government agencies are involved in flood prevention, water quality management, and water-related research. The Digital Delta project aims to improve communication and cooperation between all these groups by sharing information through a cloud-based water data management system. Each group collects tens of terabytes of data from dike sensors, pumping stations, radar and weather forecasts, water run-off level monitors, and other devices. The Dike Data Service Center collects 2 petabytes of data annually. The questions the IT system developers face are first, how can smart combinations and analytics of this data produce improved water management, and second, how can dashboards and other tools make this data easier for stakeholders to access so that Dutch authorities can respond more quickly and effectively to floods, droughts, and threats to water quality? The developers must answer these questions before they can design and develop the new system that will be based on the IBM Intelligent Operations for Water and the Smarter Water Resource Management solution.

During its first year, Digital Delta is starting with small projects to find answers. One of its first steps is to figure out how to facilitate cooperation between Rijkswaterstaat, the Dutch government agency responsible for the maintenance of waterways and water systems, and 25 other local water authorities. The water level is optimized in each district, even though the actions of one district affect the others. Water districts respond reactively to the decisions of others, and if they want to receive information from another district, they do so by phone or email. Digital Delta is providing a mechanism to share real-time data to bring the districts together not only to optimize the discharge of water and save 40 percent in energy costs, but also to improve water containment during dry spells and prevent sea-water salt from damaging agriculture.

Digital Delta is working with each stakeholder to find business processes that will overcome barriers to communication. In doing so, the project's participants hope to eventually gain the ability to discharge water at sea at just the right moment, predict when tunnels will flood, prevent sewage overflow, improve water-level forecasting, and monitor river depth more accurately for shipping transportation.

As you read this chapter, consider the following:

- What steps do IT systems developers need to take before they begin to design a new product?
- What role should users and stakeholders play in the development of new systems like Digital Delta?

Throughout this book, you have seen many examples of the use of information systems in a variety of careers. A manager at a hotel chain can use an information system to look up client preferences. An entrepreneur can use systems development to build a new information system to support a new business. An accountant at a manufacturing company can use an information system to analyze the costs of a new plant. A sales representative for a shoe store can use a mobile application on a smartphone to obtain the latest sales information. Information systems have been designed and implemented for almost every career and every industry. An individual can use systems development to create applications for smartphones and tablet computers, for profit or enjoyment. But where do you start to acquire these systems or have them developed? How can you work with IS personnel, such as systems analysts or programmers, to get what you need to succeed on the job? This chapter gives you the answers. You will see how to initiate the systems development process and analyze your needs with the help of IS personnel. You will also learn how your project can be planned, aligned with corporate goals, rapidly developed, and much more. We will start with an overview of the systems development process.

When an organization needs to accomplish a new task or change a work process, how does it proceed? Often it must develop a new system or modify an existing one. Systems development is the activity of creating new systems or modifying existing systems. It refers to all aspects of the process—from identifying problems to solve or opportunities to exploit to implementing and refining the chosen solution. Gartner, the U.S. information technology and advisory firm, forecasts that annual worldwide IT spending will grow from $3.8 trillion in 2014 to $4.4 trillion in 2018. Roughly two-thirds of this spending will be on software and IS services.[1] As a result, systems development expenditures are expected to continue at a high level over the next few years. Many IS departments and systems developers will concentrate on creating more mobile applications for their businesses and organizations.

AN OVERVIEW OF SYSTEMS DEVELOPMENT

In today's businesses, managers and employees in all functional areas work together and use business information systems. They are expected to help and, in many cases, provide project leadership. Users might request that a systems development team determine whether they should purchase new mobile computing devices or create an attractive Web site. In another case, an entrepreneur might use systems development to build a mobile application to compete with large corporations. This chapter provides you with a deeper appreciation of the systems development process.

Corporations and nonprofit organizations often use the systems development process to develop information systems to achieve their goals. The Cincinnati Zoo developed an information system that pools data from ticketing and point-of-sale systems throughout the zoo with membership information and geographical data grouped by the zip codes of all visitors. The system generates reports and dashboards that summarize this data to enable managers and staff to take actions to improve the overall customer experience and eliminate less effective promotions. Together these actions are credited with saving the zoo more than $100,000 in promotional expenses and boosting attendance by over 50,000 in just one year.[2]

Participants in Systems Development

Effective systems development requires a team effort. The development team consists of stakeholders, users, managers, systems development specialists, and various support personnel. The team is responsible for determining the objectives of the information system and delivering a system that meets these objectives. Selecting a strong team for the systems development project is critical to project success.

project manager: The person assigned by the organization doing the work of the project to achieve the project objectives.

The **project manager** is the person assigned by the organization to do the work of the project and achieve the project objectives. The project manager is responsible for coordinating all people and resources needed to complete the project successfully. Project managers need technical, business, and people skills. See Figure 8.1. In addition to completing the project on time and within the specified budget, the project manager is usually responsible for controlling project scope, ensuring project quality, training personnel, facilitating communications, managing risks, and acquiring any necessary equipment, including office supplies and sophisticated computer hardware and software systems. Often some of these tasks are delegated to various members of the project team.

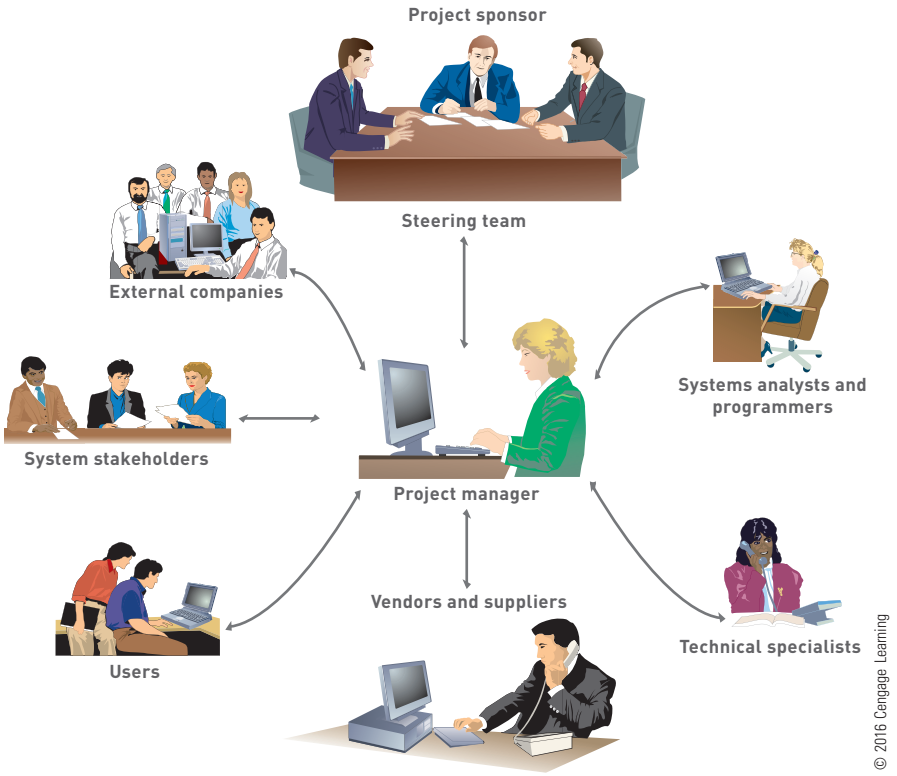

FIGURE **8.1**

Role of the project manager

The project manager plays a key role in the systems development project.

stakeholders: People who ultimately will be affected (for better or worse) by the systems development project.

users: People who will regularly interact with the system.

systems analyst: A professional who specializes in analyzing and designing business systems.

In the context of systems development, **stakeholders** are people who will ultimately be affected (for better or worse) by the systems development project. **Users** are the people who will regularly interact with the system as they complete their work. They can be employees or nonemployees such as customers, suppliers, or others outside the organization.

An information systems development team also includes systems analysts and programmers, among others. A **systems analyst** is a professional who specializes in analyzing and designing business systems. Systems analysts play various roles while interacting with the stakeholders and users, management, vendors and suppliers, external companies, programmers, and other IS support personnel. Like an architect developing blueprints for a new building, a systems analyst develops detailed plans for the new or modified system.

programmer: A specialist responsible for modifying or developing programs to satisfy user requirements.

The **programmer** is responsible for modifying or developing programs to satisfy user requirements. Like a contractor constructing a new building or renovating an existing one based on an architect's drawings, the programmer takes the system design from the systems analysis team and builds or modifies the necessary software.

Other members of the development team may include technical specialists, including database and telecommunications experts, hardware engineers, and software or hardware supplier representatives. The various members of the project may come and go depending on the phase of the project and its needs for certain specialists.

steering team: A small group of senior managers representing the business and IS organizations that provide guidance and support to the project.

In addition to the development team, each project should have a **steering team** of senior managers representing the business and IS organizations that provide guidance and support to the project. The number of members on the steering team should be limited (three to five) to simplify the decision-making process and ease the effort to schedule a quorum of these busy executives. The project manager and select members of the development team meet with the steering team on an as needed basis, typically at the end of each project phase or every few months.

project sponsor: A key member and leader of the steering committee who plays such a critical role that lack of this essential individual raises the distinct probability of project failure.

The **project sponsor** is a key member and leader of the steering committee who plays such a critical role that lack of this essential individual raises the probability of project failure. Here are the major responsibilities of the sponsor:

- Aligns project goals and objectives with organizational goals and objectives
- Obtains budget, people, and other necessary resources for the project
- Acts as a vocal and visible champion for the project to gain the support of others
- Identifies and removes barriers to project success
- Resolves any issues outside the control of the project manager
- Provides advice and counsel to the project team
- Keeps informed of major project activities and developments
- Has final approval of all requests for changes in project scope, budget, and schedule
- Signs off on approvals to proceed to each succeeding project phase

Information Systems Planning

information systems planning: The identification of those information systems development initiatives needed to support organizational strategic goals.

Information systems planning identifies those information systems development initiatives needed to support organizational strategic goals. Systems development initiatives arise from all levels of an organization and are both planned and unplanned. Systems development projects are initiated to meet organizational goals outlined in the strategic plan, as shown in Figure 8.2. Long-range IS planning is important to ensure that strategic goals are met and

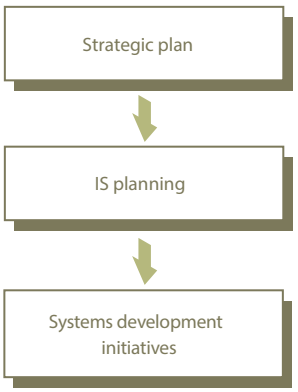

FIGURE **8.2**

Information systems planning

Information systems planning transforms organizational goals outlined in the strategic plan into specific systems development activities.

that the organization gains the best value from its IS resources. Specific systems development initiatives can spring from the IS plan, but the IS plan must also provide a broad framework for future success. The IS plan should guide development of the entire IS infrastructure over time.

Opportunities and problems that frequently trigger the initiation of an information system project include:

- The availability of new technology that creates an opportunity to improve an existing business process or to reach new customers. A New England restoration company transitioned from outdated paper-based processing to a mobile app that runs on smartphones. The new system greatly speeds up the ability to respond to customers, a critical consideration when dealing with a home or business that has been damaged by smoke and fire and has floors covered by inches of water.[3]
- Mergers and acquisitions require organizations to integrate systems, people, and procedures into a single IS function. When United and Continental Airlines merged, combining their reservation systems and data led to flight delays and lost loyalty plan data. Indeed, United Continental's chief revenue officer James Compton claimed that recurrent IS integration issues had "put a great deal of stress on our operation and our people" and harmed the company's performance.[4]
- New laws and regulations can also encourage new systems development projects in the public and private sectors. The American Taxpayer Relief Act (ATRA) contained a provision that allowed small businesses to expense the entire cost of new software in year one rather than depreciating the expense over three years.[5] Such tax relief was an encouragement to many small firms to invest in computer software.

Failure to align information systems goals to the needs of the business can have disastrous consequences. Gregg Steinhafel stepped down from the CEO position at Target following a massive data breach that affected perhaps 110 million customers and damaged the firm's reputation. Steinhafel "held himself personally responsible" for the breach.[6] Steinhafel's resignation followed the resignation of Target CIO Beth Jacob two months earlier. In an effort to better align IS effort to corporate goals, Target is elevating the priority assigned to information security and compliance structure and practices. The firm is also conducting an external search for a new CIO, chief information security officer, and chief compliance officer.[7]

TRADITIONAL SYSTEMS DEVELOPMENT LIFE CYCLE

The systems development process is also called a *systems development life cycle* (*SDLC*) because the activities associated with it are ongoing. As each system is built, the project has timelines and deadlines until at last the system is installed and accepted. A key fact of systems development is that the later in the SDLC an error is detected, the more expensive it is to correct. One reason for the mounting costs is that if an error is found in a later phase of the SDLC, the previous phases must be reworked to some extent. Thus, experienced systems developers prefer an approach that will detect and remove errors early in the project life cycle.

Common systems development life cycles include traditional, prototyping, agile, object-oriented, mobile application development, and user system development. With some companies, these approaches are formalized and documented so that systems developers have a well-defined process to follow; other companies use less formalized, undocumented (ad hoc) approaches. This first part of this chapter covers the traditional systems development life cycle and the second part of the chapter will discuss prototyping, agile, object-oriented, mobile, and user development life cycles.

traditional systems development life cycle: A sequential multistage process where work on the next stage cannot begin until the results of the previous stage are reviewed and approved or modified as necessary.

The **traditional systems development life cycle** is a sequential multistage process where work on the next stage cannot begin until the results of the previous stage are reviewed and approved or modified as necessary. The phases of the traditional systems development life cycle might vary from one company to the next, but many organizations use an approach with six phases: investigation, analysis, design, construction, integration and testing, and implementation. Once the system is built, there are additional steps of operation and maintenance and of disposition. See Figure 8.3.

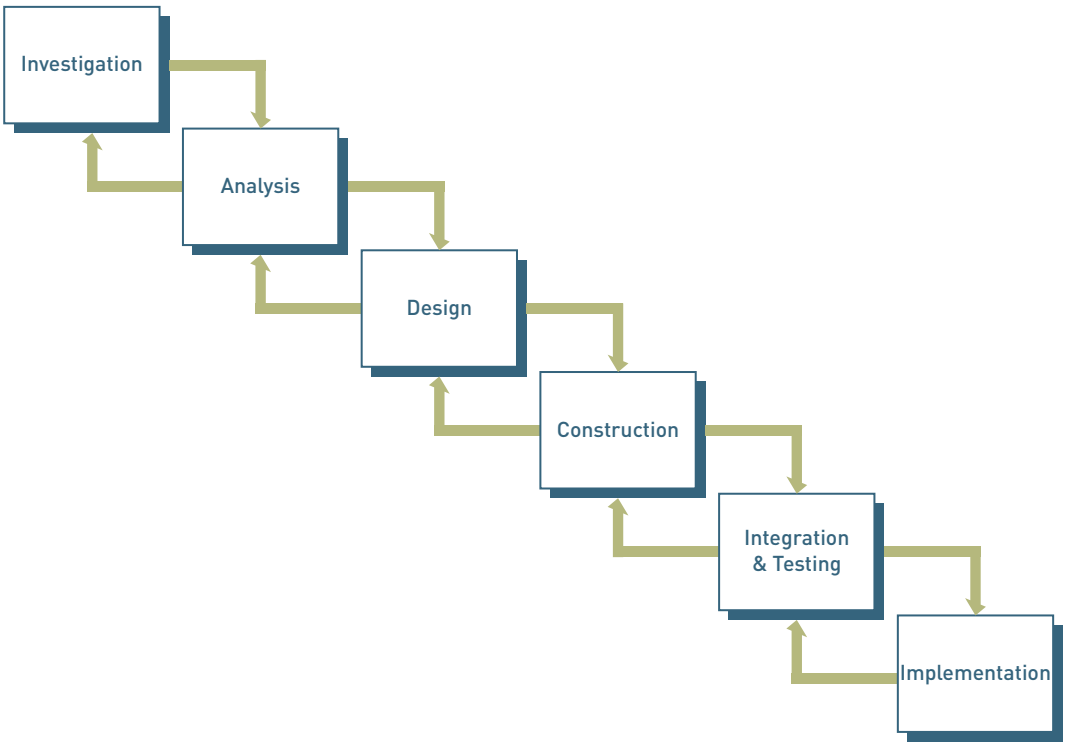

FIGURE **8.3**

Traditional systems development life cycle

The traditional systems development life cycle is also known as the "waterfall" approach.

As shown in Figure 8.3, a system under development moves from one phase of the traditional SDLC to the next. At the end of each phase, a review is conducted to ensure that all tasks and deliverables associated with that phase were produced and that they are of good quality. In addition, the overall project scope, costs, schedule, and benefits associated with the project are reviewed to ensure that the project is still attractive. As a result, the traditional SDLC allows for a high degree of management control. However, a major problem is that users do not interact with the solution until the integration and testing phase when the system is nearly complete. Table 8.1 lists additional advantages and disadvantages of the traditional SDLC.

systems investigation: The purpose of this phase of systems development is to gain a clear understanding of the specifics of the problem to be solved or the opportunity to be addressed.

The purpose of **systems investigation** is to gain a clear understanding of the specifics of the problem to be solved or the opportunity to be addressed. What is the scope of the problem? Who is affected and how? How often does this occur? After gaining a good understanding of the problem, the next question is, "Is the problem worth addressing?" Given that organizations have limited resources—people and money—this question deserves careful attention. What are the potential costs, both the one-time initial costs and recurring, ongoing costs? What risks are associated with the project? If successful, what

TABLE 8.1 Advantages and disadvantages of traditional SDLC

Advantages	Disadvantages
Formal review at the end of each phase allows maximum management control.	Users get a system that meets the needs as understood by the developers; this might not be what the users really needed.
This approach requires creation of considerable system documentation.	Documentation is expensive and time consuming to create. It is also difficult to keep current.
Formal documentation ensures that system requirements can be traced back to stated business needs.	Often, user needs go unstated or are miscommunicated or misunderstood.
Approach produces many intermediate products that can be reviewed to see whether they meet the users' needs and conform to standards.	Users can't easily review intermediate products and evaluate whether a particular product (e.g., a data-flow diagram) meets their business requirements.

benefits, both tangible (measurable) and intangible (not easily measured) will the system provide? A major step of the systems investigation phase is **feasibility analysis**, which assesses technical, economic, legal, operational, and schedule feasibility. See Figure 8.4. At this stage in the systems development process, the feasibility analysis is preliminary and will be repeated with more accuracy during the analysis and design phases when more details about the system and its requirements are known.

feasibility analysis: Assessment of the technical, economic, legal, operational, and schedule feasibility of a project.

FIGURE **8.4**

Feasibility analysis

The feasibility analysis examines the technical, economic, legal, operational, and schedule feasibility of a proposed system

After a project has completed the investigation phase and been approved for further study, the next step is to answer the question, "What must the information system do to solve the problem?" The overall emphasis of **systems analysis** is gathering data on the existing system, determining the requirements for the new system, considering alternatives within identified constraints, and investigating the feasibility of alternative solutions. The primary outcome of systems analysis is a prioritized list of systems requirements and a recommendation of how to proceed with the project.

systems analysis: This phase of systems development involves gathering data on the existing system, determining the requirements for the new system, considering alternatives within identified constraints, and investigating the feasibility of alternative solutions.

The purpose of systems design is to answer the question, "How will the information system solve this problem?" The primary result of the systems design phase is a technical design that details system outputs, inputs, controls,

INFORMATION SYSTEMS @ WORK

Queensland Health Payroll Debacle

On August 7, 2013, Queensland, the second largest state in Australia, banned IS giant IBM from entering into any new contracts with the state government. The government claims that IBM rolled out a flawed payroll system for Queensland's healthcare system that resulted in thousands of payroll errors over a period of months. Scrambling to fix the problem, Queensland Health eventually set up a system of work processes that requires over 1,000 employees to process data. The Queensland government estimates that this new system will cost the government $1.2 billion AUD (approximately $1.12 billion USD) to implement over the next eight years.

Queensland's problems, however, did not begin with IBM. In 2003, the government established its Shared Services Initiative to coordinate and improve the efficiency of information services across its many departments and agencies. The government turned to a company called CorpTech to deliver human resource and payroll services. CorpTech, however, made little progress. It employed a wide range of contractors, and only one company, Logistica, succeeded in deploying financial services to 12 agencies and payroll services to one department, Housing. As a result, the government decided to award a contract to one prime contractor who would oversee the entire Shared Services Initiative. By the time IBM won the contract in 2007, the development of a new Health payroll system had become an urgent priority. The company maintaining its legacy system, LATTICE, stated that it would no longer service or update the system after June 30, 2008. By October 2008, according a Queensland inquiry, IBM had not achieved any of its Shared Service goals. Having been paid about $32 million of its $98 million contract, the company forecasted that the true cost to achieve the goals of the contract would run up to $181 million (approximately $170 million USD). The government decided to abandon its Shared Service goals and focus only on building a new payroll system for Queensland Health.

What went wrong? The Queensland Health Payroll System Commission of Inquiry issued a 264-page report outlining the missteps in what it deemed to be one of the worst public administration failures in Australia. The first problem arose in defining the scope of the project. The Queensland government admitted that Queensland Health did not adequately communicate the business requirements for the new system. While IBM was documenting system requirements, the government pressured IBM to begin designing and developing the system. IBM issued a notice in its statement of work that the scope of the project would likely need to be redefined during development. Queensland also involved a large and ever-changing number of parties and individuals in the governance and oversight of the project. A formal report based on the Queensland inquiry noted "an unhealthy willingness to establish bureaucratic bodies to govern the Project" with no clear governance processes. Meanwhile, the miscommunication over business requirements led to a staggering 220 change orders to the original contract and a delay that meant that the system took three times longer to develop than anticipated. Finally, the new system was ready to be tested. User acceptance testing (UAT) found thousands of defects, and the UAT director warned Queensland not to go live with the program. The state ignored his advice and implemented the program in 2010. As the debacle came to public attention, the parties opted to execute manual "workarounds" to improve the system. The problem, however, was that not all the defects in the program had been identified.

In attempting to remedy the errors, Queensland insisted that IBM fix "the bugs" in the program. IBM responded that the program contained no "programming" errors and as such, IBM was not responsible for its failure. In November 2011, TechCorp assumed responsibility for the project, now called the "Payroll Stabilization Project." Queensland hired additional employees to support the new payroll system. Since the stabilization project began, the payroll staff has increased from 650 to 1,010.

In response to Queensland's actions, an IBM spokesperson said, "As the prime contractor on a complex project, IBM must accept some responsibility for the issues experienced when the system went live in 2010. However, as acknowledged by the Commission's report, the successful delivery of the project was rendered near impossible by the State failing to properly articulate its requirements or commit to a fixed scope. IBM operated in a complex governance structure to deliver a technically sound system. When the system went live it was hindered primarily through business process and data migration issues outside of IBM's contractual, and practical, control."

Queensland took the issue of blame to court in December 2013, hoping to place some of the cost for the system's failures upon IBM. The suit, however, may well be settled out of court as both parties find some means of compromising.

Discussion Questions

1. Only four companies applied for the Queensland Health payroll project and one withdrew during the bidding process. What management practices in the Queensland government should have raised red flags for IBM both before and after it accepted the contract?
2. Which party bears more responsibility for the failure of the IS project? Why?

Critical Thinking Questions

1. Identify the mistakes made at each stage of the software development process.
2. What could IBM have done to prevent the release of its defective payroll system?

SOURCES: Chesterman, The Honourable Richard N., "Queensland Health Payroll System Commission of Inquiry," The Government of Queensland Web site, July 31, 2013, *www.healthpayrollinquiry.qld.gov.au/__data/assets/pdf_file/0014/207203/Queensland-Health-Payroll-System-Commission-of-Inquiry-Report-31-July-2013.pdf*; Sharwood, Simon, "Australian State to Sue IBM over $AUD1bn Project Blowout," *The Register*, December 6, 2013, *www.theregister.co.uk/2013/12/06/australian_state_to_sue_ibm_over_aud1bn_project_blowout/*; Charette, Robert N., "Queensland Government Bans IBM from IT Contracts," *IEEE Spectrum*, August 7, 2013, *http://spectrum.ieee.org/riskfactor/computing/it/queensland-government-bans-ibm-from-it-contracts*.

systems design: The stage of systems development that creates a complete set of technical specifications that can be used to construct the information system.

system construction: The phase of systems development that converts the system design into an operational system by acquiring and installing hardware and software, coding and testing software programs, creating and loading data into databases, and performing initial program testing.

integration testing: Testing that involves linking all of the individual components together and testing them as a group to uncover any defects between individual components.

systems implementation: Involves successfully introducing an information system into an organization.

and user interfaces; specifies hardware, software, databases, telecommunications, personnel, and procedures; and shows how these components are interrelated. In other words, **systems design** creates a complete set of technical specifications that can be used to construct the information system. The scope and the user and business requirements are frozen at the end of the design phase of the traditional systems development life cycle. Any potential changes that are identified or suggested after this point must be approved by a formal scope change process before any work on them can begin.

System construction converts the system design into an operational system by acquiring and installing hardware and software, coding and testing software programs, creating and loading data into databases, and performing initial program testing.

Integration testing (sometimes called integration and testing, I & T) involves linking all of the individual components together and testing them as a group to uncover any defects in the interface between one component and other components (e.g., component 1 fails to pass a key parameter to component 2). Even if unit testing completes successfully, developers cannot assume they can combine individual components into a working system without any problems. Unfortunately, one component that functions incorrectly can affect another component and, if these problems go undetected, can cause serious trouble later. Once integration testing has been successfully completed, additional tests as outlined in Table 8.2 are performed before the system can be put into production.

System implementation involves successfully introducing an information system into an organization. It requires a mix of good organizational change skills and technical skills. Indeed, as discussed in Chapter 1, the major challenges to successful implementation of an information system are often more behavioral than technical. Strong, effective leadership is required to overcome the behavioral resistance to change and achieve a smooth and successful system introduction. Chapter 1 also introduced several change management models that can prove useful in user preparation including the Lewin and Schein three-stage approach for change of ceasing old habits and creating a climate that is receptive to change; Leavitt's diamond that proposes that every organizational system is made up of people, tasks, structure, and technology with an interaction among the four components so that any change in one of these elements will necessitate a change in the other three elements; the technology acceptance model (TAM) that specifies the factors that can lead to better attitudes about the use of a new information system, along with its higher acceptance and usage; and the diffusion of innovation theory explains that adoption

ETHICAL & SOCIETAL ISSUES

Raspberry Pi and Building a Programming Society

In this chapter, you read about computer programming as a professional activity. The great majority of the programs you use or interact with every day are produced by professional programmers. Your computer's operating system, the word processor you use to write term papers, the spreadsheet program you use to track your expenses, and the browser you use to surf the Web—all of these were written by pros.

What, however, would be the impact on society if everyone could develop his or her own apps? What if children were taught to program? Would it help their creativity, their career prospects, or anything else? Professor John Naughton teaches public understanding of technology at the U.K.'s Open University. He writes, "Starting in primary school, children from all backgrounds and every part of the United Kingdom should have the opportunity to learn some of the key ideas of computer science, understand computational thinking, learn to program, and have the opportunity to progress to the next level of excellence in these activities." He concludes, "If we don't act now, we will be short-changing our children.… They will grow up as passive consumers of closed devices and services, leading lives that are increasingly circumscribed by technologies created by elites working for huge corporations such as Google, Facebook, and the like. We will, in effect, be breeding generations of hamsters for the glittering wheels of cages built by Mark Zuckerberg and his kind." Is Professor Naughton right, or would computing become just another topic to stuff into school curricula, already overloaded with too much content and suffering from insufficient budgets?

While there may not yet be definitive answers to these questions, efforts to find those answers are under way. Many people and organizations are devoted to the cause of teaching children to program in the belief that children and society overall will benefit.

Being able to program requires a computer. Not all schools have enough computers for students in a classroom, let alone to ensure that children have them for homework. The Raspberry Pi project can provide a $35 credit-card sized computer to anyone who wants one. The project's single-board computer runs a Linux operating system and connects to a TV set as a display and to any keyboard. Storage comes in the form of inexpensive SD cards, which are used in most digital cameras. The SD cards that serious photographers discard as too small and outdated are more than sufficient.

The next requirement is for software. Programming needs a programming language. While children could in principle be taught a professional language such as C++, they need to devote many hours of study before they can create an interesting program. This makes learning a professional programming language unsuited to all but the most highly motivated students. Instead, educators have designed languages such as Logo (the first such language), Simple, Kodu, and Scratch for this purpose. A pro wouldn't use these languages to code a word processor or a CRM application, but children can use them to quickly develop simple games and animations. The languages teach, without the pupils realizing what's happening, the mental discipline of breaking a process down into logical components, planning the sequence of operations, and figuring out what data the program needs to accomplish its purpose.

Web sites such as CNET.com now abound with projects that school children can complete with Rasberry Pi computers and educational programming languages. Students can program these microcomputers to serve as arcade game machines, Web servers, or wearable computer sunglasses. Even if the project does not produce a generation of Mark Zuckerbergs, it has certainly sparked the imaginations of many.

Discussion Questions

1. Software companies are continually improving programming languages. Would learning a programming language in grade school provide you with skills that you would need more than a decade later when you enter the workforce? Why or why not?
2. Suppose a large school district decides to add programming to its elementary school curriculum. Few teachers can program. How could a school district deal with that problem? Would school districts with more money fare better with these projects than school districts with fewer financial resources?

Critical Thinking Questions

1. What type of computer and media skills and ethics should be taught in schools?
2. Do you agree with John Naughton that tomorrow's educated person will know how to program a computer?

SOURCES: Turtle Logo Web site, Codeplex, *logo.codeplex.com*, accessed July 23, 2014; Scratch Web site, Massachusetts Institute of Technology, *scratch.mit.edu*, accessed July 23, 2014; Kodu, Microsoft Research, *www.kodugamelab.com/*, accessed July 23, 2014; Naughton, J., "Why All Our Kids Should Be Taught How to Code," The Guardian, *www.guardian.co.uk/education/2012/mar/31/why-kids-should-be-taught-code*, March 31, 2012; Raspberry Pi Web site, *www.raspberrypi.org*, accessed July 23, 2014; Simple Web site, *www.simplecodeworks.com/website.html*, accessed July 23, 2014; Watters, A., "5 Tools to Introduce Programming to Kids," MindShift (blog), KQED, *blogs.kqed.org/mindshift/2011/05/5-tools-to-introduce-programming-to-kids*, May 16, 2011; Wayner, P., "Programming for Children, Minus Cryptic Syntax," *The New York Times*, *www.nytimes.com/2011/11/10/technology/personaltech/computer-programming-for-children-minus-cryptic-syntax.html*, November 9, 2011; Obscura, Audrey, Raspberry Pi Projects, Instructables Web site, June 20, 2014, *www.instructables.com/id/Raspberry-Pi-Projects/*.

TABLE 8.2 Summary of the various tests conducted on an information system

Form of Test	What Is Tested	Purpose of Test	Who Does It
User Acceptance	Test the complete, integrated system (hardware, software, databases, people, and procedures).	Verify the information system can complete required tasks in a real-world operating environment and do this according to the system design specifications.	Trained users of the system
Volume	Evaluate the performance of the information system under realistic and varying work volume and operating conditions.	Determine the work load at which systems performance begins to degrade and identify and eliminate any issues that prevent the system from reaching its required service-level performance.	System development team and members of the operations organization
System	Test the complete, integrated system (hardware, software, databases, people, and procedures).	Validate that the information system meets all specified requirements.	Independent test team separate from the software development team
Integration	Test all of the individual units of the information system linked together.	Uncover any defects between individual components of the information system.	Software developers or independent software testers using black box testing measures

of any innovation does not happen all at once for all members of the targeted population; rather, it is a drawn-out process with some people quicker to adopt the innovation than others.

Hershey's, the largest chocolate manufacturer in North America, provides a classic example of a failed system implementation. The firm planned to upgrade a hodge-podge of legacy information systems into an integrated environment of the latest software from leading vendors including SAP for ERP functionality, Manugistics for supply chain management, and Siebel for customer relationship management. The cutover was targeted for July, one of the company's busiest months when it was shipping orders for Halloween and Christmas. Unfortunately, Hershey's was not well prepared and the cutover was a fiasco. As a result, Hershey was unable to process over $100 million worth of orders. The resulting operational paralysis led to nearly a 20 percent drop in quarterly profits and an 8 percent decline in share price.[8]

systems operation: Use of a new or modified system under all kinds of operating conditions.

Systems operation and maintenance involves using the new or modified system under all kinds of operating conditions. Getting the most out of a new or modified system during its operation is the most important aspect of systems operations for many organizations. To provide adequate user support, many companies establish a formal help desk for their employees and customers. A *help desk* consists of computer systems, manuals, people with technical expertise, and other resources needed to solve problems and give accurate answers to questions. If you are having trouble accessing or using one of your organization's information systems, you can call the help desk for support.

systems maintenance: A stage of systems development that involves changing and enhancing the system to make it more useful in achieving user and organizational goals.

Systems maintenance involves changing and enhancing the system to make it more useful in achieving user and organizational goals or to enable it to take advantage of advances in technology.

The maintenance process can be especially difficult for older software. A *legacy system* is an old system that might have cost millions of dollars to develop and patch or modify repeatedly over the years. The maintenance costs for legacy systems can become quite expensive and, at some point, it becomes more cost effective to switch to new programs and applications than to repair and maintain the legacy system.

Royal Bank of Scotland (RBS) and National Westminster Bank (NatWest) are two of the United Kingdom's largest and most established banks. However, customers of these banks have been blocked from using ATMs or debit cards due to problems with legacy banking systems. Some of their systems are over 30 years old and were originally designed to handle simple branch banking. Over the years, the banks have had to make changes to support ATMs, online banking, and mobile banking as well as changes to accommodate new regulatory requirements. These changes were implemented using different programming languages running on different computers and operating systems by different development teams. It is impossible for one person or team to fully comprehend the entire system.[9] The banks recently announced that they will be spending £1 billion (approximately $1.7 billion) to improve their personal and small business banking services to make it easier for customers on the move.[10]

At some point, an existing information system may become obsolete, uneconomical to operate and/or maintain, or unrepairable. Information systems typically evolve to this stage in the life cycle because the system can no longer be modified to keep up with changing user and business requirements, outdated technology causes the system to run slowly or unreliably, or vendors are no longer able or willing to continue to provide necessary service or support. **System disposal** involves those activities that ensure the orderly dissolution of the system including closing out contracts, and safely migrating information from the system to another system or archiving it in accordance with applicable records management policies, and disposing of all equipment in an environmentally friendly manner.

system disposal: Those activities that ensure the orderly dissolution of the system including those activities required to closeout any contracts in place, dispose of all equipment in an environmentally friendly manner, and to safely migrate information from the system to another system or archive it in accordance to applicable records management policies.

Governments, environmental agencies, and leading hardware manufacturers are making an attempt to cut back on the use of hazardous materials in electronic products. However, some hardware components still contain materials that are toxic to the environment. Responsible disposal techniques should be used regardless of whether the hardware is sold, given away, or discarded. As mentioned in Chapter 2, many computer hardware manufacturers including Dell and HP have developed programs to assist their customers in disposing of old equipment.

Useful Software Development Techniques

A number of powerful software development techniques are frequently used by software development teams. These include Joint Application Development (JAD), functional decomposition, data flow diagrams, and request for proposal. These techniques are covered in the following sections.

Joint Application Development (JAD)

joint application development (JAD): A structured meeting process that can accelerate and improve the efficiency and effectiveness of the investigation, analysis, and design phases of a systems development project.

Joint application development (JAD) is a structured meeting process that can accelerate and improve the efficiency and effectiveness of not only the investigation phase, but also the analysis and design phases of a systems development project. JAD involves carefully planned and designed meetings in which users, stakeholders, and IS professionals work together to analyze existing systems, define problems, identify solution requirements, and propose and evaluate possible solutions including costs and benefits. See Figure 8.5. The JAD process has proven to be extremely effective and efficient at accomplishing these tasks. In addition, the highly participative nature of the sessions goes a long way to helping ensure stakeholders and users buy into the results. With today's technology such as group decision support systems and video conferencing, it is possible to conduct effective live JAD sessions with people located in many different places without the need for expensive travel.[11]

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FIGURE **8.5**

JAD session

JAD can accelerate and improve the efficiency and effectiveness of the investigation, analysis, and design phases of a systems development project.

The success or failure of a JAD session depends on how well the JAD facilitator plans and manages the session. It is not unusual for the facilitator to spend three hours planning and preparing for each hour the JAD session lasts. In addition, the participants of a JAD session must be carefully chosen to include users of the system as well as people from other organizations

who will likely be affected by, provide input for, or receive output from the system. Ideally, people from the operational level as well as the executive level will attend. Table 8.3 identifies the JAD session participants as well as their role and qualifications.[12]

TABLE 8.3 JAD participants and their role

Role	Responsibilities	Qualifications
Facilitator	• Determines JAD session objectives • Plans JAD session to meet objectives • Leads JAD session • Encourages everyone to participate	• Excellent meeting facilitator • Unbiased and does not take sides
Decision makers	• Resolve conflicts • Avoid gridlock	• Stakeholders selected by project sponsor to make decisions • Have the authority and willingness to make decisions
Users	• Describe business as it is and as it should be • Provide business expertise • Define problems, identify potential benefits, analyze existing system, define requirements of a new system, and propose and evaluate possible solutions	• Represent all major areas affected • Expert in their area of the business
System developers	• Observe carefully • Offer technical opinion on cost or feasibility, if requested • Gain deep understanding of customers' needs and desires	• Member of system development team
Scribe	• Participate in discussion to clarify points and capture them accurately • Document key points, issues, next steps, and decisions throughout the JAD session • Publish results of JAD session and solicit feedback	• Excellent listening skills • Experience in using software engineering tools to document requirements and create system models

The consulting firm Liquid Mercury Solutions uses JAD in working with its clients to develop information system solutions.[13] The firm used JAD in working with the USDA Biotechnology Regulatory Services branch to streamline work processes and implement systems to eliminate a large backlog of petitions to deregulate various genetically engineered organisms.[14]

Functional Decomposition

functional decomposition: A technique used during the investigation, analysis, and design phases to define the business processes included within the scope of the system.

Functional decomposition is a technique used primarily during the investigation phase to define the business processes included within the scope of the system. Recall from Chapter 1 that a process is a set of logically related tasks performed to achieve a defined outcome. A process is usually initiated in response to a specific event and requires input, which it processes to create output. Often feedback is generated that is used to monitor and refine the process.

To create the functional decomposition chart (see Figure 8.6), begin with the name of the system, and then identify the highest-level processes to be performed. Each process should be given a two word "verb-subject" name that clearly defines the process. Next, break those high-level processes down into lower-level subprocesses. For the systems investigation phase, three or four levels of decomposition are usually sufficient to define the scope of the system.

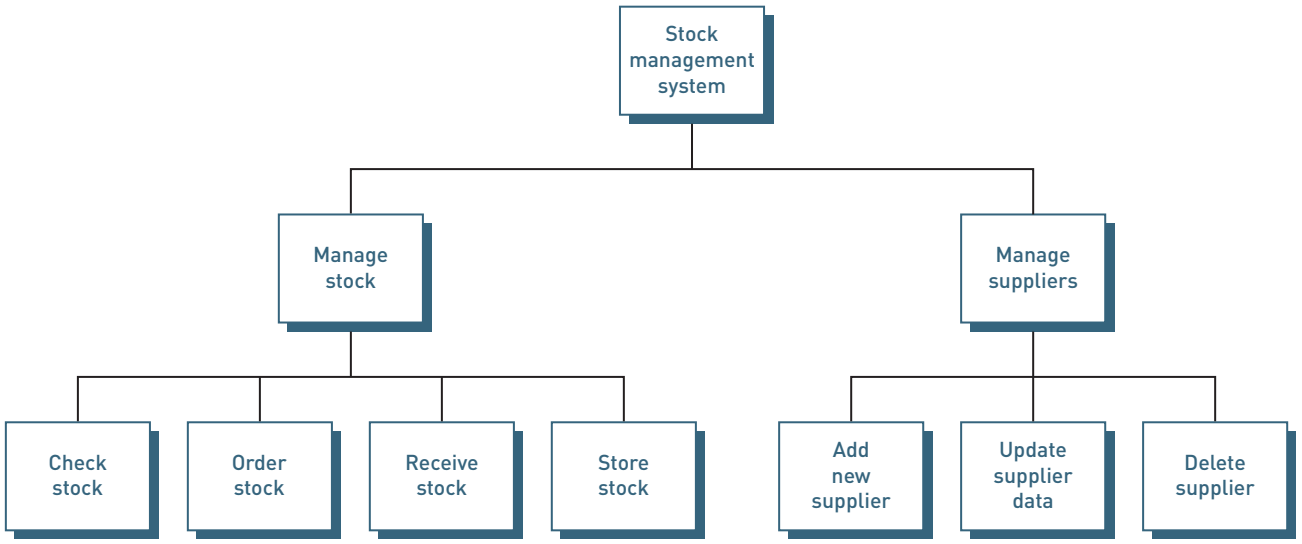

FIGURE 8.6

Functional decomposition chart

Functional decomposition is used to define the scope of the system.

Data Flow Diagram

data-flow diagram (DFD): A diagram used during both the analysis and design phases to document the processes of the current system or to provide a model of a proposed new system.

A **data flow diagram (DFD)** is a diagram used during both the analysis and design phases to document the processes of the current system or to provide a model of a proposed new system. It shows not only the various processes within the system but also where the data needed for each process comes from, where the output of each process will be sent, and what data will be stored and where. The DFD does not provide any information about the process timing (e.g., whether the various processes happen in sequence or in parallel).

DFDs are easy to develop and easily understood by nontechnical people. Data-flow diagrams use four primary symbols, as shown in Figure 8.7:

data-flow line: A line that includes arrows showing the direction of data movement.

process symbol: A symbol that identifies the function being performed.

entity symbol: A symbol that shows either the source or destination of the data.

data store: A symbol that reveals a storage location for data.

1. The **data-flow line** includes arrows that show the direction of data movement
2. The **process symbol** identifies the function being performed (e.g., Check Status, Issue Status Message)
3. The **entity symbol** shows either the source or destination of the data (e.g., Customer, Warehouse)
4. A **data store** symbol reveals a storage location for data (e.g., Pending Orders, Accounts Receivable).

Figure 8.7 shows a level 1 DFD. Each of the processes shown in this diagram could be documented in more detail to show the subprocesses and create a level 2 DFD. Frequently, level 3 DFD diagrams are created and used in the analysis and design phases.

Request for Proposal

Today, most organizations purchase or rent the software they need rather than make it—simply because it costs too much and takes too long to build a quality information system. Organizations elect to build proprietary systems only in rare situations where its information system requirements are truly unique. This may be due to the nature of the business or because the organization is attempting to build an information system that will provide it with a strategic competitive advantage.

A software application can vary from being a totally unmodified, commercial off-the-shelf (COTS) software package at one extreme to being a completely custom, written-from-scratch program at the other extreme. See Figure 8.8.

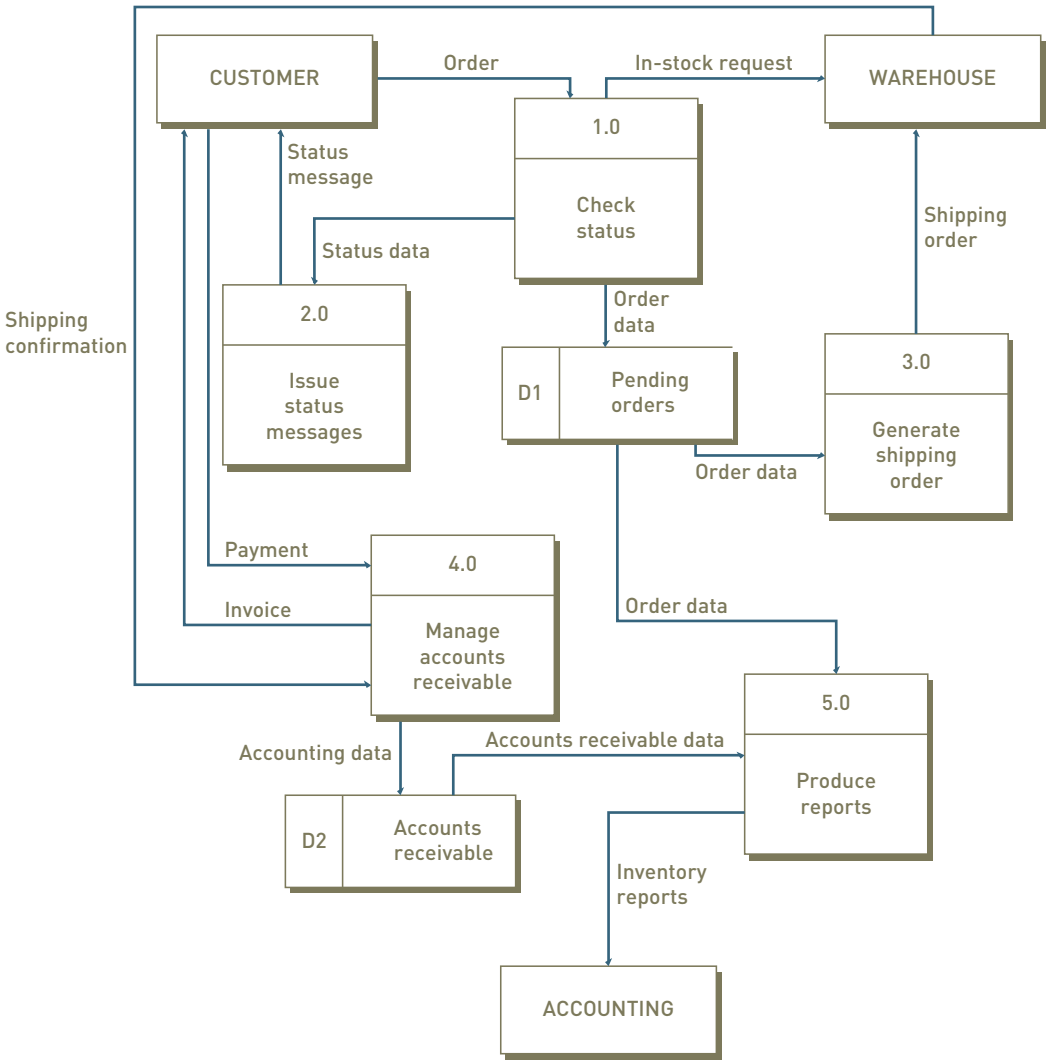

FIGURE **8.7**

Data flow diagram

A data flow diagram documents the processes of the current system or provides a model of a proposed new system.

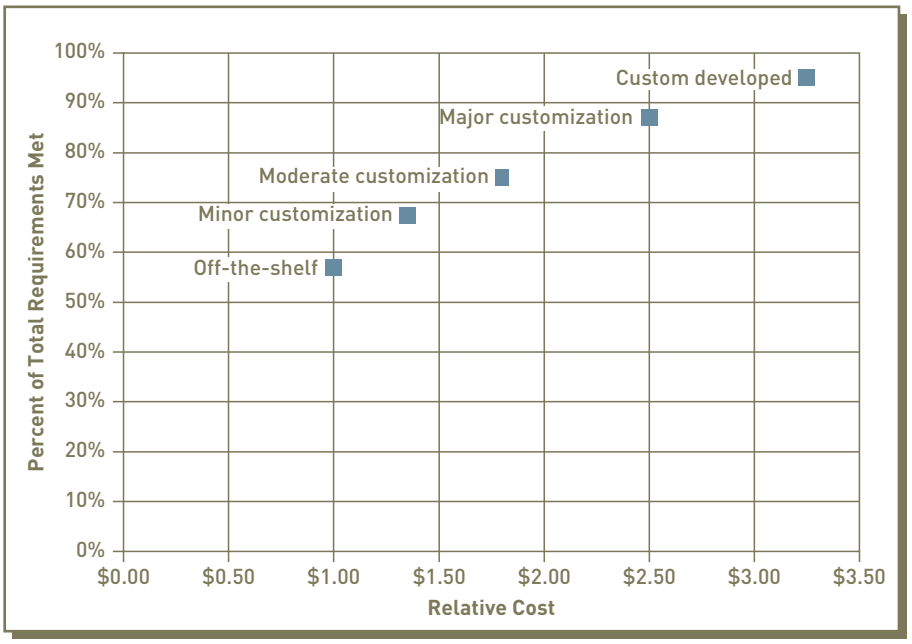

FIGURE **8.8**

Relative cost of custom software

The greater the amount of customization in software, the greater is the cost to implement.

make-versus-buy decision: The decision regarding whether to obtain the necessary software from internal or external sources.

In between those two extremes is a range of options based on the degree of customization. The greater the amount of customization, the greater is the cost to implement. A comparison of the two extreme approaches is shown in Table 8.4. One question to be answered during systems analysis is: which solution approach is best for this particular system? This decision is often called the **make-versus-buy decision**.

TABLE 8.4 Comparison of off-the-shelf and developed software

Factor	Develop (Make)	Off-the-Shelf (Buy)
Cost	The cost to build the system can be difficult to estimate accurately and is frequently higher than off-the-shelf	The true cost to implement an off-the-shelf solution is also difficult to estimate accurately but is likely to be less than a custom software solution
Needs	Custom software is more likely to satisfy your needs	Might not get exactly what you need
Process improvement	Tend to automate existing business processes even if they are poor	Adoption of a package may simplify or streamline a poor existing business process
Quality	Quality can vary depending on the development team	Can assess the quality before buying
Speed	Can take years to develop	Can acquire it now
Staffing and support	Requires in-house skilled resources to build and support a custom built solution	Requires paying the vendor for support
Competitive advantage	Can develop a competitive advantage with good software	Other organizations can have the same software and same advantage

request for proposal (RFP): A formal document that outlines an organization's hardware or software needs and requests vendors to develop a detailed proposal of how they would meet those needs and at what cost.

The analysis team should assess the software marketplace to determine if pre-existing packages can meet the organization's needs. The primary tool for doing this is the **request for proposal (RFP)**, a formal document that outlines an organization's hardware or software needs and requests vendors to develop a detailed proposal of how they would meet those needs and at what cost. See Figure 8.9. The RFP outlines the desired system and its

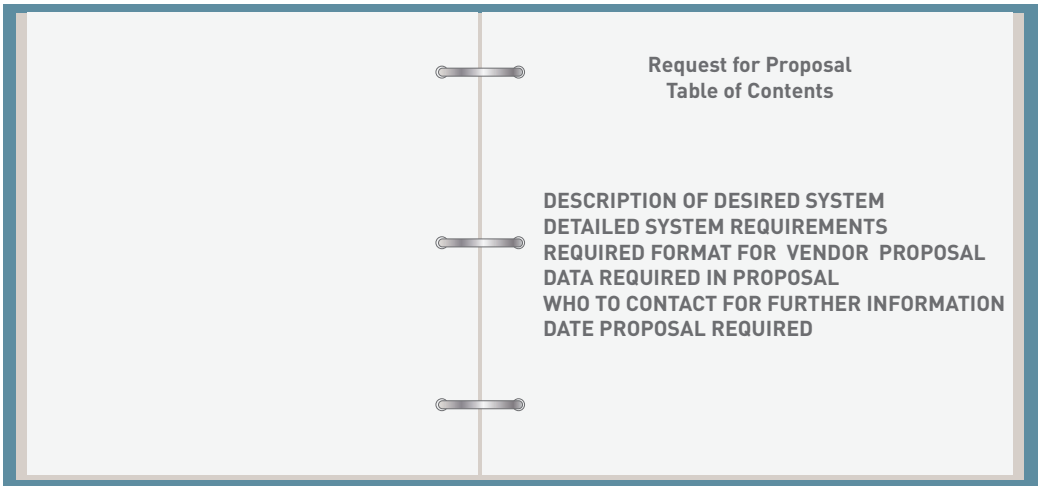

FIGURE 8.9

Recommended table of contents for a request for proposal

The RFP outlines the desired system and its requirements, and identifies the pieces of data that the software vendor must include in the proposal.

requirements. It also identifies the pieces of data that the software vendor must include in the proposal. Insisting that all vendors provide the same data in a consistent manner will greatly reduce the time and effort to compare vendor proposals. This document is sent to vendors who are capable of providing the desire software.

Before sending out the RFP, the team should seek input from the organization's purchasing and legal departments as to whether any vendor under consideration should be excluded because of their financial standing, credit worthiness, reputation within the software industry, or involvement in disputes with customers or governments.

The systems analysis team will evaluate the vendor proposals and narrow their choice to the most promising two or three solutions as alternatives for further evaluation. Often this may require a visit to the vendor's place of business to meet managers and observe a demo of the vendor's system.

Alternative system development approaches are discussed next, including Agile, prototype, object oriented, mobile application development, and user system development.

ALTERNATE SYSTEMS DEVELOPMENT LIFE CYCLES AND APPROACHES

Now that we have covered all the phases of the traditional systems development life cycle, we will discuss alternate system development life cycles including prototyping, agile, object oriented, mobile, and end-user development.

Prototyping

prototype: A working model of a system developed to enable users to interact with the system and provide feedback so developers can better understand what is needed.

prototyping: An iterative software development approach based on the use of software prototypes.

throw-away prototype: A prototype that is used to help define the software solution but does not become part of the final solution.

working prototype: A prototype that starts with an initial prototype that undergoes a series of iterations of demo, feedback, and refinement and eventually evolves into the final software solution.

Rational Unified Process (RUP): An iterative systems development approach that was developed by IBM and includes a number of tools and techniques that are typically tailored to fit the needs of a specific company or organization.

agile development: An iterative system development process that develops the system in "sprint" increments lasting from two weeks to two months.

A software **prototype** is a working model of a system developed to enable users to interact with it and provide feedback so developers can better understand what is needed. Building and using a prototype enables developers and users to test concepts and evaluate alternatives before expending a major effort to implement the system. Prototypes can be classified as throw-away prototypes or working prototypes.[15]

Prototyping is an iterative software development approach based on the use of software prototypes as shown in Figure 8.10. The advantages and disadvantages of prototyping are summarized in Table 8.5.[16]

A **throw-away prototype** is one that is used to help define the software solution but does not become part of the final solution. Throw-away prototypes provide a highly effective way for developers to demonstrate their understanding of how the system should work to the client or users. The feedback generated during the demo identifies misunderstood or overlooked user requirements. The demo also provides the users with an opportunity to change their mind once they see the prototype system in action.[17]

A **working prototype** starts with an initial prototype that undergoes a series of iterations of demo, feedback, and refinement and eventually evolves into the final software solution. The client or users are deeply involved throughout the development process by providing continuous feedback. With each iteration, the working prototype moves further from the initial prototype and closer to a working system that meets the needs of its users.

The **Rational Unified Process (RUP)** is an iterative systems development approach developed by IBM and includes a number of tools and techniques that are typically tailored to fit the needs of a specific company or organization. RUP stresses quality as the software is changed and updated over time. Many companies have used RUP to their advantage.[18]

Agile Development

Agile development is an iterative system development process that develops the system in "sprint" increments lasting from two weeks to two months.

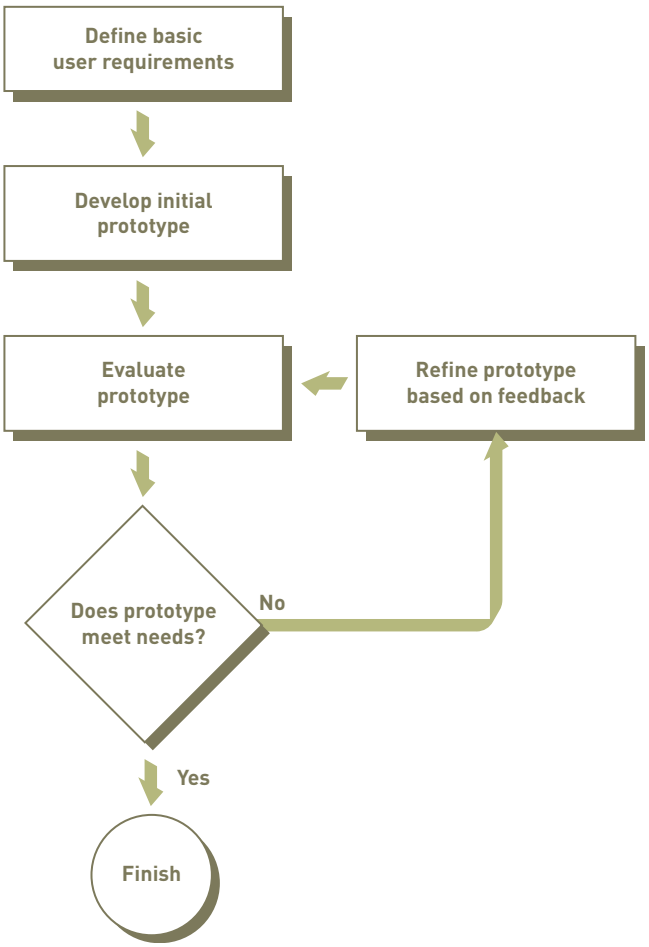

FIGURE **8.10**

Prototyping

Prototyping is an iterative approach to systems development. Each generation of prototype is a refinement of the previous generation based on user feedback.

TABLE 8.5 Advantages and disadvantages of prototyping

Advantages	Disadvantages
Users can try the system and provide constructive feedback during development.	Each iteration builds on the previous one. The final solution might be only incrementally better than the initial solution.
A throw-away prototype can be produced in days.	Formal end-of-phase reviews might not occur. Thus, it is very difficult to contain the scope of the prototype, and the project never seems to end.
As solutions emerge, users become more positive about the process and the results.	System documentation is often absent or incomplete because the primary focus is on development of the prototype.
Prototyping enables early detection of errors and omissions.	System backup and recovery, performance, and security issues can be overlooked in the haste to develop a prototype.

scrum: A method employed to keep the agile system development effort focused and moving quickly.

scrum master: The person who coordinates all scrum activities.

Unlike the traditional system development process, agile development accepts the fact that system requirements are evolving and cannot be fully understood or defined at the start of the project. Agile development concentrates instead on maximizing the team's ability to deliver quickly and respond to emerging requirements—hence the name agile. When a team stops and re-evaluates the system every two weeks to two months, it has ample opportunity to identify and implement new or changed system requirements.[19]

Scrum is a method employed to keep the agile system development effort focused and moving quickly. A **scrum master** is the person who coordinates all scrum activities, and a scrum team consists of a dozen or fewer people

who perform all systems development activities from investigation to testing. Thus there is less personnel turnover on a typical agile project than when using the traditional system development process. The scrum master does not fill the role of a traditional project manager and has no people management responsibilities. Instead, the primary responsibility of the scrum master is to anticipate and remove barriers to the project team producing its deliverables and meeting the project schedule.[20]

product owner: A person who represents the project stakeholders and is responsible for communicating and aligning project priorities between the stakeholders and development team.

The **product owner** is a person who represents the project stakeholders and is responsible for communicating and aligning project priorities between the stakeholders and development team.

Using the scrum method, the product owner works with the stakeholders and team to create a prioritized list of system requirements called a product backlog. Next, a sprint planning session is held during which the team selects the highest priority requirements from the top of the product backlog to create the sprint backlog and decides how to implement those requirements. The team sets a certain amount of time—typically two to eight weeks—to complete its work. During the sprint, each day at the same time, the team meets briefly (15 minutes at most) to share information necessary for coordination. At this meeting, team members describe what they completed the previous day and identify any obstacles that stand in their way of completing the day's activities. The sprint is complete when the team presents a working system that incorporates the new requirements and that can be used and evaluated. During the sprint review meeting, the team shares what it learned from the current sprint iteration so that knowledge can be applied in the next sprint iteration. See Figure 8.11. Along the way, the scrum master keeps the team focused on its goals.[21]

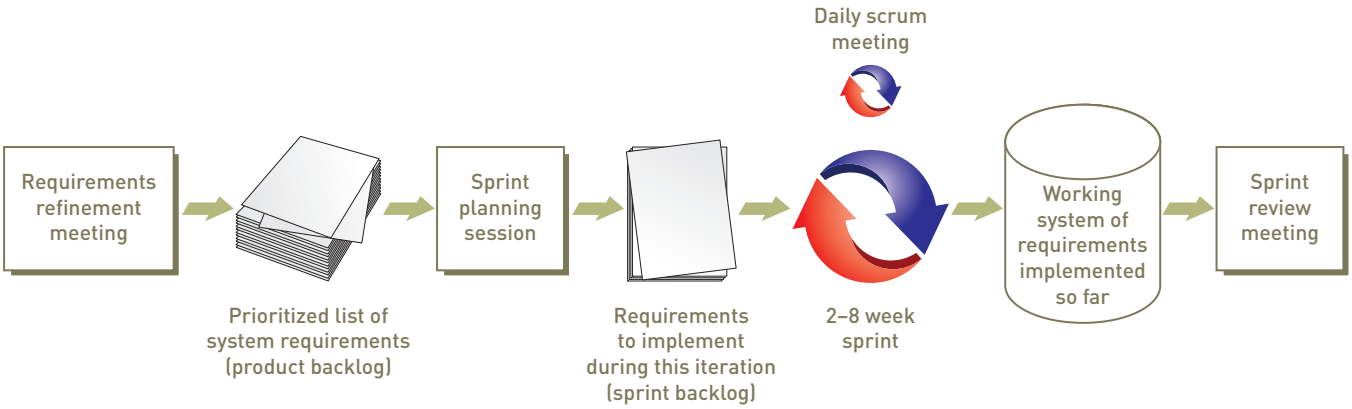

FIGURE **8.11**

Agile system development life cycle

The agile approach aims to develop a system in sprint increments lasting from two weeks to two months.

Agile development requires cooperation and frequent face-to-face meetings with all participants, including systems developers and users, as they modify, refine, and test the system's capabilities and how it meets users' needs. Organizations are using agile development to a greater extent today to improve the results of systems development, including global projects requiring IS resources distributed in many locations. Agile is better suited for developing smaller information systems than larger ones. During an agile project, the level of participation of stakeholders and users is much higher than in other approaches. Table 8.6 lists advantages and disadvantages of agile development.[22]

In 2005, British Telecom (BT) took a big risk: BT dropped its traditional systems development cycle and embraced agile development. Previously, BT had outsourced the gathering of system requirements to a third company, which would take between three and nine months to meet with customers and stakeholders and create a list. Then the project would move in house where programmers struggled to interpret the requirements and then develop

TABLE 8.6 Advantages and disadvantages of agile development

Advantages	Disadvantages
For appropriate projects, this approach puts an application into production sooner than any other approach.	This intense SDLC can burn out systems developers and other project participants.
Documentation is produced as a by-product of completing project tasks.	This approach requires systems analysts and users to be skilled in agile systems development tools and agile techniques.
Agile forces teamwork and lots of interaction between users and stakeholders.	Agile requires a larger percentage of stakeholders' and users' time than other approaches.

and test the system within 18 months—although projects sometimes fell behind. In late 2005, BT rolled out a new Web-based phone-traffic monitoring system with a 90-day development system. The monitoring system allowed traffic managers to change switches and other physical devices more quickly to handle shifts in load along BT's telecommunications network. The success of this initial project reverberated throughout the IT world, as BT became the first telecommunications giant to adopt agile development—sometimes developing products in three 30-day iterative cycles.[23]

extreme programming (XP): An approach to writing code that promotes incremental development of a system using short development cycles to improve productivity and to accommodate new customer requirements.

Extreme programming (XP) is an approach to writing code that promotes incremental development of a system using short development cycles to improve productivity and to accommodate new customer requirements. Other essentials of XP include programming in pairs, performing extensive code review, unit testing of all code, putting off the programming of system features until they are actually needed, use of a flat project management structure, simplicity and clarity in code, expecting changes in system requirements as the project progresses and the desired solution is better understood, and frequent communication with the customer and among programmers. These qualities make XP compatible with agile software development.[24]

Table 8.7 compares the main features of the agile, prototype, and traditional system development life cycles.

TABLE 8.7 Comparison of system development life cycles

Characteristic	System Development Life Cycle		
	Agile	Prototype	Traditional
Description	An iterative process that develops the system in sprint increments lasting 2–8 weeks; each increment focuses on implementing the highest priority requirements that can be completed in the allotted time	An iterative process that constructs prototypes and/or uses application frameworks	A sequential multi-stage process where work on the next stage cannot begin until the results of the previous stage are reviewed and approved or modified as necessary
Basic assumption	System requirements cannot be fully defined at start of project	System requirements cannot be fully defined at start of project	All critical system requirements can be fully defined at start of project
How requirements and design are defined	Users interacting with systems analysts and working software	Users interacting with systems analysts and prototypes	Users interacting with systems analysts and system documentation and/or models
Associated processes	Scrum	Rapid application development	Structured systems analysis and design

Object-Oriented Systems Development

As discussed in Chapter 3, an object consists of data and the actions that can be performed on the data. The object containing the data, instructions, and procedures is a programming building block. An object can relate to data on a product, an input routine, or an order-processing routine. The object-oriented (OO) approach is frequently used in the investigation, analysis, and design phases of system development.

Consider a kayak rental business in Maui, Hawaii, where the owners want to computerize their operations, including renting kayaks to customers and adding new kayaks into the rental program. See Figure 8.12. As shown in the figure, the kayak rental clerk rents kayaks to customers and adds new kayaks to the current inventory available for rent. The stick figure is an example of an *actor*, and the ovals each represent an event, called a *use case*. In this example, the actor (the kayak rental clerk) interacts with two use cases (rent kayaks to customers and add new kayaks to inventory). The use case diagram is part of the Unified Modeling Language (UML) used in object-oriented systems development.

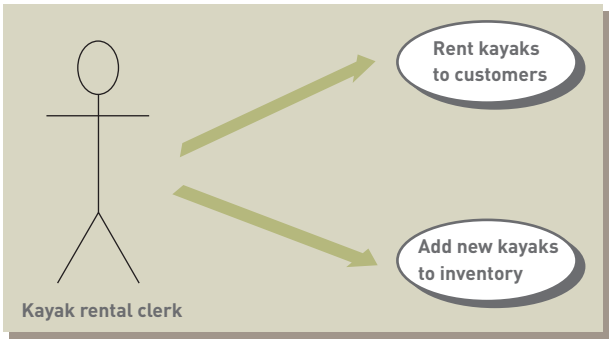

FIGURE **8.12**

Use case diagram for a kayak rental application

The kayak rental clerk is an actor that interacts with the use cases, which are the actions in the ovals.

The object-oriented approach can also be used during systems analysis. Like traditional analysis, problems or potential opportunities are examined and key participants and essential data are identified during object-oriented analysis. Instead of analyzing the existing system using data-flow diagrams, the team uses an object-oriented approach.

A more detailed analysis of the kayak rental business reveals that there are two classes of kayaks: single kayaks for one person and tandem kayaks that can accommodate two people. With the OO approach, classes are used to describe different types of objects, such as single and tandem kayaks. The classes of kayaks can be shown in a generalization/specialization hierarchy diagram as in Figure 8.13. KayakItem is an object that will store the kayak identification number (ID) and the date the kayak was purchased (datePurchased).

Of course, the system could have subclasses of customers, life vests, paddles, and other items. For example, price discounts for kayak rentals could be given to seniors and students. Thus, the Customer class could be divided into regular, senior, and student customer subclasses.

The object-oriented approach can be used during the design phase to design important objects and classes of objects in the new or updated system. This process includes considering the problem domain, the operating environment, and the user interface. The problem domain involves the classes of objects related to solving a problem or realizing an opportunity. In our example of the kayak rental shop, KayakItem in Figure 8.13 is an example of a problem domain object that will store information on kayaks in the rental program. The operating environment for the rental shop's system includes objects that interact with printers, system software, and other software and hardware

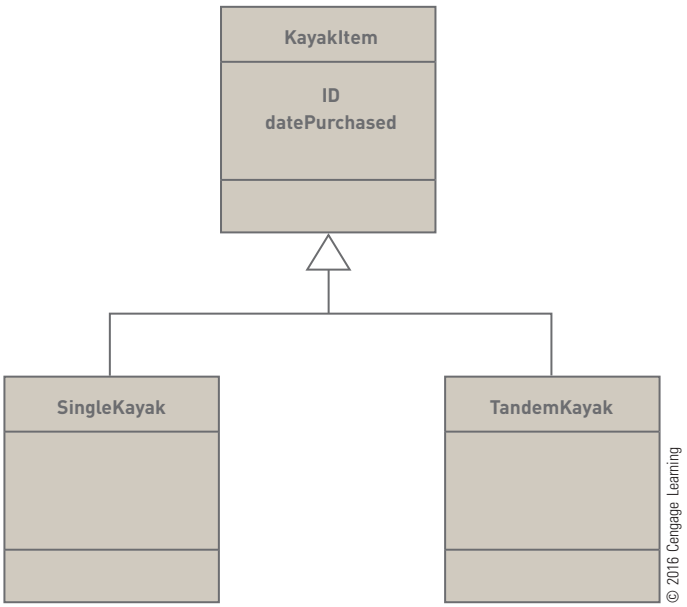

FIGURE **8.13**

Generalization/specialization hierarchy diagram

This generalization/specialization hierarchy diagram describes single and tandem kayak classes.

devices. The user interface for the system includes objects that users interact with, such as buttons and scroll bars in a Windows program.

During the design phase, you also need to consider the sequence of events that must happen for the system to function correctly. For example, you might want to design the sequence of events for adding a new kayak to the rental program. The event sequence is often called a *scenario*, and it can be diagrammed in a sequence diagram. See Figure 8.14.

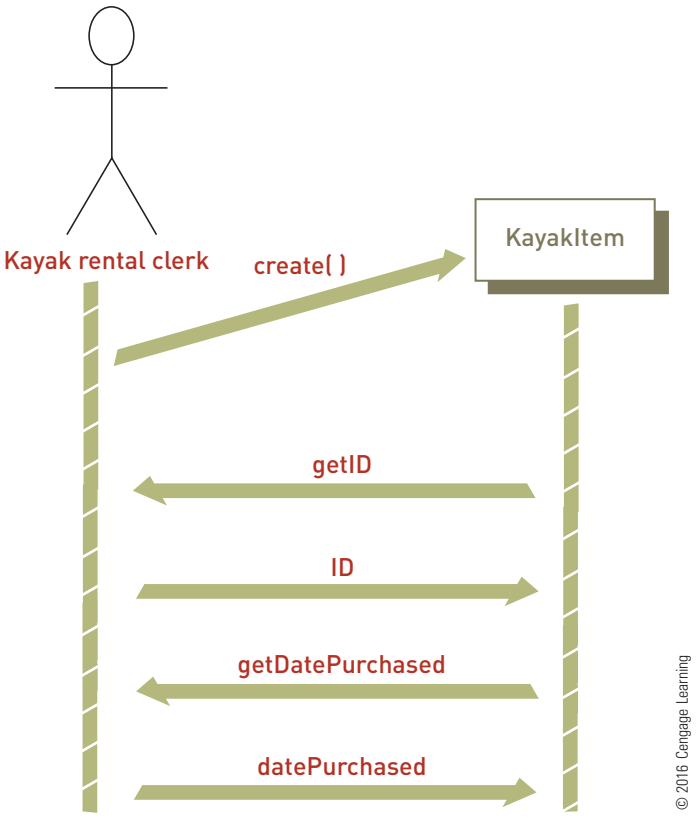

FIGURE **8.14**

Sequence diagram

This sequence diagram adds a new KayakItem scenario.

You read a sequence diagram starting at the top and moving down:

1. The Create arrow at the top is a message from the kayak rental clerk to the KayakItem object to create information on a new kayak to be placed into the rental program.
2. The KayakItem object knows that it needs the ID for the kayak and sends a message to the clerk requesting the information (see the getID arrow).
3. The clerk then types the ID into the computer. This action is shown with the ID arrow. The data is stored in the KayakItem object.
4. Next, KayakItem requests the purchase date. This is shown in the getDatePurchased arrow.
5. Finally, the clerk types the purchase date into the computer. The data is also transferred to KayakItem object, as shown in the datePurchased arrow at the bottom of Figure 8.14.

This scenario is only one example of a sequence of events. Other scenarios might include entering information about life jackets, paddles, suntan lotion, and other accessories. The same types of use case and generalization/specialization hierarchy diagrams can be created for each event, and additional sequence diagrams will also be needed.

Mobile Application Development

Today, many more organizations are developing or buying mobile applications for their managers and workers. Demand for mobile application developers is on the rise with requests moving from B2C apps to B2B apps. Ideally, these applications should work on a variety of devices, including iPhones, Android phones, BlackBerry phones, tablet computers, and other mobile devices. To create successful mobile apps, developers should consider who will use the app and what their goals are. This means developers must gain input from the users before the app is developed.[25]

While the overall approach of systems development is the same for mobile devices compared to traditional systems development projects, there are some important differences. The user interface is not the typical graphical user interface discussed in Chapter 2. Instead, most mobile devices use a touch user interface, called a *natural user interface* (*NUI*), or multitouch interface by some. The systems development teams for mobile devices are typically smaller, allowing them to be more flexible and agile. It can also be difficult to find IS personnel with the skills and experience to develop good mobile applications. Having the application communicate with the Internet or corporate computers is another issue that must be resolved. How to handle phone calls in the middle of running an application also needs to be considered.

Some systems development tools available for mobile applications are listed in Table 8.8.[26]

TABLE 8.8 Application development tools for mobile environment

Tool	Target Environment
Alpha Anywhere	iOS, Android, Windows Phone
App Press	iPhone, iPad, Android
iBuildApp	iPhone, iPad, Android
Mobile Chrome Development Kit	iOS, Android, Chrome
Salesforce1	iOS, Android
ViziApps	iOS, Android

Ethan Nicholas is legendary among independent iPhone app developers. His tank artillery game iShoot was not an immediate success, so Nicholas decided to develop a free version of the app—iShoot Lite—inside which he advertised the $3 full version of iShoot. The free version was downloaded 2.4 million times from the Apple Store in just a few weeks and led to 320,000 iShoot Lite players paying for iShoot.[27] In addition to the Apple Store, Google has the Google Play store and BlackBerry has App World. Although most people purchase individual applications from authorized Web sites, unauthorized application stores that are not supported by the smartphone or cellular company can also be used to purchase or acquire useful applications.

In addition to developing innovative applications, organizations are using innovative approaches to deliver these applications to workers and managers. Some CIOs, for example, are investigating the use of application stores to deliver corporate information and applications to workers and executives. As with users of smartphones, tablet computers, and other mobile devices, workers and executives could go to a corporate applications store and download the latest programs, decision support systems, or other work-related applications. See Figure 8.15.

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FIGURE **8.15**

Mobile application development

Some organizations are using application stores to deliver corporate information and applications to workers and executives.

User Systems Development

For decades, professional software developers have been unable to keep up with the nearly insatiable appetite of today's workers, managers, and executives for more and more information, more and more reports, and more and more analysis. Users have grown weary of lengthy software development processes that all too frequently lead to implementation of systems that cost too much yet do not meet their expectations. As a result, users are increasingly doing their own software development and are now building over 25 percent of new business applications.[28]

end-user systems development: The creation, modification, or extension of software by people who are nonprofessional software developers.

End-user systems development is the creation, modification, or extension of software by people who are nonprofessional software developers. See Figure 8.16. Creating spreadsheets by tens of millions of people worldwide is perhaps the most common example of user development. Users also work with high-level programming languages such as Cognos BI, Crystal Reports,

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FIGURE **8.16**

End-user systems development

Many users are demonstrating their systems development capability by designing and implementing their own PC-based systems.

Focus, and SaS to create reports, dashboards, and graphs. Users also work with simple scripting languages such as ASP, JavaScript, Perl, PHP, Python, Ruby, and Tcl to add functionality to Web pages. They use software such as Visual Basic for Applications to extend and add capabilities to Microsoft Office programs.[29]

Programming by example (PbE or PbD, for programming by demonstration) involves teaching an information system or a robot to perform in a certain manner by demonstrating the new behavior instead of by programming it using machine commands. The system records the user actions and infers a generalized program that can then be used with new examples. The students and professors at the MIT Media Lab (*web.media.mit.edu/~lieber/PBE/*) are experimenting with PbE languages such as Cocoa, Eager, Pygmalion, and Mondrian for potential use by systems users.[30]

User-developed systems are subject to the same reliability, performance, and quality issues as software developed by professionals. Care must be exercised to perform careful checking of user-developed software code including rigorous code review and testing.

TIPS TO AVOID PROJECT FAILURE

Successful systems development means delivering a system that meets user and organizational needs—on time and within budget. However, the number of failed and challenged projects (those that are late, over budget, or lacking required features) stands at 61 percent.[31] Another study found that half of all large information system software development projects costing more than $15 million run 66 percent over budget and disappoint their stakeholders by delivering 17 percent less value than expected.[32]

Following are the major reasons projects fail:

- Executives fail to provide leadership and direction
- Project scope is unclear
- Expectations are poorly managed
- Insufficient user involvement
- Organization is not prepared for change
- Poor planning

See Figure 8.17. These factors are discussed and summarized in Table 8.9.

FIGURE **8.17**

Project failure

Projects fail for six major reasons: lack of executive leadership, unclear project scope, stakeholder expectations poorly managed, insufficient user involvement, lack of organizational preparation, and poor planning.

TABLE 8.9 Factors in project failure

Factors	Potential Reason(s)	Countermeasures
Business executives fail to provide leadership and direction to project team	Project is not aligned with business strategy or addresses the wrong problem or opportunity Correct business sponsor is not identified or recruited to provide leadership	System investigation team must work hard to ensure that the problem or opportunity is aligned with business strategy and worth working on Project manager must insist that project steering team be appointed including the correct business sponsor
Scope of the project is unclear	The root cause of the problem to be solved or opportunity to be addressed has not been well defined	System investigation team must work with stakeholders to correctly define scope of the project Narrow the project focus to address only the most important business opportunities
Expectations are poorly managed	Project manager incorrectly assumes that the initial statement of stakeholder and end-user expectations is complete and unchanging	Project manager must meet with stakeholders and end users on a regular basis to discuss expectations, document project success criteria, and share project results and status
Insufficient user involvement	Users are busy and do not see value in their participation	Key users should be part of the project team and have an ongoing role in ensuring that their needs and the needs of the business are met Use of prototyping
Organization not prepared for change	Project team focuses on technical aspects of project	Project steering team should assist in preparing organization to accept change
Poor planning	Project team unable to define schedule for complex project	Use project management tools to determine and document who needs to do what and when

Executives Fail to Provide Leadership and Direction

The appointment of a steering team of senior managers representing the business and IS organizations to provide guidance and support to the project is absolutely essential to the success of any project. However, business executives are extremely busy addressing many priorities competing for their attention. They must be shown how a potential information system project is clearly aligned to the business strategy and will help achieve important organizational goals. Failure to do so means they will have no interest and no time available to provide leadership and support for the project.

The system investigation team must work hard to ensure that the problem or opportunity is aligned with business strategy and worth working on; otherwise, they cannot expect future management support of the effort. Indeed, if the project is not aligned with business strategy, it should be terminated.

Occasionally, the wrong senior managers are appointed to the steering team. This can happen when a large project will have a major impact on one portion of the organization and a lesser impact on other portions of the organization. The correct manager for the steering team is the one whose portion of the organization will be affected the most. Thus the investigation team should confirm that the correct managers have been appointed to the steering team. It is not unusual for the project team to suggest some changes to the steering team at the end of the investigation phase.

Project Scope Is Unclear or Not Managed

Without a clear definition of the problem to be solved, a good solution is unlikely. The system investigation team must work with stakeholders and users to correctly define the scope of the project using techniques such as functional decomposition.

Even after the initial scope is defined, the project team should strive to narrow the project focus to address only the most important business opportunities. Narrowing the scope of a project helps the development team concentrate on the 20 percent of the project requirements that will deliver 80 percent of the benefits. This approach reduces project cost and shortens the schedule. Reduced scope also decreases project complexity and can greatly increase the probability of a successful project.

scope creep: The temptation to add more features and functionality to the original scope of the system.

As the project evolves, team members are often tempted to expand the scope of the project (this is called **scope creep**) to add more features and functionality. Scope creep is one of the most dangerous developments in a project. If not handled properly, it can lead to cost and schedule overrun. The scope of the project should be carefully managed with the formal approval of the steering committee necessary to allow a scope change.

Expectations Are Poorly Managed

Project stakeholders and users, in the absence of clear, complete, current information from the development team, will form their own expectations about the information system project, such as what it will deliver, when it will be ready for use, how easy it will be to convert from the old system to the new system, and what level of support will be provided.

Even if the project manager met with stakeholders and users during the system investigation phase to define expectations, it is naive to assume this initial statement of expectations is complete and unchanging. Things change as the project progresses.

The project manager must meet with stakeholders and users on a regular basis to discuss expectations, document project success criteria, and share project results and status. Failure to do so sets up stakeholders and users for frustration when project progress differs from their expectations and disappointment with when and how the system is finally implemented. Effective

and continuous communications should be one of a project manager's most important tasks. While formal meetings and status reports are necessary, useful information can also be conveyed informally by meeting for coffee or lunch with a group of users. Such meetings also help build rapport and trust.

Insufficient User Involvement

Users are busy and often do not understand the value of their participation in what they view as a purely technical project. The development team should explain that user involvement is necessary to the success of the project.

In addition, users must be shown that their input is necessary in determining the project schedule. Users must be available to complete tasks such as providing feedback on prototypes, user acceptance testing, user training, and system cutover. Furthermore, such activities should be scheduled to avoid peaks in business volume and activities.

Key users should be part of the project team and have an ongoing role in ensuring that their needs and the needs of the business are met. The use of prototyping and agile system development methods are effective in increasing user involvement.

Organization Not Prepared for Change

The organization should recognize the concerns and needs of users and deal with them before they become a threat to the success of the new or modified system. This means that all members of the organization are prepared for and motivated to change from the old way of doing things to the new way. Members of the project steering team can help the organization prepare by communicating a compelling need for change. Managers can also make it clear that use of the new information system is not optional and that users are expected to modify their behaviors according to the new way of completing tasks. Often incentives need to be put in place to motivate users to adopt the new behaviors and procedures.

Many larger projects will assign a change management specialist from the Human Resources department to the project team. Some organizations hire professional trainers to develop user training materials and design and deliver training courses.

Poor Planning

The bigger the project, the more likely that poor planning will lead to significant problems. Well-managed projects use effective planning tools and techniques, including schedules, milestones, and deadlines.

project schedule: A detailed description of when project activities are performed.

project milestone: A critical date for the completion of a major part of the project.

project deadline: The date the entire project should be completed and operational.

critical path: Activities that, if delayed, would delay the entire project.

A **project schedule** is a detailed description of when project activities are performed. The schedule includes each project activity, the use of personnel and other resources, and expected start and completion dates. A **project milestone** is a critical date for completing a major part of the project, such as program design, coding, testing, and cutover. The **project deadline** is the date the entire project should be completed and operational—when the organization can expect to begin to reap the benefits of the project.

In systems development, each activity has an earliest start time, earliest finish time, and slack time, which is the amount of time an activity can be delayed without delaying the entire project. The **critical path** consists of all activities that, if delayed, would delay the entire project. These activities have zero slack time. Any problems with critical path activities will cause problems for the entire project. To ensure that critical path activities are completed on time, project managers use certain approaches and tools such as Microsoft Project to help compute these critical project attributes.

Program Evaluation and Review Technique (PERT): A formalized approach for developing a project schedule that creates three time estimates for an activity.

Gantt chart: A graphical tool used for planning, monitoring, and coordinating projects.

Although the steps of systems development seem straightforward, larger projects can become complex, requiring hundreds or thousands of separate activities. For these systems development efforts, formal project management methods and tools are essential. A formalized approach called **Program Evaluation and Review Technique (PERT)** creates three time estimates for an activity: shortest possible time, most likely time, and longest possible time. A formula is then applied to determine a single PERT time estimate. A **Gantt chart** is a graphical tool used for planning, monitoring, and coordinating projects; it is essentially a grid that lists activities and deadlines. Each time a task is completed, a marker such as a darkened line is placed in the proper grid cell to indicate the completion of a task. See Figure 8.18.

PROJECT PLANNING DOCUMENTATION — Page 1 of 1

System: Warehouse Inventory System (Modification) — Date: 12/10

System: — Scheduled activity, ▬ Completed activity — Analyst: Cecil Truman — Signature:

Activity*	Individual assigned	Week 1	2	3	4	5	6	7	8	9	10	11	12	13	14
R — Requirements definition															
R.1 Form project team	VP, Cecil, Bev	▬													
R.2 Define obj. and constraints	Cecil	—	▬												
R.3 Interview warehouse staff for requirements report	Bev		▬	▬	▬										
R.4 Organize requirements	Team				—	▬									
R.5 VP review	VP, Team				—	▬									
D — Design															
D.1 Revise program specs.	Bev					—	▬								
D. 2. 1 Specify screens	Bev					—	▬								
D. 2. 2 Specify reports	Bev						—	▬							
D. 2. 3 Specify doc. changes	Cecil						—	▬							
D. 4 Management review	Team							—							
I — Implementation															
I. 1 Code program changes	Bev								—						
I. 2. 1 Build test file	Team									—					
I. 2. 2 Build production file	Bev										▬	▬			
I. 3 Revise production file	Cecil										—				
I. 4. 1 Test short file	Bev									—	▬				
I. 4. 2 Test production file	Cecil												▬		
I. 5 Management review	Team													▬	
I. 6 Install warehouse**															
I. 6. 1 Train new procedures	Bev												▬		
I. 6. 2 Install	Bev													▬	
I. 6. 3 Management review	Team														▬

*Weekly team reviews not shown here
**Report for warehouses 2 through 5

FIGURE **8.18**

Sample Gantt chart

A Gantt chart shows progress through systems development activities by putting a bar through appropriate cells.

Both PERT and Gantt techniques can be automated using project management software. Project management software helps managers determine the best way to reduce project completion time at the least cost. Popular software packages include OpenPlan by Deltek, Microsoft Project, and Unifier by Skire.

SUMMARY

Principle:

Effective systems development requires a team effort from stakeholders, users, managers, systems development specialists, and various support personnel, and it starts with building an information systems plan.

The systems development team consists of stakeholders, users, systems development specialists, and various support personnel. The development team determines the objectives of the information system and delivers to the organization a system that meets its objectives.

Stakeholders are people who, either themselves or through the area of the organization they represent, ultimately benefit from the systems development project. Users are people who will interact with the system regularly. They can be employees, managers, customers, or suppliers. The project manager is the person assigned by the organization doing the work of the project to achieve the project objectives. A systems analyst is a professional who specializes in analyzing and designing business systems. The programmer is responsible for modifying or developing programs to satisfy user requirements. Other support personnel on the development team include technical specialists, either employees from the IS department or outside consultants.

In addition to the development team, each project should have a steering team of senior managers representing the business and IS organizations that provide guidance and support to the project. The project sponsor is a key member and leader of the steering committee who plays such a critical role that lack of this essential individual raises the probability of project failure.

Information systems planning involves the translation of strategic and organizational goals into systems development initiatives. Benefits of IS planning include a long-range view of information technology use and better use of IS resources. Failure to align information system project goals to the needs of the business can have disastrous consequences.

Principle:

The traditional systems development process is a sequential multistage process where work on the next stage cannot begin until the results of the previous stage are reviewed and approved or modified as necessary.

The systems investigation is designed to assess the technical, economic, legal, operational, and schedule feasibility of implementing solutions for business problems.

Systems analysis involves the examination of existing systems to further understand the system's weaknesses and examine inputs, outputs, processes, security and controls, and system performance.

Several solution options should be identified and a feasibility analysis performed to identify a candidate solution to recommend to the project steering team.

System design creates a complete set of technical specifications that can be used to construct the information system.

The scope and the user and business requirements are frozen at the end of the design phase of the traditional systems development life cycle. Any potential changes that are identified or suggested after this point must be approved by a formal scope change process before any work on them can begin.

Systems construction converts the system design into an operational system by acquiring and installing hardware and software, coding and testing software components, creating and loading data into databases, and performing initial program testing.

Integration and testing involves linking all of the individual components together and testing them as a group to uncover any defects between individual components.

System implementation is switching from an old information system to a replacement system. Cutover can be critical to the success of the organization because, if not done properly, the results can be disastrous.

Systems operation involves using the new or modified system under all kinds of operating conditions. Getting the most out of a new or modified system during its operation is the most important aspect of systems operations for many organizations.

Systems maintenance involves changing and enhancing the system to make it more useful in achieving user and organizational goals.

The maintenance costs for legacy systems can become quite expensive and, at some point, it becomes more cost effective to switch to new programs and applications than to repair and maintain the legacy system.

System disposal involves ensuring the orderly dissolution of the system including disposing all equipment in an environmentally friendly manner, closing out any contracts in place, and safely migrating information from the system to another system or archiving it in accordance with applicable records management policies.

Principle:

A number of powerful techniques are frequently used by software development teams.

Joint application development (JAD) has proven extremely efficient and effective at analyzing existing systems, defining problems, identifying solution requirements, and proposing and evaluating possible solutions including costs and benefits.

Functional decomposition is used to define the business processes included with the scope of the new system.

Data-flow diagrams are used to document the processes of the current system or to provide a model of a proposed new system.

Most organizations buy or rent the software they need rather than build it. Thus, it is important to perform a preliminary make-versus-buy analysis during the analysis phase. The primary tool for doing this is the request for proposal.

Principle:

The systems development team must select the appropriate systems development approach to match the needs of the project.

A prototype is a working model of a system developed to enable users to interact with the system and provide feedback so developers can better understand what is needed. Prototypes can be classified as throw-away or working prototypes.

The Rational Unified Process (RUP) is an iterative systems development approach that was developed by IBM and includes a number of tools and techniques that are typically tailored to fit the needs of a specific company or organization.

Agile development is an iterative process that develops the system in "sprint" increments lasting from two weeks to two months. Unlike the

traditional system development process, agile development accepts the fact that system requirements are evolving and cannot be fully understood or defined at the start of the project.

Scrum keeps the agile system development effort focused and moving quickly. Scrum components include a scrum master who coordinates all scrum activities, the scrum team consisting of a dozen or fewer people who perform all systems development activities from investigation to testing, and the product owner who represents the project stakeholders and is responsible for communicating and aligning project priorities between the stakeholders and development team.

Agile development requires cooperation and frequent face-to-face meetings with all participants, including systems developers and users, as they modify, refine, and test the system's capabilities and how it meets users' needs.

Extreme programming (XP) is an approach to writing code that promotes incremental development of a system using short development cycles to improve productivity and allow for the introduction of new customer requirements.

The object-oriented approach is frequently used in the investigation, analysis, and design phases of system development.

Creating successful mobile apps requires developers to consider who will be using the app and what their goals may be. Systems development tools are available for mobile applications.

While the overall approach of systems development is the same for mobile devices compared to traditional systems development projects, there are some important differences.

User systems development is the creation, modification, or extension of software by people who are nonprofessional software developers. User-developed systems are subject to the same reliability, performance, and quality issues as software developed by professionals. User developed software code must be checked carefully through rigorous code review and testing.

Principle:

The systems development team must take special measures to ensure project success.

The main reasons projects fail are: 1) executives fail to provide leadership and direction, 2) the project scope is unclear, 3) project expectations are poorly managed, 4) user involvement is insufficient, 5) the organization is not prepared for the change, and 6) project planning is poor.

KEY TERMS

agile development
critical path
data flow diagram (DFD)
data flow line
data store
end-user systems development
entity symbol
extreme programming (XP)
functional decomposition
Gantt chart
information systems planning
integration testing
make-versus-buy decision
mission-critical process
process symbol
product owner
programmer
Program Evaluation and Review Technique (PERT)
project deadline
project manager

project milestone
project schedule
project sponsor
prototype
prototyping
Rational Unified Process (RUP)
scope creep
scrum
scrum master
stakeholder
steering team
systems investigation request
systems analysis
systems analyst
system construction
system disposal
systems design
systems investigation
systems maintenance
systems operation
technical feasibility
throw-away prototype
traditional system development life cycle
users
working prototype

CHAPTER 8: SELF-ASSESSMENT TEST

Effective systems development requires a team effort from stakeholders, users, managers, systems development specialists, and various support personnel, and it starts with building an information systems plan.

1. Which of the following people ultimately benefit from a systems development project?
   a. computer programmers
   b. systems analysts
   c. stakeholders
   d. senior-level manager
2. The _____ is a key member and the leader of the steering team who plays such a critical role that lack of this essential individual raises the possibility of project failure.

The traditional systems development process is a sequential multistage process where work on the next stage cannot begin until the results of the previous stage are reviewed and approved or modified as necessary.

3. During systems investigation, the feasibility of implementing a solution to a business problem is determined and includes the technical, economic, operational, schedule, and _____ feasibility.
4. Feasibility analysis is typically done during which systems development stage?
   a. investigation
   b. analysis
   c. design
   d. all of the above
5. Any potential changes in system requirements that are identified or suggested after the design phase must _____.
   a. go through a formal scope change process before work on them begins
   b. be evaluated in terms of how they might affect system performance
   c. require feasibility analysis
   d. all of the above
6. The maintenance costs for legacy systems can become so expensive it becomes more cost effective to switch to new programs than to repair and maintain a legacy system. True or False?

A number of powerful techniques are frequently used by software development teams.

7. _____ is a technique used during the systems investigation phase to identify the processes included within the scope of the system.
8. Data modeling is most often accomplished through the use of a(an) _____.
   a. entity-relationship diagram
   b. data-flow diagram
   c. functional decomposition diagram
   d. activity diagram

The systems development team must select the appropriate systems development approach to match the needs of the project.

9. A(n) _____ is a working model of a system developed to enable users to interact with the system and provide feedback so developers can better understand what is needed.
10. _____ is an iterative systems development approach developed by IBM.
    a. Agile
    b. Scrum
    c. Prototype
    d. Rational Unified Process

11. _____ is an iterative system development process that develops the system in "sprint" increments lasting from two weeks to two months.
    a. Agile
    b. Scrum
    c. Prototype
    d. Rational Unified Process

The systems development team must take special measures to ensure project success.

12. It is necessary to show alignment with strategic business objectives and goals to motivate senior executives to join a steering team for an information system project. True or False?
13. The _____ consists of all activities that, if delayed, would delay the entire project.

CHAPTER 8: SELF-ASSESSMENT TEST ANSWERS

1. c
2. project sponsor
3. legal
4. d
5. d
6. True
7. Functional decomposition
8. a
9. prototype
10. d
11. a
12. True
13. critical path

REVIEW QUESTIONS

1. What is the purpose of a project steering team? Who are members of the team? What is the role of the project sponsor?
2. What is the purpose of IS planning? What are the benefits of performing IS planning?
3. Identify three advantages and three disadvantages associated with the traditional system development life cycle.
4. Describe what is involved in feasibility analysis.
5. What is the purpose of systems analysis? Identify the major steps of this phase.
6. What is the result or outcome of systems analysis? What happens next?
7. Identify and briefly discuss four types of tests commonly performed on an information system.
8. What is the make-versus-buy decision? Briefly explain how this decision is made.
9. Briefly explain the scrum process and how it works.

DISCUSSION QUESTIONS

1. What personality characteristics should an effective project sponsor possess?
2. You have been selected to participate on the systems investigation team for a new system in your area of the business. How can you contribute to the success of the effort? How might you use critical success factors to identify important system requirements?
3. You must approach one of the mid-level line managers in your organization and convince her to assign one of her key people to lead the system investigation phase of an important project. This phase of the project is expected to last three months and the individual will be needed full time during the investigation. What resistance do you expect from this manager? What counterpoints can you offer to convince her to assign this person?
4. Your company wants to develop or acquire a new customer relationship management system to help sales representatives identify potential new customers. Describe what factors you would consider in deciding whether to develop the application in-house or buy a software package to fulfill this need.
5. How important are communications skills to the IS members of a systems development team? Consider this statement: "IS personnel need a combination of skills—one-third technical skills, one-third business skills, and one-third communications skills." Do you think this is true? How might this affect the selection and training of IS personnel?
6. You have been hired to perform systems investigation for an Indian restaurant owner in a large metropolitan area. She is thinking of opening a

new restaurant with a state-of-the-art computer system that would allow customers to place orders on the Internet or at kiosks at restaurant tables. Describe how you would determine the technical, economic, legal, operational, and schedule feasibility for the restaurant and its proposed computer system.

PROBLEM-SOLVING EXERCISES

1. For a business of your choice, use a graphics program to develop a data-flow diagram of one of its main processes and an entity-relationship diagram showing the data within the scope of the system.
2. A project team has estimated the costs associated with the development and maintenance of a new system. One approach requires a more complete design and will result in a slightly higher design and implementation cost but a lower maintenance cost over the life of the system. The second approach cuts the design effort, saving some dollars but with a likely increase in maintenance cost.
   a. Enter the following data in the spreadsheet. Print the result.

Benefits of good design

	Good Design	Poor Design
Design Costs	$14,000	$10,000
Implementation Cost	$42,000	$35,000
Annual Maintenance Cost	$32,000	$40,000

   b. Create a stacked bar chart that shows the total cost, including the design, implementation, and maintenance costs over an expected system life of seven years. Be sure that the chart has a title and that the costs are labeled on the chart.
   c. Use your word-processing software to write a paragraph that recommends an approach to take and why.

TEAM ACTIVITIES

1. Have your team interview people involved in a systems development project at a local business or at your college or university. Identify each team member and document their role on the project. Solicit their feedback on how the project is going and how they feel about their participation. With the benefit of 20–20 hindsight, is there anything they would like to change?
2. Your team has been hired to perform system investigation for a new billing program for a small heating and air conditioning company. Perform a functional decomposition to define the scope of the system.
3. As a team, find two or three project managers and do a group interview on the topic of causes for project failure. Identify and prioritize their top causes for project failure. How does their list of causes compare to the causes presented in this chapter?

WEB EXERCISES

1. Using the Internet, explore the most useful mobile applications for a business or industry of your choice. Also explore mobile applications for this business or industry that are not currently available. Write a report describing what you found.
2. HealthCare.gov is a health insurance exchange Web site operated by the U.S. federal government. It is intended to support citizens who want to sign up to receive benefits under the Patient Protection and Affordable Care Act. The Web site was implemented to serve the residents of the 36 states that elected to not build their own state exchanges. The Web site enables the sale of private health insurance plans, offers subsidies to low-income citizens, and assists those persons who are eligible to sign up for Medicaid.

   The launch of the Healthcare.gov Web site occurred on October 1, 2013. Do research on the Web to identify specific problems that users encountered. Identify steps that could have been taken to ensure a smoother system start-up. What measures are being used to track the performance of this important Web site?

CAREER EXERCISES

1. Pick a career that you are considering. Identify an information system frequently employed by people in that career field. Discuss how you might be involved as a user or stakeholder in the development of such a system for your future company. Identify three things that you could do that would greatly improve the success of such a project. Identify three things that you could do (or fail to do) that could greatly reduce the probability of success of such a project.
2. Do research on the role of project manager. What personal characteristics, education, and work experiences are usually associated with a project manager? Are project manager certifications available? What is the need for project managers in business? What sort of starting salaries do project managers command?

CASE STUDIES

Case One

System Testing Reveals Problems in the Kill Vehicle Program

On June 23, 2014, the U.S. Missile Defense Agency reported long-awaited good news. Its Exoatmospheric Kill Vehicle (EKV) Capability Enhanced II kill vehicle successfully intercepted a missile fired from the Marshall Islands. The kill vehicle, a warhead launched from the Vandenberg Air Force Base in California, hit the intercontinental ballistic missile in midcourse, that is, after it had been launched and prior to its reaching the target. Although the engineers at the air force base left little to chance by programming the exact coordinates of its target into the kill vehicle, the test was considered an important success. The three previous attempts, all executed between 2008 and 2014, had failed. In fact, of the 17 tests of the Ground-based Midcourse Defense (GMD) system, only eight had hit their targets, giving the project—which will cost American taxpayers $40 billion by 2017—a 47 percent success rate.

In 1983, President Ronald Reagan first backed the idea of creating missile defense technology that would render nuclear weapons obsolete. The Strategic Defense Initiative (SDI), popularly known as Star Wars, cost taxpayers approximately $30 billion before the project was abandoned. In 1999, however, the U.S. Congress decided that it would begin development of the GMD system to protect the United States against a nuclear missile launched by a rogue nation. In 2006, communist North Korea had launched its first successful test of a nuclear missile, and both Iran and Iraq had made efforts to obtain nuclear technology. Congress set no date for the completion of the GMD system, but simply specified that it should be deployed as soon as it was technologically feasible.

However, terrorists attacked the Twin Towers and the Pentagon on September 11, 2001. On December 16, 2002, President George W. Bush issued a directive to deploy the GMD system by 2004, although two tests of the system had failed a week earlier. Rather than continuing work on the prototype and test the system, the Missile Defense Agency began deploying missiles in silos. Approximately 38 percent of the kill vehicles' software had not been validated through flight testing. The political pressure to deploy in the wake of the 9/11 attacks overrode concerns about faults in the software and other components. In 2004 and 2005, however, the Missile Defense Agency aborted tests of the GMD system when the missiles remained stuck in their silos due to software failures. In 2010, a test failed because the sea-based radar system the kill vehicle used to calculate the trajectory of the transcontinental ballistic missile became confused by pieces of metal that tore away from the missile as it approached the kill vehicle. Before each new test, engineers redesigned the defective component. However, the Missile Defense Agency has stopped short of a total redesign and carefully planned systems development of a new prototype.

In February 2013, Frank Kendall, the undersecretary of Defense for acquisition, technology, and logistics, became the first to admit to the inherently failed development process when he announced, "The root cause was a desire to field these things very quickly and very cheaply.... We are seeing a lot of bad engineering, frankly, and it was because there was a rush."

Clearly, if the kill vehicles can only hit the missiles when they are given the coordinates in advance, these warheads will likely fail to bring down a nuclear missile fired by a rogue nation when both the launch time and position of the missile is unknown. The question remains as to whether the United States will be able to develop a functional GMD system before a rogue nation or terrorist organization becomes capable of launching a nuclear missile that can reach the United States.

Discussion Questions

1. What error did the Missile Defense Agency make in the development of the GMD system?
2. How do the factors that pushed the agency to release the GMD compare to those that rush the development of business software?

Critical Thinking Questions

1. What steps can businesses take to ensure that engineers report all potential problems that arise during development?
2. What steps can IT professionals take to make business managers aware of the importance of following the complete systems development process?

SOURCES: "First in 6 Years: Troubled US Missile Defense System Hits Test Target," *RT Network*, June 23, 2014, *http://rt.com/usa/167728-gmd-launch-successful-failure/*; Willman, David, "$40-Billion Missile Defense System Proves Unreliable," *LA Times*, June 15, 2014, *www.latimes.com/nation/la-na-missile-defense-20140615-story.html#page=1*; "Timeline on North Korea's Nuclear Program," *New York Times*, August 6, 2013, *www.nytimes.com/interactive/2013/02/05/world/asia/northkorea-timeline.html?_r=0#/#time238_7085*.

Case Two

Improving Requirements Implementation at Honeywell

As you read in this chapter, determining system requirements is a vital part of the development of any information system. Complex information systems have many sets of requirements. It is, therefore, essential to have a systematic way to determine them.

Honeywell Technology Solutions Lab (HTSL), through its IT Services and Solutions business unit, develops software solutions for other parts of Honeywell Inc. HTSL is based in Bengaluru (Bangalore), India, with centers in Beijing (China), Brno (Czech Republic), Hyderabad (India), Madurai (India), and Shanghai (China).

In 2010, the company identified a problem: At HTSL, various groups such as requirement writers and development, quality assurance (QA), and project management teams worked independently in separate "silos." It was difficult to track project requirements and the status of their implementation. HTSL needed a system to manage the requirements and their relationships to each other.

Beyond managing the requirements, HTSL needed an application that could coordinate test cases, design elements, and defects. Requirement writers would create the requirements for software, and HTSL customers (other Honeywell divisions) would review and approve these requirements. Once approved, the development team would implement them, and the QA team would generate test cases based on them. Any defects found in executing the test cases would also be tracked.

HTSL had a great deal of experience in developing software for aerospace, automation and control, specialty materials, and transportation systems. However, they had no experience in developing software to manage the development process itself. The company recognized this deficit and turned to specialists.

Kovair, of Santa Clara, California, is such a specialist. Its Application Lifecycle Management (ALM) package is for "implementing a software development life cycle (SDLC) process, collaborating on the entire development cycle and tracing implementations back to original specs. [It] ensures that all developers are working from the same playbook … and that there are no costly last minute surprises."

One ALM module is Requirements Management. Using it, HTSL can gather requirements, rank them, manage their changes, and coordinate them with system test cases. The Requirements Management module can also produce a variety of reports, including formatted requirements specifications and reports showing the distribution of requirements by type, criticality, source, or any other descriptor.

Honeywell already had a formal development process called "Review, Approval, Baseline, Technical Design, Test Design, Implementation and Testing." Kovair's ALM solution was customized to fit into this process. When a requirement is entered into ALM, it is marked "Submitted," and the review process begins. ALM generates Review tasks for stakeholders, ensuring that they will give their views on the new requirement. When they approve it, perhaps after changes, its status is changed to "Approved," and a task is entered for its owner to add it to the baseline system design. When this step is completed, two new tasks are created: one for the development team to develop technical specifications and then the software and one for the quality assurance team to develop test cases. Development can then continue.

What were the results? HTSL reduced rework due to incorrect requirements and speeded up development. Development team productivity was improved by about 20 percent, and requirements-related defects were reduced by at least 1 percent.

Discussion Questions

1. Why did Honeywell turn to Kovair for help? What goals did Kovair help Honeywell meet?
2. The ALM software is intended to help companies manage the steps of software development. Software development is only one of the processes that businesses use every day. What are the characteristics of a process that make a software package like ALM useful?

Critical Thinking Questions

1. Honeywell reported that it increased team productivity by 20 percent and reduced requirements errors by 10 percent. What functionalities of ALM may have enabled Honeywell to accomplish this?
2. This case is based in part on information from Kovair. Many organizations need to track software development projects, so other companies besides Kovair offer packages to do that. Suppose you were given the job of choosing such a package, list at least four criteria you would use in comparing different packages. Rank the items on your list from most to least important.

SOURCES: Kovair, Inc., "Requirements Management Case Study for Honeywell," *www.kovair.com/whitepapers/Requirements-Management-Case-Study-for-Honeywell.pdf*, August 2011, accessed July 14, 2014; HTSL Web site, http://aerospace.honeywell.com/services/maintenance-and-monitoring/depot-partnerships/life-cycle-management, accessed July 3, 2014; Kovair ALM Web site, *www.kovair.com/alm/application-lifecycle-management-description.aspx*, accessed July 3, 2014.

Questions for Web Case

See the Web site for this book to read about the Altitude Online case for this chapter. The following are questions concerning this Web case.

Altitude Online: Systems Development Considerations

Discussion Questions

1. What important activities did Jon's team engage in during the systems investigation stage of the systems development life cycle?
2. Why are all forms of feasibility considerations especially important for an ERP development project?

Critical Thinking Questions

1. Why is the quality of the systems analysis report crucial to the successful continuation of the project?
2. Why do you think Jon felt the need to travel to communicate with Altitude Online colleagues rather than using email or phone conferencing? What benefit does face-to-face communication provide in this scenario?

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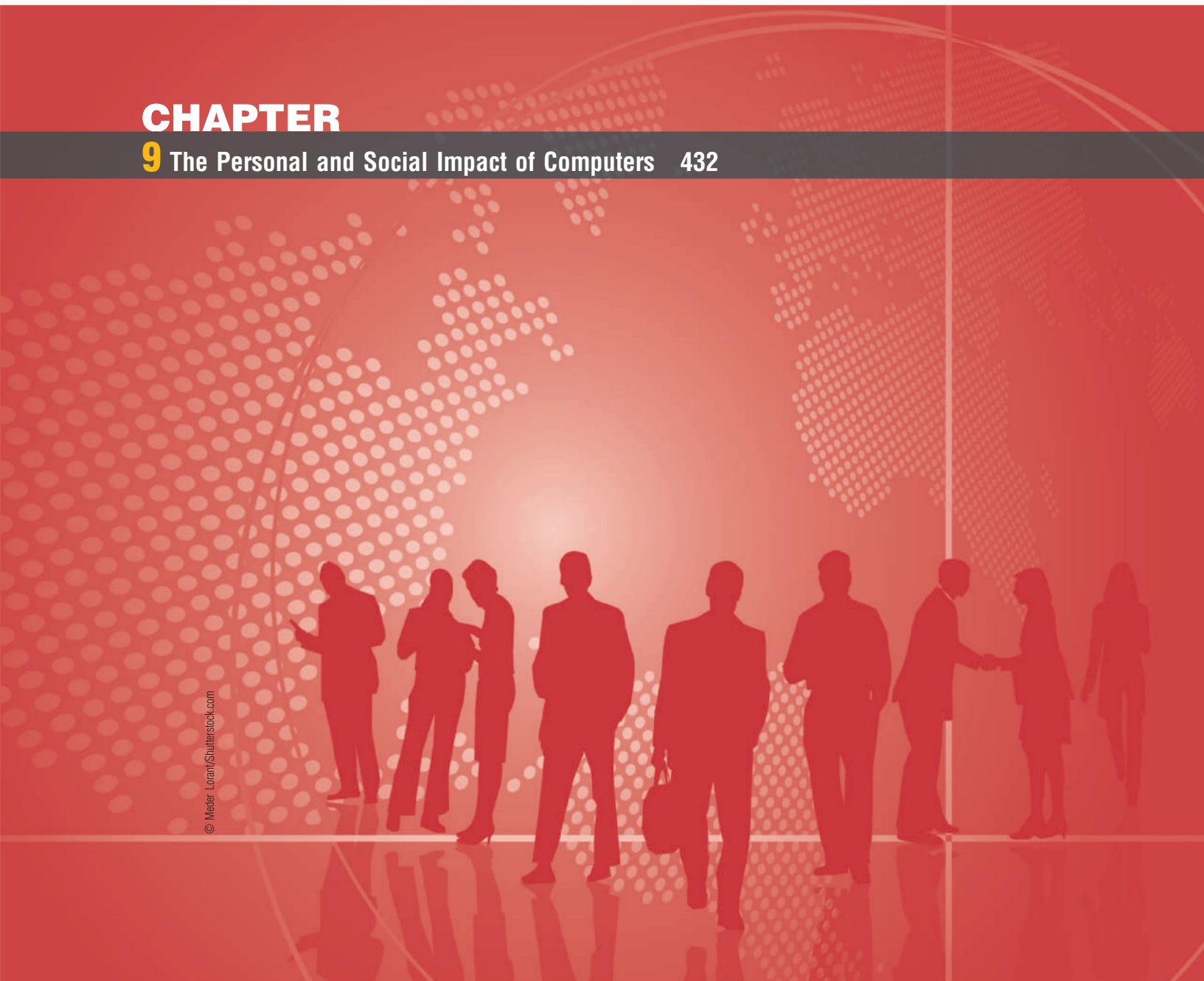
Information Systems in Business and Society

CHAPTER



9 The Personal and Social Impact of Computers

Principles	Learning Objectives
• Policies and procedures must be established to avoid waste and mistakes associated with computer usage.	• Describe some examples of waste and mistakes in an IS environment, their causes, and possible solutions. • Identify policies and procedures useful in eliminating waste and mistakes.
• Computer crime is a serious and rapidly growing area of concern requiring management attention.	• Explain the types of computer crime and their effects. • Identify specific measures to prevent computer crime.
• Privacy is an important social issue related to information systems.	• Discuss the principles and limits of an individual's right to privacy.
• Jobs, equipment, and working conditions must be designed to avoid negative health effects from computers.	• List the important negative effects of computers on the work environment. • Identify specific actions that must be taken to ensure the health and safety of employees.
• Practitioners in many professions subscribe to a code of ethics that states the principles and core values that are essential to their work.	• Outline criteria for the ethical use of information systems.

Information Systems in the Global Economy
MT. GOX, JAPAN

Millions in Bitcoins Go Missing

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In the wake of the 2008 and 2009 global financial crisis, an entirely new type of currency called a "bitcoin" emerged in the online marketplace. Similar to the use of cigarettes as currency in prisoner-of-war camps, the completely digital currency made use of the peer-to-peer (P2P) technology, with only a small group of individuals and companies trading bitcoins among themselves at first. As more currency was generated and released into circulation, a fast-growing pool of online and real-world merchants began to accept them as payment.

"The mission," says Gavin Andresen, chief scientist of the Bitcoin Foundation, "is really to create a stable worldwide currency for the Internet. And to let people all over the world transact with each other as easily as people all over the world send email to each other."

As the number of bitcoins on the market increased, people began purchasing them on bitcoin exchanges. Mt. Gox, a leading exchange in Tokyo, Japan, became an early leader, capturing almost 80 percent of the market.

Although people can buy bitcoins using credit cards or cash transfers, many simply go to a local bitcoin exchange, located in thousands of cities around the world, and use their country's currency to buy bitcoins. People can then transfer bitcoins to a family member's or a merchant's wallet over the Internet.

Bitcoin exchanges allow individuals to transfer money across the globe or make international payments, which are cheaper because the Bitcoin cuts out the middle men, the banks, and credit card companies. Unlike credit card transactions, neither the consumer nor the business needs to pay a transaction fee, and all purchases are as anonymous as a cash payment. These exchanges can service people without access to bank accounts, including aspiring entrepreneurs in developing economies. The downside is that like cash, bitcoins are not insured and can be lost, stolen by hackers, or destroyed by viruses.

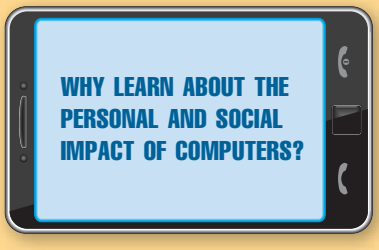
These disadvantages proved overwhelming for the Mt. Gox exchange. On February 10, 2014, the company issued a press release that Mt. Gox had lost 850,000 bitcoins, valued at $827 apiece. Of these, 750,000 belonged to customers. The company claimed that it had been the victim of a malleability bug, and that hackers had fooled the company into making it think that bitcoin transfers had failed when they had not, so that Mt. Gox had transferred the money twice.

Computer scientists, who had been monitoring the bitcoin network for these types of fraudulent transactions, argued that the number of fraudulent transactions could not possibly account for the amount Mt. Gox claimed to have lost. Mt. Gox insiders leaked that the company was very badly managed. In fact, a little over a month later, the company happily reported that it had found 200 of the missing bitcoins in an old bitcoin wallet on a hard drive. Eventually, however, Mt. Gox was forced to file for bankruptcy, and some $473 million of bitcoins remain "lost."

At first, in early 2014, the value of the bitcoin fell. However, SecondMarket, Inc. began to buy the currency. Soon, other exchanges such as London-based Bitstamp were grabbing a greater share of the bitcoin market. The digital currency proved more resilient than anyone would have expected.

As you read this chapter, consider the following:

- How can new technologies, like Bitcoin, change societies and economies?
- What actions should governments take, if any, to ensure that new technologies help, rather than hurt, consumers?



Both opportunities and threats surround a wide range of nontechnical issues associated with the use of information systems and the Internet. The issues span the full spectrum—from preventing computer waste and mistakes, to avoiding violations of privacy, to complying with laws on collecting data about customers, and to monitoring employees. If you become a member of a human resources, an information systems, or a legal department within an organization, you will likely be charged with leading the organization in dealing with these and other issues covered in this chapter. Also, as a user of information systems and the Internet, it is in your own self-interest to become well versed on these issues. You need to know about the topics in this chapter to help avoid becoming a victim of crime, fraud, privacy invasion, and other potential problems. This chapter begins with a discussion of preventing computer waste and mistakes.

Earlier chapters detailed the significant benefits of computer-based information systems in business, including increased profits, superior goods and services, and higher quality of work life. Computers have become such valuable tools that today's businesspeople have difficulty imagining work without them. Yet, the information age has also brought the following potential problems for workers, companies, and society in general:

- Computer waste and mistakes
- Computer crime
- Privacy issues
- Work environment problems
- Ethical issues

This chapter discusses some of the social and ethical issues as a reminder of these important considerations underlying the design, building, and use of computer-based information systems. No business organization, and hence no information system, operates in a vacuum. All IS professionals, business managers, and users have a responsibility to see that the potential consequences of IS use are fully considered. Even entrepreneurs, especially those who use computers and the Internet, must be aware of the potential personal and social impact of computers.

COMPUTER WASTE AND MISTAKES

Computer-related waste and mistakes are major causes of computer problems, contributing to unnecessarily high costs and lost profits. Examples of computer-related waste include organizations operating unintegrated information systems, acquiring redundant systems, and wasting information system resources. Computer-related mistakes refer to errors, failures, and other computer problems that make computer output incorrect or not useful; most of these are caused by human error. This section explores the damage that can be done as a result of computer waste and mistakes.

Computer Waste

Some organizations continue to operate their businesses using unintegrated information systems, which make it difficult for decisions makers to collaborate and share information. This practice leads to missed opportunities, increased costs, and lost sales. For example, local health departments use a combination of state-provided and locally implemented information systems for patient data collection, management, and reporting. Users report system inefficiencies, difficulties in generating reports, and limited data accessibility, necessitating the need for system workarounds. In addition, the use of a

"shadow system" to maintain a duplicate set of information is common.[1] Such inefficient systems add to the growth in healthcare costs.

Many organizations unknowingly waste money to acquire systems in different organizational units that perform nearly the same functions. Implementation of such duplicate systems unnecessarily increases hardware and software costs. The U.S. government spends billions of dollars on information systems each year, with $80 billion spent in fiscal year 2013 alone. Some of this spending goes toward providing information systems that provide similar functions across the various branches and agencies of the government. The Government Accounting Office (GAO) conducted a check of the three federal departments with the largest IT budgets—the Defense Department, Department of Homeland Security, and Department of Health and Human Services. It uncovered a total of $321 million spent in the six-year period from 2008 to 2013 on projects that duplicated other efforts within those same agencies.[2]

A less dramatic, yet still relevant, example of waste is the amount of company time and money employees can spend playing computer games, sending personal email, surfing the Web, buying items online, liking a new picture on Instagram, and checking their status on LinkedIn. Some 60 percent of workers check their Facebook page daily and Nielsen found that 25 percent of working adults admit to viewing pornography on a computer while at work.[3] As a result, many companies, including Cintas, General Electric Aviation, Kroger, Procter & Gamble, and TriHealth have all found it necessary to limit employee access to nonwork-related Web sites.[4]

Computer-Related Mistakes

Despite many people's distrust of them, computers rarely make mistakes. If users do not follow proper procedures, however, even the most sophisticated hardware cannot produce meaningful output. Mistakes can be caused by unclear expectations coupled with inadequate training and a lack of feedback. A programmer might also develop a program that contains errors, or a data-entry clerk might enter the wrong data. Unless errors are caught early and corrected, the speed of computers can intensify mistakes. As information technology becomes faster, more complex, and more powerful, organizations and computer users face increased risks of experiencing the results of computer-related mistakes. Consider these recent examples of computer-related mistakes:

- Federal agencies reported an estimated $106 billion in improper payments for 2013. This includes payments that should not have been made, payments made in the wrong amount, or payments not supported by sufficient documentation. The payments came from 84 programs spread across 18 agencies.[5] See Figure 9.1.
- The Florida Comprehensive Assessment Test (FCAT) for students in grades 3 to 11 can have a tremendous impact on students, teachers, and schools. Poor test scores can hold back a student. Test scores are also a major factor in teacher evaluations. Those schools that produce low test scores are forced to undergo major changes or may even be closed. A series of widespread computer glitches prevented thousands of students across the state from signing into their computers and taking the test. At the same time, many students who had begun the test were interrupted. Some questioned whether the results from testing will be reliable and whether the tests should be retaken by all students.[6]
- The flight of a U-2 spy plane uncovered a design problem in the U.S. air traffic control system that temporarily shut down the system and grounded or delayed hundreds of Los Angeles area flights. The $2.4 billion En Route Automation Modernization system built by Lockheed Martin Corporation failed because it limits how much data each plane can send to the system. Most commercial planes have simple flight plans, so they

FIGURE **9.1**

Computer-related mistakes

Federal agencies recently reported an estimated $106 billion in improper payments.

do not approach that limit. However, the U-2 operates at high altitude, and that day had a complex flight plan that put it over the system's limit. Fortunately, no accidents or injuries were reported from the failure, though numerous flights were delayed or canceled.[7]

- The U.S. Centers for Medicare and Medicaid Services (CMS) is the lead agency responsible for implementing the Patient Protection and Affordable Care Act. The agency is working to help some 22,000 Americans fix enrollment mistakes that led to excessive charges, enrolled them in the wrong health plan, or denied them coverage altogether.[8]

PREVENTING COMPUTER-RELATED WASTE AND MISTAKES

To remain profitable in a competitive environment, organizations must use all resources wisely. To employ IS resources efficiently and effectively, employees and managers alike should strive to minimize waste and mistakes. This effort involves establishing, implementing, monitoring, and reviewing effective policies and procedures.

Establishing Policies and Procedures

The first step to prevent computer-related waste is to establish policies and procedures regarding efficient acquisition, use, and disposal of systems and devices. Computers permeate organizations today, and it is critical for organizations to ensure that systems are used to their full potential. As a result, most companies have implemented stringent policies on the acquisition of computer systems and equipment, including requiring a formal justification

statement before computer equipment is purchased, definition of standard computing platforms (operating system, type of computer chip, minimum amount of RAM, etc.), and the use of preferred vendors for all acquisitions.

Prevention of computer-related mistakes begins by identifying the most common types of errors, of which there are surprisingly few. See Figure 9.2. Types of computer-related mistakes include the following:

- Data-entry or data-capture errors
- Errors in computer programs
- Errors in handling files, including formatting a disk by mistake, copying an old file over a newer one, and deleting a file by mistake
- Mishandling of computer output
- Inadequate planning for and control of equipment malfunctions
- Inadequate planning for and control of environmental difficulties (e.g., electrical and humidity problems)
- Installing computing capacity inadequate for the level of activity
- Failure to provide access to the most current information by not adding new Web links and not deleting old links

FIGURE **9.2**

Preventing common computer errors

Preventing computer-related mistakes begins by identifying the most common types of errors.

To control and prevent potential problems caused by computer-related mistakes, companies have developed policies and procedures that cover the acquisition and use of computers. Training programs for individuals and work groups as well as manuals and documents covering the use and maintenance of computer systems also help prevent problems. The Error Prevention Institute offers online training on preventing human errors that explains the underlying reasons that humans make mistakes and how these mistakes can be prevented.[9] Other preventive measures include approval of certain systems and applications before they are implemented and used to ensure compatibility and cost effectiveness and a requirement that documentation and descriptions of certain applications, including all cell formulas for spreadsheets and a description of all data elements and relationships in a database system be filed or submitted to a central office. Such standardization can ease access and use for all personnel.

Many organizations have established strong policies to prevent employees from wasting time using computers inappropriately at work. See Figure 9.3.

FIGURE **9.3**

Computer usage policies

Organizations establish polices to keep employees from wasting time.

After companies plan and develop policies and procedures, they must consider how best to implement them. In some cases, violating these policies can lead to termination.

Genius is an iPhone app that allows users to provide annotations and interpretations of song lyrics, news stories, poetry, and other forms of text. Mahbod Moghadam, Genius's cofounder, allegedly was asked to leave the company after he annotated the 141-page manifesto left by Elliot Rodger with some strange comments. Rodger was the 22-year-old man who went on a shooting spree in Santa Barbara, California, killing six people and then committing suicide.[10]

Implementing Policies and Procedures

Implementing policies and procedures to minimize waste and mistakes varies according to the business conducted. Most companies develop such policies and procedures with advice from the firm's internal auditing group or its external auditing firm. The policies often focus on the implementation of source data automation, the use of data editing to ensure data accuracy and completeness, and the assignment of clear responsibility for data accuracy within each information system. Some useful policies to minimize waste and mistakes include the following:

- Changes to critical tables, HTML, and URLs should be tightly controlled, with all changes documented and authorized by responsible owners.
- A user manual should be available covering operating procedures and documenting the management and control of the application.
- Each system report should indicate its general content in its title and specify the time period covered.
- The system should have controls to prevent invalid and unreasonable data entry.
- Controls should exist to ensure that data input, HTML, and URLs are valid, applicable, and posted in the right time frame.
- Users should implement proper procedures to ensure correct input data.

Training is another key aspect of implementation. Many users are not properly trained in using applications, and their mistakes can be very costly. Because more and more people use computers in their daily work, they should understand how to use them. Training is often the key to acceptance and implementation of policies and procedures. See Figure 9.4. Because of the importance of maintaining accurate data and of people understanding their responsibilities, companies converting to ERP and e-commerce systems invest weeks of training for key users of the system's various modules.

FIGURE **9.4**

Computer training

Training helps to ensure acceptance and implementation of policies and procedures.

Monitoring Policies and Procedures

To ensure that users throughout an organization are following established procedures, the next step is to monitor routine practices and take corrective action if necessary. By understanding what is happening in day-to-day activities, organizations can make adjustments or develop new procedures. Many organizations perform audits to measure actual results against established goals, such as percentage of end-user reports produced on time, percentage of data-input errors detected, number of input transactions entered per eight-hour shift, and so on.

When accounting firm KPMG audited the Boston Redevelopment Authority, it found that the agency failed to collect millions of dollars in lease payments and fees owed by developers for affordable housing. The agency keeps most of its records on paper and lacks adequate systems for monitoring and enforcing agreements with developers to improve roads and parks in exchange for city approval of their projects and collecting rents on public property.[11]

Reviewing Policies and Procedures

The final step is to review existing policies and procedures and determine whether they are adequate. During review, people should ask the following questions:

- Do current policies cover existing practices adequately? Were any problems or opportunities uncovered during monitoring?
- Does the organization plan any new activities in the future? If so, does it need new policies or procedures addressing who will handle them and what must be done?
- Are contingencies and disasters covered?

This review and planning allows companies to take a proactive approach to problem solving, which can enhance a company's performance, such as increasing productivity and improving customer service. During such a review, companies are alerted to upcoming changes in information systems that could have a profound effect on many business activities.

The results of failing to review and plan changes in policies and procedures can lead to disastrous consequences. For example, Walmart has one of the most sophisticated supply chain management systems in the consumer packaged goods industry. It employs an automated replenishment system so that as goods are purchased nationwide, computers in its headquarters create resupply orders to ensure that everything from Bounty paper towels to tomatoes are delivered to stores with amazing efficiency. Walmart needs workers who use pallet jacks and hand trucks to move the goods from Walmart back rooms to the store shelves. However, the company recently decided to slash operating costs by $740 million, largely by reducing the number of these workers.[12] These changes in policy and procedures have had a negative impact on the firm. Walmart was recently rated at the bottom among department and discount stores in the American Customer Satisfaction Index. Walmart customers' complaints about empty shelves and poor customer service are increasing. See Figure 9.5.[13]

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FIGURE **9.5**

Evaluating policies and procedures

Walmart's reduction of operating costs has had a negative impact on customer service.

Information systems professionals and users still need to be aware of the misuse of resources throughout an organization. Preventing errors and mistakes is one way to do so. Another is implementing in-house security measures and legal protections to detect and prevent a dangerous type of misuse: computer crime.

COMPUTER CRIME

Even good IS policies might not be able to predict or prevent computer crime. A computer's ability to process millions of pieces of data in less than one second makes it possible for a thief to steal data worth millions of dollars. Compared with the physical dangers of robbing a bank or retail store with a gun, computer crime is less dangerous as a computer criminal with the right equipment and know-how can steal large amounts of money without leaving his or her home.

Internet Crime Computer Center (IC3): An alliance between the White Collar Crime Center and the Federal Bureau of Investigation that provides a central site for Internet crime victims to report and to alert appropriate agencies of crimes committed.

The **Internet Crime Computer Center (IC3)** is an alliance between the White Collar Crime Center and the Federal Bureau of Investigation (FBI) and was formed in 2000. It provides a central site for Internet crime victims to report and to alert appropriate agencies of crimes committed. By May 2014, the IC3 had received 3 million consumer Internet crime complaints. Over the past five years, an average of 25,000 complaints were received per month. In 2013 alone, the verifiable dollar loss of complaints submitted to the IC3 totaled nearly $800 million. See Figure 9.6.[14]

FIGURE **9.6**

Computer crime

Computer crime is a serious and growing global concern.

Unfortunately, these numbers represent only a small fraction of total computer-related crimes, as many crimes go unreported because companies don't want the bad publicity or don't think that law enforcement can help. Such lack of publicity makes the job even tougher for law enforcement. Additionally, most companies that have been electronically attacked won't talk to the press. A big concern is loss of public trust and image—not to mention the fear of encouraging copycat hackers.

Today, computer criminals are a new breed—bolder and more creative than ever. With the increased use of the Internet, computer crime is now global. It's not just on U.S. shores that law enforcement has to battle cybercriminals. Regardless of its nonviolent image, computer crime is different only because a computer is used. It is still a crime. Part of what makes computer crime unique and difficult to combat is its dual nature—the computer can be both the tool used to commit a crime and the object of that crime.

THE COMPUTER AS A TOOL TO COMMIT CRIME

A computer can be used as a tool to gain access to valuable information and as the means to steal millions of dollars. It is, perhaps, a question of motivation—many people who commit computer-related crime claim they do it for the challenge, not for the money. Credit card fraud—whereby a criminal illegally gains access to another's line of credit with stolen credit card numbers—is a major concern for today's banks and financial institutions. In general, criminals need two capabilities to commit most computer crimes.

First, the criminal needs to know how to gain access to the computer system. Sometimes, obtaining access requires knowledge of an identification number and a password. Second, the criminal must know how to manipulate the system to produce the desired result. Frequently, a critical computer password has been talked out of a person, a practice called **social engineering**. Social engineering attacks are often conducted by phone with the hacker imitating someone in a position of authority and attempting to gradually draw information out of the user. Often the hacker claims to be a member of the help desk of the victim's organization or ISP service provider. Following is a brief list of tips to avoid becoming a victim of social engineering.

social engineering: Using social skills to get computer users to provide information that allows a hacker to access an information system or its data.

- Never provide information such as your user name, logon ID, password, Social Security number, account numbers, or answers to security questions (e.g., the name of the street where your best friend lives).
- Be highly suspicious of anyone who proactively contacts you about a problem with your computer or computer services.
- Ask for proof of identity if someone calls claiming to be from a different office in your company or from one of your suppliers and asks for sensitive information. For example, ask for an extension number so that you can call back. If they claim to be from a law enforcement agency, ask for a badge number.

Think no one would ever stoop so low as to hunt through your trash in search of bills that you already paid? Wrong! A dumpster can be an excellent source of information for an identity thief. Data from discarded bills, credit card approval letters, or financial statements can provide all the information needed to rob you of your identity. Sometimes the attackers simply go through the trash—**dumpster diving**—for important pieces of information that can help crack the computers or convince someone at the company to give them more access. See Figure 9.7. In addition, over 2,000 Web sites offer the digital tools—often without charge—that let people snoop, crash computers, hijack control of a machine, or retrieve a copy of every keystroke. While some of the tools were intended for legitimate use to provide remote technical support or monitor computer usage, hackers take advantage of them to gain unauthorized access to computers or data.

dumpster diving: Going through the trash of an organization to find secret or confidential information, including information needed to access an information system or its data.

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FIGURE **9.7**

Dumpster diving

Identity thieves are not above searching an organization's trash to find confidential information.

Cyberterrorism

cyberterrorism: The intimidation of government or civilian population by using information technology to disable critical national infrastructures (e.g., energy, transportation, telecommunications, banking and finance, law enforcement, and emergency response) to achieve political, religious, or ideological goals.

Cyberterrorism is the intimidation of government or civilian population by using information technology to disable critical national infrastructures (e.g., energy, transportation, financial, law enforcement, emergency response) to achieve political, religious, or ideological goals. Cyberterrorism is an increasing concern for countries and organizations around the globe.

The U.S. government considered the potential threat of cyberterrorism serious enough that in February 1998 it established the National Infrastructure Protection Center. This function was later transferred to the Homeland Security Department's Information Analysis and Infrastructure Protection Directorate to serve as a focal point for threat assessment of, warning of, investigation of, and response to threats or attacks against the country's critical infrastructure, which provides telecommunications, energy, banking and finance, water systems, government operations, and emergency services. Successful cyberattacks against the facilities that provide these services could cause widespread and massive disruptions to the normal function of American society. See Figure 9.8.

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FIGURE **9.8**

Cyberterrorism

Cyberterrorism includes threats or attacks against a country's critical infrastructure, such as the air traffic control system.

cyberterrorist: Someone who intimidates or coerces a government or organization to advance his or her political or social objectives by launching computer-based attacks against computers, networks, and the information stored on them.

A **cyberterrorist** is someone who intimidates or coerces a government or organization to advance his or her political or social objectives by launching computer-based attacks against computers, networks, and the information stored on them. Following are a few recent examples of attacks by cyberterrorists from around the world:

- The United States and Israeli governments collaborated to develop Stuxnet, computer malware designed to attack industrial Programmable Logic Controllers (PLCs) that regulate industrial machinery. The Stuxnet malware was used to infect the computers that controlled the centrifuges for separating nuclear material for Iran's nuclear program. Government estimates have stated that the Stuxnet attacks set back the Iranian nuclear program by as much as two years, although outside experts are skeptical of that claim.[15]
- Russian hackers broke into the networks of at least three manufacturers of industrial control software and inserted malware into their product software. The software is used by many companies in the oil and energy

industry to enable their employees to access industrial control systems remotely. It is estimated that some 250 companies unknowingly downloaded malware-infected software. While there is no indication that the hackers intended to commit an act of cyberterrorism such as to blow up an oil rig or refinery, the potential for sabotage exists.[16]

- Ellie Mae, Inc. provides end-to-end business automation software for the residential mortgage industry. Roughly 20 percent of all mortgage obligations flow through its system. On March 31 and April 1, 2014, a critical end-of-the-month processing period, the loan origination system was unable to run, and lenders were unable to finish closing their loans. The outage was suspicious and raised speculation of a cyberattack designed to test the defenses of critical banking systems.[17]

Identity Theft

identify theft: A crime in which an imposter obtains key pieces of personal identification information, such as Social Security or driver's license numbers, to impersonate someone else.

Identity theft is a crime in which an imposter obtains key pieces of personal identification information, such as Social Security or driver's license numbers, to impersonate someone else. The information is then used to obtain credit, merchandise, or services in the name of the victim or to provide the thief with false credentials. More than 13 million U.S. adults fell victim to identity fraud in 2013, an increase of 500,000 from 2012. See Figure 9.9.[18]

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FIGURE **9.9**

Identity theft

More than 13 million U.S. adults fell victim to identity fraud in 2013.

The perpetrators of these crimes employ such an extensive range of methods that investigating them is difficult. One method of gaining personal identity information is from hackers gaining unauthorized access to the employee and customer records of organizations. From 2005, when the Identity Theft Resource Center began tracking security breaches, until July 2014, 4,652 total breaches have been recorded, affecting 633 million individuals. (Some individuals were affected multiple times, some were fortunate and were unaffected.)[19]

The number of U.S. taxpayers affected by identity theft has increased sixfold from 270,000 in 2010 to over 1.6 million in 2013. These thefts have resulted in billions of dollars in potentially fraudulent refunds. For example, a Florida mother of three pleaded guilty to using stolen identities to cheat the IRS out of $3 million, but only after she bought a $92,000 Audi, proclaimed herself a millionaire, and foolishly announced on her Facebook page that she was "the queen of IRS tax fraud."[20]

Another rapidly growing area of identity theft involves child identity theft. A recent survey found that 2.5 percent of U.S. households with children under age 18 experienced child identity fraud at some point during their child's lifetime.[21] Children's Social Security numbers are considered "clean," and their theft may not be detected for years. Signs of potential child identity theft include collection calls to the child, difficulty opening a bank account in the child's name, receiving bills or bank statements for the child, and teenagers that are denied an ID card or driver's license due to one already having been issued. Parents should request credit reports for their children to ensure that nothing is amiss.

In some cases, the identity thief uses personal information to open new credit accounts, establish a cellular phone service, or open a new checking account to obtain blank checks. In other cases, the identity thief uses personal information to gain access to the person's existing accounts. Typically, the thief changes the mailing address on an account and runs up a huge bill before the person whose identity has been stolen realizes there is a problem. The Internet has made it easier for an identity thief to use the stolen information because transactions can be made without any personal interaction.

Computer Theft

The number of bank robberies has been reduced by 60 percent since their peak in 1991, with robberies down 23 percent just between 2011 and 2012. The classic bank robbery is being replaced by ATM-skimming and other cybercrimes.[22] Ploutus (also called "Plotos") is malware designed to steal money directly from ATM machines. See Figure 9.10. The malware is uploaded to the ATM on a CD-ROM after picking a lock on the machine to access the CD-ROM drive. The thief can send a command to the malware using the ATM keypad interface to dispense cash. Use of the malware was first detected in Mexico in September 2013 when Mexican police arrested two Venezuelan men suspected of using the malware.[23]

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FIGURE **9.10**

Computer theft

Ploutus malware is designed to steal money directly from ATM machines.

Financial institutions are also concerned about the potential for a "brick attack," where hackers infect the servers that store customer data and render them completely useless, unable to be turned on. The National Security Agency (NSA) reported that it thwarted such a brick attack directed at computers across the United States at the end of 2013.[24]

THE COMPUTER AS A TOOL TO FIGHT CRIME

The computer is also used as a tool to fight computer crime. Information systems are used to fight crime in many ways, including helping recover stolen property, monitoring sex offenders, and helping to better understand and diminish crime risks.

Recovery of Stolen Property

The LeadsOnline Web-based service system is one of several information systems used by law enforcement to recover stolen property. The system contains hundreds of millions of records in its database. Over 680 million transactions have been entered into the system from pawn brokers, secondhand dealers, and salvage yards. In some areas, state or local laws require that all such businesses register (with no charge to business owners) with LeadsOnline. The system allows law enforcement officers to search the database by item serial number or by individual. It even has a partnership with eBay that makes it possible to locate possible stolen merchandise that has been listed for sale or sold online.

The LeadsOnline system has frequently helped to catch criminals and return stolen property to its rightful owners. A police officer was assigned a theft case involving stolen aluminum coils and chain link fencing. To search LeadsOnline, he used a possible suspect name provided by the victim and found that the suspect had recently scrapped a large amount of metal at a local scrap yard. The police officer followed up at the scrap yard and obtained photos of the suspect and the items that he scrapped. The items were positively identified by the victim. Charges are pending in this case.[25]

Monitoring Criminals

JusticeXchange is a Web-based data sharing system that places millions of nationwide booking records at the fingertips of law enforcement officials. The system makes it easy to collaborate with other law enforcement professionals to locate persons of interest.

The system receives data from agencies that book and house offenders through interfaces to their existing jail management systems. Users can search for historical and current information about prisoners, create a "watch" so that they are notified of a specific offender's booking or release by email, and add behavioral information about currently incarcerated offenders to the database.[26]

Watch Systems is a technology partner and consultant to law enforcement organizations nationwide. Its Offender Watch program is a sex offender management and community notification solution for law enforcement. Some 4,500 local, county, and state agencies use it to manage 60 percent of the nation's sex offenders. This Web-based system stores the registered offender's address, physical description, and vehicle information. The public can access the information at *www.communitynotification.com*. The information available varies depending on the county and state. For example, in Hamilton County, Ohio, the data is provided by the sheriff's department and allows the user to search for registered sex offenders by township, school district, zip code, or within one mile of an entered address. The information displayed includes a photo of all registered sex offenders, their description, and current addresses. Law enforcement agencies can search the database based on full or partial license plate number or vehicle description.[27]

Assessing Crime Risk for a Given Area

The ready availability of personal computers, coupled with the development of mapping and analysis software, has led law enforcement agencies to use crime-related data, powerful analysis techniques, and geographic information

systems (GIS) to better understand and even diminish crime risks. The use of such software enables law enforcement agencies, members of an organization's security department, and individuals to gain a quick overview of crime risk at a given address or in a given locale, as shown in Figure 9.11.

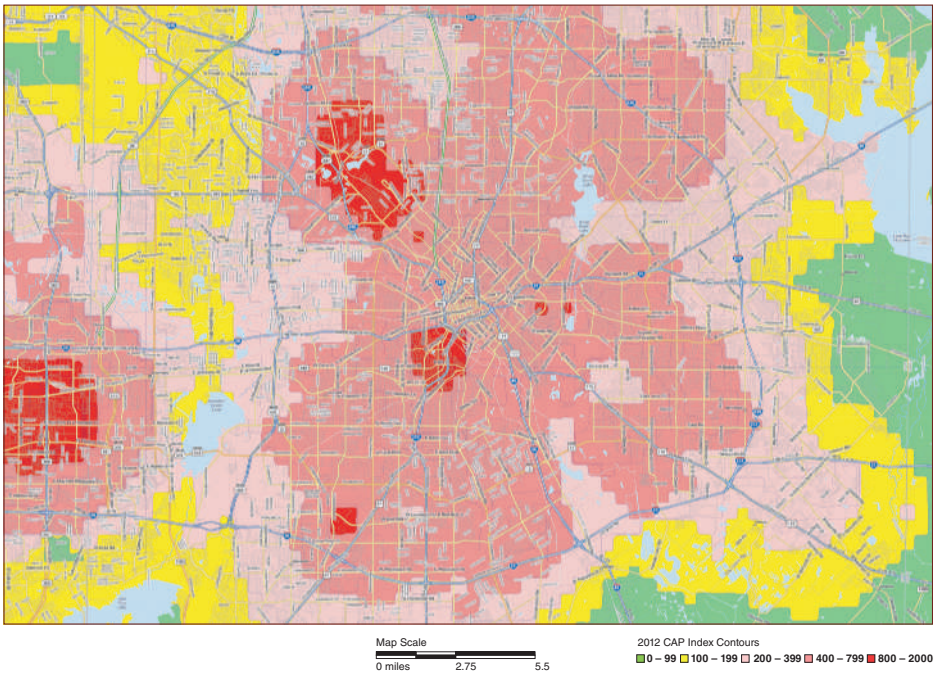


FIGURE **9.11**

Mapping crime risk

A GIS helps law enforcement agencies track and even diminish crime risks.

CAP Index Inc.'s CRIMECAST Reports provide a quick and thorough overview of the crime risk at any given location in the United States, Canada, and the United Kingdom. A detailed map and spreadsheet of risk scores isolate and identify crime-related issues in the vicinity of a specific site. Figure 9.11 shows Dallas, Texas. CRIMECAST clients include more than 80 percent of FORTUNE 100 companies, including Bank of America, Cabela's, Kraft, Lowe's, Nationwide, and Marriott. Companies and government organizations use CRIMECAST data to assess crime risk levels at their facilities, for selection of new sites, for allocation of security resources, and to defend against litigation related to premises security.[28]

With GIS tools, law enforcement agencies can analyze crime data relative to other factors, including the locations of common crime scenes (e.g., convenience stores and gas stations) and certain demographic data (e.g., age and income distribution). Common GIS systems include the following:

- The National Equipment Registry maps mobile equipment thefts in areas where peak equipment thefts have occurred so that police and equipment owners can take appropriate action. It includes more than 15 million ownership records for construction and farm equipment.[29]
- The CompStat (short for computer statistics) program uses GIS software to map crime and identify problem precincts. The program has a proven track record of reducing crime in Boston, Los Angeles, Miami, Newark, New Orleans, New York, and Philadelphia. Other cities are exploring its use, including San Francisco.[30]
- CargoNet is a national database that helps law enforcement and the transportation industry track cargo crimes, identify cargo theft patterns, and improve stolen property recovery rates. The database can be accessed by traditional desktop and laptop computers, tablet computers, and even smartphones.

THE COMPUTER AS THE OBJECT OF CRIME

A computer can also be the object of a crime rather than the tool for committing it. Tens of millions of dollars' worth of computer time and resources are stolen every year. Each time system access is illegally obtained, data or computer equipment is stolen or destroyed, or software is illegally copied, the computer becomes the object of crime. These crimes fall into several categories: illegal access and use, data alteration and destruction, information and equipment theft, software and Internet piracy, computer-related scams, and international computer crime. See Table 9.1.

TABLE 9.1 Common methods used to commit computer crimes

Methods	Examples
Add, delete, or change inputs to the computer system.	Delete records of absences from class in a student's school records.
Modify or develop computer programs that commit the crime.	Change a bank's program for calculating interest so it deposits rounded amounts in the criminal's account.
Alter or modify the data files used by the computer system.	Change a student's grade from C to A.
Operate the computer system in such a way as to commit computer crime.	Access a restricted government computer system.
Divert or misuse valid output from the computer system.	Steal discarded printouts of customer records from a company trash bin.
Steal computer resources, including hardware, software, and time on computer equipment.	Make illegal copies of a software program without paying for its use.
Offer worthless products for sale over the Internet.	Send emails requesting money for worthless hair growth product.
Blackmail executives to prevent release of harmful information.	Eavesdrop on organization's wireless network to capture competitive data or scandalous information.
Blackmail company to prevent loss of computer-based information.	Plant a logic bomb and send a letter threatening to set it off unless paid a considerable sum.

Illegal Access and Use

hacker: A person who enjoys computer technology and spends time learning and using computer systems.

criminal hacker (cracker): A computer-savvy person who attempts to gain unauthorized or illegal access to computer systems to steal passwords, corrupt files and programs, or even transfer money.

script bunny: A derogatory term for inexperienced hackers who download programs called "scripts" that automate the job of breaking into computers.

insider: An employee, disgruntled or otherwise, working solo or in concert with outsiders to compromise corporate systems.

Crimes involving illegal system access and use of computer services are a concern to both government and business. Since the outset of information technology, computers have been plagued by criminal hackers. Originally, a **hacker** was a person who enjoyed computer technology and spent time learning and using computer systems. A **criminal hacker**, also called a **cracker**, is a computer-savvy person who attempts to gain unauthorized or illegal access to computer systems to steal passwords, corrupt files and programs, or even transfer money. In many cases, criminal hackers are people who are looking for excitement—the challenge of beating the system. Today, many people use the term "hacker" and "cracker" interchangeably. **Script bunnies** is a derogatory term for inexperienced hackers who download programs called "scripts" that automate the job of breaking into computers. **Insiders** are employees, disgruntled or otherwise, working solo or in concert with outsiders to compromise corporate systems. The biggest threat for many companies is not external hackers but their own employees. Insiders have extra knowledge that makes them especially dangerous—they know logon IDs, passwords, and company procedures that help them evade detection.

Malaysia Airlines Flight 370 disappeared somewhere over the Indian Ocean in March 2014 with 239 passengers and crew on board. See Figure 9.12. The investigation of the disappearance has raised suspicions that an

FIGURE **9.12**

Insider threats

The loss of Malaysia Airlines Flight 370 may have been an inside crime.

insider (one of the pilots) was responsible for disabling the transponder that signals to ground controllers the location and speed of the aircraft and for reprogramming the aircraft's flight management system to cause the jetliner to deviate from its intended flight path.[31]

Catching and convicting criminal hackers remains a difficult task. The method behind these crimes is often hard to determine, even if the method is known, and tracking down the criminals can take a lot of time.

Because contractors often must be trusted with logon names and passwords and access to secure information systems to complete their job assignment, they can also be considered an insider threat. A man who served 10 years of a 20-year sentence on a murder conviction slipped through the screening process and was hired as a contractor to work at the Chicago O'Hara airport. He subsequently was caught on surveillance video stealing two laptops from a footlocker.[32]

Data and information are valuable corporate assets. The intentional use of illegal and destructive programs to alter or destroy data is as much a crime as destroying tangible goods. The most common of these programs are viruses and worms, which are software programs that, when loaded into a computer system, will destroy, interrupt, or cause errors in processing. Such programs are also called **malware**, and the growth rate for such programs is epidemic. It is estimated that hundreds of previously unknown viruses and worms emerge each day. Table 9.2 describes the most common types of malware.

malware: Software programs that when loaded into a computer system will destroy, interrupt, or cause errors in processing.

In some cases, a virus or a worm can completely halt the operation of a computer system or network for days until the problem is found and repaired. In other cases, a virus or a worm can destroy important data and programs. If backups are inadequate, the data and programs might never be fully functional again. The costs include the effort required to identify and neutralize the virus or worm and to restore computer files and data as well as the value of business lost because of unscheduled computer downtime.

The Trojan horse program Pandemiya monitors its host's input and output data streams looking for user names and passwords for banking and financial accounts. It also scans for Social Security numbers, credit card details, and other data useful to identity thieves. All data of interest is forwarded to the computer of a cybercriminal who then packages the data for resale to other cybercrooks.[33]

TABLE 9.2 Common types of computer malware

Type of Malware	Description
Logic Bomb	A type of Trojan horse that executes when specific conditions occur. Triggers for logic bombs can include a change in a file by a particular series of keystrokes or at a specific time or date.
Rootkit	A set of programs that enables its user to gain administrator level access to a computer or network. Once installed, the attacker can gain full control of the system and even obscure the presence of the rootkit from legitimate system administrators.
Trojan Horse	A malicious program that disguises itself as a useful application or game and purposefully does something the user does not expect.
Variant	A modified version of a virus that is produced by the virus's author or another person by amending the original virus code.
Virus	A malicious program that copies itself and infects a computer, spreading from one file to another, and then from one computer to another when the files are copied or shared. Most viruses attach themselves to executable files, but some can target a master boot record, autorun scripts, or Microsoft Office macros.
Worm	A malicious program that spreads from computer to computer, but unlike a virus, it can spread without any human action. For example, a worm can send a copy of itself to everyone listed in your email address book.

Hackers have recently turned their attention to smartphones—especially ones running the popular Android operating system—for a couple of reasons. First, people have smartphones to be able to download an almost limitless array of apps; however, seemingly innocent programs can provide hackers with easy access to your phone. In addition, few smartphones have much security and antimalware protection, creating a situation ripe for exploitation. Malware creators can access email and contacts lists, monitor personal communications, and capture vital data such as the password used to access a mobile banking app.

One smartphone-hacking technique is taking a popular app such as Jetpack Joyride or 4 Pics, 1 Word, inserting a string of malicious commands into its code, and then relisting it on a third-party app site that doesn't have the same stringent application process as Google Play or the Apple Store. When a user downloads the app from the third-party app store for what they think is a bargain price, they instead get problems.[34]

The Star N9500, a cheap Android-powered smartphone made in China, ships with more than an 8-megapixel camera and quad-core processor, according G Data, a Germany cybersecurity company. The company says it has discovered malicious software—which could be used to track the phone's user and manipulate the device remotely—embedded in the device.[35]

Spyware

spyware: Software that is installed on a personal computer to intercept or take partial control of the user's interaction with the computer without the knowledge or permission of the user.

Spyware is software installed on a personal computer to intercept or take partial control of the user's interaction with the computer without the knowledge or permission of the user. Some forms of spyware secretly log keystrokes so that user names and passwords may be captured. Other forms of spyware record information about the user's Internet surfing habits and sites that have been visited. Still other forms of spyware change personal computer settings so that the user experiences slow connection speeds or is redirected to Web pages other than those expected. Spyware is similar to a Trojan horse in that users unknowingly install it when they download freeware or shareware from the Internet.

The Hacking Team is an Italian computer spyware firm whose software allegedly has been used by foreign governments to snoop on dissidents and journalists. Its software can filch documents from hard drives, eavesdrop on video chats, scan emails, steal contact lists, and remotely turn on cameras and microphones to spy on a computer's unsuspecting user. Victims include a

human rights activist in Dubai, a group of journalists in Morocco critical of the government, and an Ethiopian journalist in the United States. All were hacked and had their email read without their knowledge. Many fear that in the wrong hands, the Hacking Team software can become a highly intrusive tool placing dissidents and activists at risk.[36] Such software also can be used by industrial spies and those who are suspicious of their significant other.

Information and Equipment Theft

Data and information are assets or goods that can also be stolen. People who illegally access systems often do so to steal data and information. To obtain illegal access, criminal hackers require identification numbers and passwords. Some criminals try various identification numbers and passwords until they find ones that work. Using password sniffers is another approach. A **password sniffer** is a small program hidden in a network or a computer system that records identification numbers and passwords. In a few days, a password sniffer can record hundreds or thousands of identification numbers and passwords. Using a password sniffer, a criminal hacker can gain access to computers and networks to steal data and information, invade privacy, plant viruses, and disrupt computer operations.

password sniffer: A small program hidden in a network or a computer system that records identification numbers and passwords.

The Mask is a collection of malware that infects computers running the Windows, OS X, and Linux operating systems. It is considered to be the most sophisticated malware-driven espionage campaign uncovered to date. The malware captures key strokes, Skype conversations, and other forms of sensitive data. The Mask is aimed at specific people or organizations that possess unique data or capabilities with strategic national or business value. Its primary targets appear to be activists, energy companies, government agencies and embassies, private equity firms, and research institutions. Given its targets and degree of sophistication, experts believe that the Mask is the product of hackers sponsored by a well-financed nation-state.[37]

In addition to theft of data and software, all types of computer systems and equipment have been stolen from homes, offices, schools, and vehicles. Software is available to enable you to locate your laptop in the event it is lost or stolen. For example, MyTheftProtection enables you to track, trace, and monitor your computer using GPS technology and Google Maps. You can even get pictures of the thief via the webcam as well as communicate with the thief or user.[38]

ghassem khosrownia/Getty Images

FIGURE **9.13**

Protecting computers

To fight computer crime, many companies use devices that disable the disk drive or lock the computer to the desk.

In many cases, the data and information stored in these systems are more valuable than the equipment. Personal data can be used in identity theft. In addition, the victim organization receives a tremendous amount of negative publicity that can cause it to lose existing and potential future customers. Often, the victim organization offers to pay for credit-monitoring services for those people affected in an attempt to restore customer goodwill and avoid law suits.

Patent and Copyright Violations

Works of the mind, such as art, books, films, formulas, inventions, music, and processes that are distinct and "owned" or created by a single person or group, are called "intellectual property." Copyright law protects authored works such as art, books, film, and music. Patent laws protect processes, machines, objects made by humans or machines, compositions of matter, and new uses of these items. Software is considered intellectual property and may be protected by copyright or patent law.

software piracy: The act of unauthorized copying, downloading, sharing, selling, or installing of copyrighted software.

Software piracy is the act of unauthorized copying, downloading, sharing, selling, or installing of software. When you purchase software, you are purchasing a license to use it; you do not own the actual software. The license states how many times you can install the software. If you make more copies of the software than the license permits, you are pirating.

The Business Software Alliance (BSA) has become a prominent software antipiracy organization. Software companies, including Adobe, Apple, Hewlett-Packard, IBM, Intel, and Microsoft contribute funds to the operation of BSA. The BSA estimates that the global rate of unlicensed PC software use was 43 percent in 2013 with a global commercial value of $62.7 billion. The region with the lowest overall rate of unlicensed software was North America at 19 percent, and the region with highest overall rate of unlicensed software was the Asia-Pacific region at 62 per cent.[39]

digital rights management (DRM): Refers to the use of any of several technologies to enforce policies for controlling access to digital media, such as movies, music, and software.

Digital rights management (DRM) refers to the use of any of several technologies to enforce policies for controlling access to digital media, such as movies, music, and software. Many digital content publishers state that DRM technologies are needed to prevent revenue loss due to illegal duplication of their copyrighted works. While the costs of movie piracy can only be estimated imprecisely, the Motion Picture Association of America (MPAA) estimates that 29 million U.S. adults have watched illegal copies of movies or TV shows. It is estimated that over 300 million users use BitTorrent, a commonly used peer-to-peer file-sharing service, to download free content each month.[40] On the other hand, many digital content users argue that DRM and associated technologies lead to a loss of user rights. For example, users can purchase a music track online for less than a dollar through Apple's iTunes music store. They can then burn that song to a CD and transfer it to an iPod. However, the purchased music files are encoded in the AAC format supported by iPods and protected by FairPlay, a DRM technology developed by Apple. To the consternation of music lovers, most music devices are not compatible with the AAC format and cannot play iTunes' protected files. See Figure 9.14.

Penalties for software piracy can be severe. If the copyright owner brings a civil action against someone, the owner can seek to stop the person from using its software immediately and can also request monetary damages. The copyright owner can then choose between compensation for actual damages—which includes the amount lost because of the person's infringement as well as any profits attributable to the infringement—and statutory damages, which can be as much as $150,000 for each program copied. In addition, the government can prosecute software pirates in criminal court for copyright infringement. If convicted, they could be fined up to $250,000 or sentenced to jail for up to five years or both.

Project Options Ltd, an engineering design company in the United Kingdom, was found to be using several unlicensed copies of Autodesk software for computer-aided design (CAD). The firm was ordered to pay £33,000 (over $55,000) in related fines. The software piracy was brought to the attention of the BSA from a confidential online report filed through their Web site. The BSA encourages the reporting of software piracy by promising a cash reward for anonymous reports.[41]

FIGURE **9.14**

Digital rights management

Due to digital rights management (DRM) technology, music files that iTunes members purchase and download play only on iPods and other AAC-compatible devices.

Another major issue in regards to copyright infringement is the downloading of copyright-protected music. Estimates vary widely as to how much music piracy is costing the recording industry. In the decade since peer-to-peer (p2p) file-sharing site Napster emerged in 1999, music sales in the United States dropped 47 percent, from $14.6 billion to $7.7 billion. The Institute for Policy Innovation estimates that the U.S. global recording industry loses about $12.5 billion in revenue from music piracy every year. It is projected that this results in 71,000 lost jobs and $2.7 billion in lost wages for U.S. workers.[42]

A Louisiana man was sentenced to two years in federal prison for manufacturing and distributing pirated movies and music albums. The individual duplicated copyrighted motion pictures and music using a home DVD/CD burner and then sold these illegal copies for $10 from his parked car. During a search of his home, investigators seized over 1,000 pirated DVDs and CDs with an estimated retail value of more than $12,000.[43]

Patent infringement is also a major problem for computer software and hardware manufacturers. It occurs when someone makes unauthorized use of another's patent. If a court determines that a patent infringement is intentional, it can award up to three times the amount of damages claimed by the patent holder. It is not unusual to see patent infringement awards in excess of $10 million.

Apple and Samsung are involved in a series of patent infringement legal battles regarding the design of smartphones and tablet computers. The problems began in spring 2010, when Samsung launched the Galaxy S, a new entry into the smartphone market. Apple designers thought the overall appearance of the Galaxy S, its screen, its icons, and even its box closely resembled the iPhone. See Figure 9.15. In addition, Apple alleged that many of its patented features such as "pinch to zoom" were copied in the Galaxy S. Samsung, in turn, claimed that Apple had violated over 22 of its patents. By October 2011, Apple and Samsung were litigating 19 ongoing cases in 10 countries. To date, the two companies have litigation costs exceeding $1 billion.[44]

To obtain a patent or to determine if a patent exists in an area a company seeks to exploit requires a search by the U.S. Patent Office; these can last longer than 25 months. Indeed, the patent process is so controversial that manufacturing firms, the financial community, consumer and public interest groups, and government leaders are demanding patent reform.

FIGURE **9.15**

Patent infringement

Apple and Samsung are involved in a series of patent infringement legal battles regarding the design of smartphones and tablet computers.

Computer-Related Scams

People have lost hundreds of thousands of dollars to real estate, travel, stock, and other business scams. Today, many of these scams are being perpetrated with computers. Using the Internet, scam artists offer get-rich-quick schemes involving bogus real estate deals, tout "free" vacations with huge hidden costs, commit bank fraud, offer fake telephone lotteries, sell worthless penny stocks, and promote illegal tax-avoidance schemes.

Many cases of Internet fraud involve nondelivery of automobiles advertised for sale on the Internet. The hoaxer posts photos and a description of a vehicle offered for sale. When an interested buyer responds, the victim is told that the vehicle is located overseas. The fraudster then tells the victim to send a deposit via a wire transfer to initiate the shipping process. Once that transfer is done, the buyer hears nothing further from the fraudster. In a devious variation on this scam, the hoaxer advises the victim about a problem with the initial wire transfer. To correct the problem, the hoaxer sends the victim a cashier's check (counterfeit) and tells the victim to cash the check and resend a second wire to a different account. The victim is unaware that the cashier's check is counterfeit and follows the directions, getting stung a second time.[45]

Another common complaint involves romance scams in which scammers target individuals searching for companionship or romance online. The fraudsters often use a stolen identity to appear reputable and begin to "friend" potential victims trying to develop an online relationship with their victims. Victims believe they are "dating" a good and honest person without ever physically meeting them. As the relationship grows, the fraudsters reveal that they are in a predicament and need cash. Perhaps they are overseas on urgent business and a family member has fallen ill. They need money to get home. Victims end up wiring funds (sometimes repeatedly) to the fraudster, believing they are involved in a genuine relationship.[46]

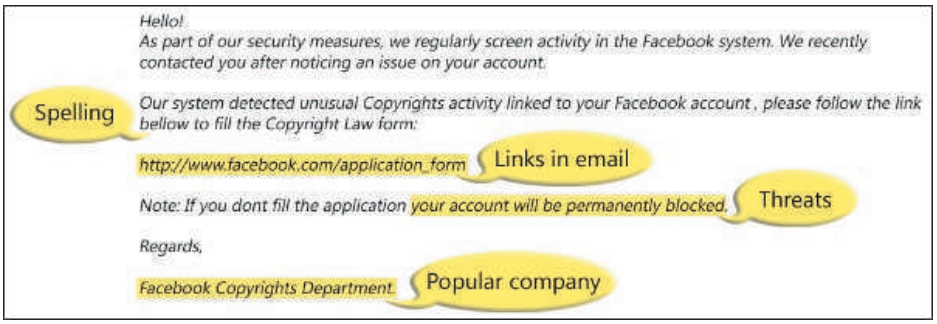
Over the past few years, credit card customers of various banks have been targeted by scam artists trying to get personal information needed to use their credit cards. The scam works by sending customers an email including a link that seems to direct users to their bank's Web site. At the site, they are greeted with a pop-up box asking them for their full credit card numbers, their personal

identification numbers, and their credit card expiration dates. The problem is that the Web site is fake, operated by someone trying to gain access to customers' private information, a form of computer scam called **phishing**.

phishing: A form of computer scam that attempts to get users to gain access to a customer's private information through a fake Web site.

Phishing attacks worldwide have been increasing and set a record in the first quarter of 2014 when 125,215 attacks were observed. The fraudsters attacking the Web sites of payment services accounted for 47 percent of the targets, financial services firms were the target in 20 percent of the attacks, and retail/service firms were targeted 11 percent of the time.[47]

The current round of phishing scams are so sophisticated that they look like emails you would expect to receive from a major bank. Messages display a familiar bank logo and clicking it takes you to the real bank's Web site. The email uses a real no-reply email address from the bank itself rather than a clearly fake Yahoo or Hotmail address. However, the messages inform recipients that because the bank found a serious problem with their account, they must complete a form and provide account numbers, personal identification numbers, and other key information scammers need to impersonate you. See Figure 9.16. Phishing has become such a serious problem that the Bank of America, Facebook, Fidelity Investments, Google, JP Morgan Chase & Company, LinkedIn, Microsoft, PayPal, Yahoo, and other organizations have formed the Domain-based Message Authentication, Reporting, and Conformance (DMARC) group to provide improved email security and protection from phishing.[48]



Microsoft product screenshots used with permission from Microsoft Corporation.

FIGURE **9.16**

Sample phishing email message

Phishing attacks worldwide have been increasing.

vishing: A scam that attempts to steal an individual's private information by having them call a phone number and enter personal data.

Vishing is similar to phishing. However, instead of using the victim's computer, it uses the victim's phone. The victim is typically sent a notice or message to call to verify account information. If the victim returns the message, the caller asks for personal information, such as a credit card account number or name and address. The information gained can be used in identity theft to acquire and use credit cards in the victim's name. Vishing criminals can even use the Spoof Card, sold online for less than $5 dollars for 25 calls. It causes phones to display a caller ID number specified by the caller rather than the actual number of the caller.[49]

smishing: A scam that attempts to steal an individual's private information by having them respond to a text message.

Smishing is similar to phishing and vishing. It is text-message fraud that occurs when criminals, posing as financial institutions, attempt to dupe mobile-phone users into giving personal information through text messages, calling a telephone number, or visiting a fraudulent Web site.

International Computer Crime

Computer crime becomes more complex when it crosses borders. Money laundering is the practice of disguising illegally gained funds so that they seem legal. With the increase in electronic cash and funds transfer, some are concerned that terrorists, international drug dealers, and other criminals are using information systems to launder illegally obtained funds.

Federal prosecutors indicted four Russians and a Ukrainian in what is one of the largest computer crimes in U.S. history. The five conspired in a worldwide scheme that targeted major corporate networks, stole more than 160 million

INFORMATION SYSTEMS @ WORK

The United States Charges the Chinese People's Liberation Army with Stealing Trade Secrets

In May, 2014, the United States Department of Justice (DOJ) charged five members of the Unit 61398 of the China's army, the Chinese People's Liberation Army (PLA), with 31 counts of cyber espionage. The charges accuse Gu Chunhui, Wang Dong, Sun Kailiang, Wen Xinyu, and Huang Zhenyu, members of PLA Unit 61398, of stealing trade secrets pertaining to Westinghouse AP1000 nuclear power plant technology, nabbing manufacturing plans and costs from SolarWorld, swiping the network credentials for every single Allegheny Technologies Incorporated (ATI) employee, and intercepting emails at Alcoa.

The information looted from U.S. corporations through these and the many other misdeeds listed in the indictment provide significant advantages to government-owned Chinese competitors. First, by illegally obtaining the plans to the Westinghouse technology, the Chinese nuclear companies gain both time and money they would have had to invest in the research and development necessary to develop the system themselves. Second, SolarWorld's manufacturing costs and plans will aid Chinese companies in their current campaign to undercut U.S. and other Western solar firms by flooding the market with cheaper solar technologies. Finally, the attacks on steel giants, ATI and Alcoa, aim at stealing the manufacturing secrets Chinese companies need to make high-quality steel so that they may gain a wider hold in the international marketplace.

The legal motion marked a new approach of the U.S. government toward government-sponsored Chinese espionage. "In the past, when we brought concerns such as these to Chinese government officials, they responded by publicly challenging us to provide hard evidence of their hacking that could stand up in court," explained John Carlin, director of DOJ's national security division. This time, the U.S. government turned to cyber defense company Mandiant, which issued a lengthy report based on an investigation it had conducted.

According to Mandiant, PLA Unit 61398 is located in a nondescript 12-floor building in Shanghai's Pudong District—a building that can house a maximum of 2,000 cyber spies. The unit may have other locations, as it controls over 1,000 servers. Since 2006, Mandiant estimates that Unit 61398 has stolen hundreds of terabytes of data from 141 companies, 115 of which were based in the United States. The unit's high-tech fiber-optic communications infrastructure is provided by state-owned China Telecom.

What is unclear, however, is whether legal action taken in a U.S. court can counter the Chinese threat. According to Mandiant, PLA Unit 61398 is only one of 20 Chinese cyberattack groups. Moreover, PLA Unit 61398 besides hacking into IT systems, has installed malware. Hackers could potentially break into a company's system and sabotage a factory's machines right before an important delivery deadline.

Even more frightening, perhaps, is that the PLA Unit 61398 and other Chinese hackers have not only breached the systems of strategic American industries, including aerospace, telecommunications, satellite, and IT, they have breached the IT systems of federal agencies, including those dedicated to defense. In July 2014, the U.S. DOJ charged Chinese national Su Bin with stealing 65 gigabytes of information related to Boeing fighter jets. In August 2014, well-known security expert Brian Krebs reported that PLA Unit 61398 had stolen 700 documents from three defense contractors that had developed Israel's missile defense system, the Iron Dome.

There's no question that these Chinese-government-sponsored hackers present a serious threat both economically and militarily. The question that remains open is what the U. S. government can do about it.

Discussion Questions

1. What is PLA Unit 61398 and what type of crimes are they charged with?
2. What can and should the United States do to stop PLA Unit 61398 and similar groups?

Critical Thinking Questions

1. What impact will the crimes PLA Unit 61398 have on Westinghouse, SolarWorld, Alcoa, ATI, and other victims of the group?
2. What are the potential military threats that PLA Unit 61398 poses to the U.S. and other Western nations?

SOURCES: "US Justice Department Charges Chinese with Hacking," *BBC News*, May 19, 2014, *www.bbc.com/news/world-us-canada-27475324*; Pagliery, Jose, "What Were China's Hacker Spies After?"*CNN Money*, May 19, 2014, *http://money.cnn.com/2014/05/19/technology/security/china-hackers/*; Li, Zoe, "What We Know about the Chinese Army's Alleged Cyber Spying Unit,"*CNN World*, May 20, 2014, *www.cnn.com/2014/05/20/world/asia/china-unit-61398/*; Musil, Steven, "US Charges Chinese Executive with Hacking Military Data,"*CNET*, *www.cnet.com*, July 13, 2014; Ghoshal, Debalina, "China Hacking Iron Dome, Arrow Missile Defense Systems," Gatestone Institute International Policy Council, August 5, 2014, *www.gatestoneinstitute.org/4578/china-hacking-missile-defense*.

credit card numbers, and resulted in hundreds of millions of dollars in losses.[50] The hacked companies included the French firm Carrefour SA, and several U.S.-based firms including JCPenney, JetBlue Airways, Nasdaq, and Visa. Two of the criminals hacked into networks; one mined data to steal user names and passwords, personal identification data, and credit and debit card numbers; one provided anonymous Web-hosting services to conceal the actions of the group; and another sold the stolen data and distributed the profits.[51]

PREVENTING COMPUTER-RELATED CRIME

Because of increased computer use today, greater emphasis is placed on the prevention and detection of computer crime. Although all states have passed computer crime legislation, some believe that these laws are not effective because companies do not always actively detect and pursue computer crime, security is inadequate, and convicted criminals are not severely punished. However, all over the United States, private users, companies, employees, and public officials are making individual and group efforts to curb computer crime, and recent efforts have met with some success.

Crime Prevention by State and Federal Agencies

State and federal agencies have begun aggressive attacks on computer criminals, including criminal hackers of all ages. In 1986, Congress enacted the Computer Fraud and Abuse Act, which mandates punishment based on the victim's dollar loss.

United States Computer Emergency Readiness Team (US-CERT): Part of the Department of Homeland Security that leads U.S. efforts to improve the nation's cybersecurity posture, coordinate cyber information sharing, and proactively manage cyber risks to the nation.

United States Computer Emergency Readiness Team (US-CERT) is part of the Department of Homeland Security. US-CERT leads U.S. efforts to improve the nation's cybersecurity posture, coordinate cyber information sharing, and proactively manage cyber risks to the nation. It attempts to do all this while protecting the constitutional rights of Americans. US-CERT partners with private sector critical infrastructure owners and operators, academia, federal agencies, Information Sharing and Analysis Centers (ISACs), state and local partners, and domestic and international organizations to enhance the country's cybersecurity position.[52]

Advice for providing good computer and network security as well as a complete listing of computer-related legislation by state can be found at the US-CERT Web site at *https://www.us-cert.gov/ncas* and at the Online Security Web site at *www.onlinesecurity.com/forum/article46.php*. Recent court cases and police reports involving computer crime show that lawmakers are ready to introduce newer and tougher computer crime legislation.

Crime Prevention by Organizations

Public and private organizations are also taking crime-fighting efforts seriously. Many businesses have designed procedures and specialized hardware and software to protect their corporate data and systems. Specialized hardware and software, such as encryption devices, can be used to encode data and information to help prevent unauthorized use. Encryption is the process of converting an original electronic message into a form that can be understood only by the intended recipients. A key is a variable value that is applied using an algorithm to a string or block of unencrypted text to produce encrypted text or to decrypt encrypted text. Encryption methods rely on the limitations of computing power for their effectiveness: If breaking a code requires too much computing power, even the most determined code crackers will not be successful. The length of the key used to encode and decode messages partially determines the strength of the encryption algorithm.

Over 75 percent of U.S. organizations view data protection activities as a key component of enterprise risk management. Thus, the use of encryption

to protect data stored on backup files and laptops and data transmitted externally is increasing. The primary justification for implementing encryption is to protect an organization's brand or reputation from the damage that would result from a serious data breach.

As a consequence of the Affordable Care Act, the government is now enforcing the healthcare data security laws, with major fines being imposed on noncompliant organizations. For example, when a laptop computer carrying the health information of 441 patients was stolen from the Hospice of North Idaho, the organization was fined over $50,000 by the Department of Health and Human Services.[53]

A class-action lawsuit was filed against the Maricopa County Community College District over a computer security breach that exposed the personal information of more than 2.4 million current and former students, employees, and vendors going back some 30 years. Banking information, Social Security numbers, and academic information were exposed. The lawsuit alleges that the district was negligent by not protecting the personal information of these people. The district has budgeted $17 million to deal with the incident including $10 million for credit-monitoring expenses for those affected.[54]

As employees move from one position to another in a company, they can build up access to multiple systems if inadequate security procedures fail to revoke access privileges. It is clearly not appropriate for people who have changed positions and responsibilities to still have access to systems that they no longer use. To avoid this problem, many organizations create role-based system access lists so that only people filling a particular role (e.g., invoice approver) can access a specific system.

Hackers sometimes gain access to systems by exploiting inactive user accounts. It is critical that accounts of employees or contractors who have left the company or who are on extended disability be terminated. A fired, former campaign manager for New Mexico's governor pleaded guilty to two felony counts of intercepting her email. Prosecutors alleged that he used her password and username information to change the computer account for the governor's 2010 campaign organization after she took office as governor. As a result, messages sent through the campaign email system by the governor and her aides were directed to a computer account controlled by the man.[55]

separation of duties: The careful division of the tasks and responsibilities associated with a key process so that they must be performed by more than one person.

In addition, a fundamental concept of good internal controls is the careful separation of duties associated with a key process so that they must be performed by more than one person. **Separation of duties** is essential for any process that involves the handling of financial transactions so that fraud requires the collusion of two or more parties. When designing an accounts receivable information system, for instance, separation of duties dictates that you separate responsibility for the receipt of customer payments, approving write-offs, depositing cash, and reconciling bank statements.

Proper separation of duties is frequently reviewed during any audit. A deputy in a county clerk's office was suspended for five days after using the county's server to work on his boss's re-election campaign. In addition, the county clerk himself used the county server to do campaign work. The state's campaign disclosure law requires a separation of duties so that candidates and those working on their campaigns cannot use taxpayer resources for political purposes.[56]

Crime-fighting procedures usually require additional controls on the information system. Before designing and implementing controls, organizations must consider the types of computer-related crime that might occur, the consequences of these crimes, and the cost and complexity of needed controls. In most cases, organizations conclude that the trade-off between crime and the additional cost and complexity weighs in favor of better system controls. Having knowledge of some of the methods used to commit crime is also helpful in preventing, detecting, and developing systems

resistant to computer crime. Some companies actually hire former criminals to thwart other criminals.

Many current and proposed biometric ID systems have been designed to prevent crime. For example, fingerprint authentication devices provide security in the PC environment by using fingerprint recognition instead of passwords. Laptop computers from Lenovo, Toshiba, and others have built-in fingerprint readers used to log on and gain access to the computer system and its data. In addition, many new biometric ID systems are being considered for use with smartphones. Indeed, it is predicted that 619 million people will be using biometrics on their mobile devices by the end of 2015. See Figure 9.17. As smartphones become more and more valuable to us, the need for secure phone access becomes vital.[57]

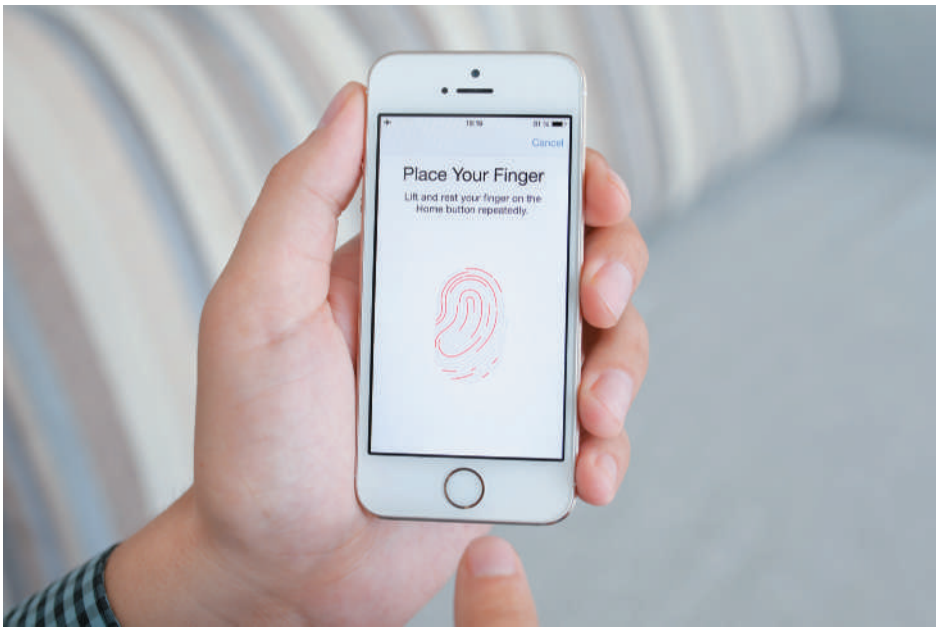


FIGURE **9.17**

Biometric smartphone

Many new biometric ID systems are being considered for use with smartphones.

The following list provides a set of useful guidelines to protect corporate computers from criminal hackers:

- Install strong user authentication and encryption capabilities on the corporate firewall.
- Install the latest security patches, which are often available at the vendor's Internet site.
- Disable guest accounts and null user accounts that let intruders access the network without a password.
- Do not provide overfriendly sign-in procedures for remote users (e.g., an organization that used the word "welcome" on its initial logon screen found it had difficulty prosecuting a criminal hacker).
- Restrict physical access to the server and configure it so that breaking into one server won't compromise the whole network.
- Dedicate one server to each application (email, File Transfer Protocol, and domain name server). Turn audit trails on.
- Install a corporate firewall between your corporate network and the Internet.
- Install antivirus software on all computers and regularly download vendor updates.
- Conduct regular IS security audits.
- Verify and exercise frequent data backups for critical data.

Using Intrusion Detection System

intrusion detection system (IDS): Monitors system and network resources and traffic and notifies network security personnel when it senses a possible intrusion.

An **intrusion detection system (IDS)** monitors system and network resources and traffic and notifies network security personnel when it senses a possible intrusion. Examples of suspicious activities include repeated failed logon attempts, attempts to download a program to a server, and access to a system at unusual hours. Such activities generate alarms that are captured on log files. When they detect an apparent attack, intrusion detection systems send an alarm, often by email or pager, to network security personnel. Unfortunately, many IDSs frequently provide false alarms that result in wasted effort. If the attack is real, network security personnel must make a decision about what to do to resist the attack. Any delay in response increases the probability of damage. Use of an IDS provides another layer of protection in case an intruder gets past the outer security layers—passwords, security procedures, and corporate firewall.

Metro Madrid is the public rail transportation system for Madrid, Spain. See Figure 9.18. With 175 miles of track, 300 stations, and over one billion passengers a year, it is one of the largest metropolitan rail systems in the world. Devices on its information system and control networks manage everything from automated ticketing machines to back office business systems to turnstiles and track management systems. Ensuring the security of these networks is essential for Metro Madrid to deliver safe, efficient, and reliable services. Metro Madrid implemented an intrusion detection system to monitor its tens of thousands of devices and application servers and protect from unwanted hackers.[58]

© Iakov Filimonov/Shutterstock.com

FIGURE **9.18**

Metro Madrid

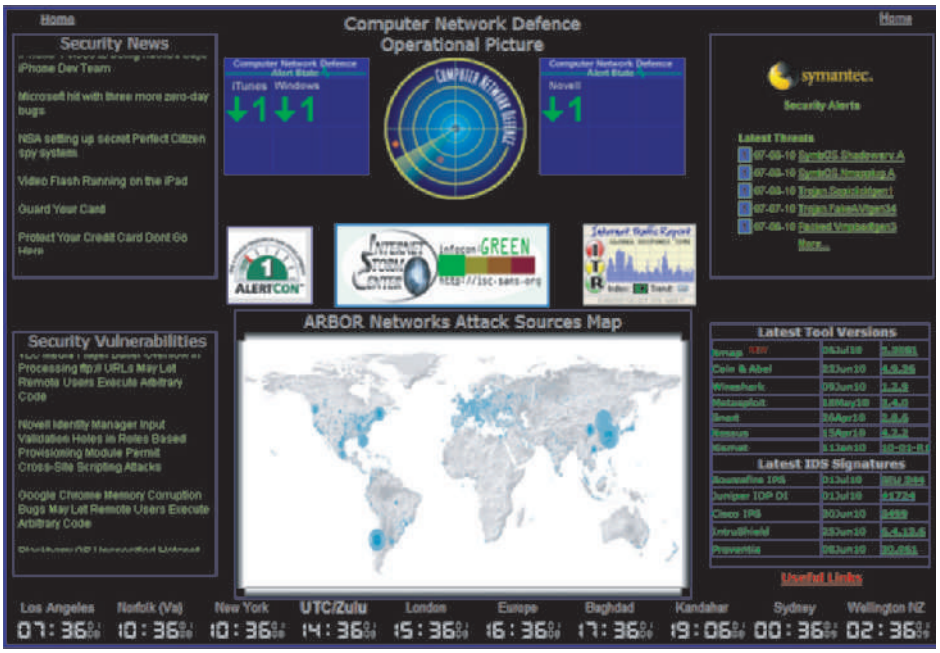
Metro Madrid uses an intrusion detection system to monitor the devices and application servers on its network and protect them from hackers.

Security Dashboard

security dashboard: Software that provides a comprehensive display on a single computer screen of all the vital data related to an organization's security defenses, including threats, exposures, policy compliance and incident alerts.

Many organizations use **security dashboard** software to provide a comprehensive display on a single computer screen of all the vital data related to an organization's security defenses, including threats, exposures, policy compliance, and incident alerts. The goal is to reduce the effort required for monitoring and to identify threats in time. Data comes from a variety of sources, including firewalls, applications, servers, and other software and hardware devices. See Figure 9.19.

McKesson Corporation is the largest pharmaceutical company in the world with recent annual sales of $137 billion, 50 global offices, and over 37,000 employees.[59] The firm implemented a security dashboard to gain a



Computer Network Defence Ltd

FIGURE **9.19**

Computer Network Defence Internet Operational Picture

The Computer Network Defence Internet Operational Picture, a security dashboard designed for the United Kingdom government and military networks, displays near real-time information on new and emerging cyber threats.

clear enterprise-wide view of its network vulnerability status. The dashboard provides actionable information to enable the security team to prioritize known and emerging vulnerabilities on its global network.[60]

Using Managed Security Service Providers

managed security service providers (MSSPs): Organizations thatmonitor, manage, and maintain network security for both hardware and software for other organizations.

Keeping up with computer criminals—and with new regulations—can be daunting for organizations. Criminal hackers are constantly poking and prodding, trying to breach the security defenses of companies. Also, such legislation as HIPAA, Sarbanes-Oxley, and the USA Patriot Act requires businesses to prove that they are securing their data. For most small and mid-sized organizations, the level of in-house network security expertise needed to protect their business operations can be quite costly to acquire and maintain. As a result, many are outsourcing their network security operations to **managed security service providers (MSSPs)**, such as AT&T, Computer Sciences Corporation (CSC), Dell SecureWorks, IBM, Symantec, and Verizon. MSSPs monitor, manage, and maintain network security for both hardware and software. These companies provide a valuable service for IS departments drowning in reams of alerts and false alarms coming from virtual private networks (VPNs); antivirus, firewall, and intrusion detection systems; and other security-monitoring systems. In addition, some provide vulnerability scanning and Web blocking and filtering capabilities.

OnCue Express operates over 50 gas and convenience stores in the Midwest. Nearly 10 million credit card transactions traverse its network annually. The firm must comply with the Payment Card Industry Data Security Standards (PCI DSS), which require it to achieve minimal levels of information security or face significant fines for noncompliance. In addition, OnCue would incur at least a $12,000 per hour loss in revenue if its network were disrupted. Facing these serious risks, OnCue decided to engage an MSSP to assess its network security and provide recommendations to improve it. OnCue now produces PCI Scanning reports of externally facing systems, such as point of sale (POS) servers, to identify and remediate any vulnerabilities detected. With the help of the MSSP, OnCue was able to upgrade its network security without an increase in staff.[61]

Guarding against Theft of Equipment and Data

Organizations need to take strong measures to guard against the theft of computer hardware and the data stored on it. Here are a few measures to be considered:

- Set clear guidelines on what kind of data (and how much of it) can be stored on vulnerable laptops. In many cases, private data or confidential company data may not be downloaded to laptops that leave the office.
- Require that data stored on laptops be encrypted and do spot checks to ensure that this policy is followed.
- Require that all laptops be secured using a lock and chain device so that they cannot be easily removed from an office area.
- Provide training to employees and contractors on the need for safe handling of laptops and their data. For example, laptops should never be left in a position where they can be viewed by the public, such as on the front seat of an automobile.
- Consider installing tracking software on laptops. The software sends messages via a wireless network to the specified email address, pinpointing its location and including a picture of the thief (for those computers with an integrated Web cam).

Crime Prevention for Individuals and Employees

This section outlines actions that individuals can take to prevent becoming a victim of computer crime, including identity theft, malware attacks, theft of equipment and data, and computer scams.

Identity Theft

The U.S. Congress passed the Identity Theft and Assumption Deterrence Act of 1998 to fight identity theft. Under this act, the Federal Trade Commission (FTC) is assigned responsibility to help victims restore their credit and erase the impact of the imposter. It also makes identity theft a federal felony punishable by a prison term ranging from 3 to 25 years.

Consumers can protect themselves from identity theft by regularly checking their credit reports with major credit bureaus, following up with creditors if their bills do not arrive on time, not revealing any personal information in response to unsolicited email or phone calls (especially Social Security numbers and credit card account numbers), and shredding bills and other documents that contain sensitive information.

Some consumers contract with a service company that provides fraud-monitoring services, helps file required reports, and disputes unauthorized transactions in accounts. Some services even offer identity theft guarantees of up to $1 million. Some of the more popular services include TrustedID, LifeLock, ProtectMyID, IDWatchdog, and Identity Guard. These services cost between $6 and $20 per month.

Malware Attacks

antivirus program: Software that runs in the background to protect your computer from dangers lurking on the Internet and other possible sources of infected files.

The number of personal computers infected with malware (viruses, worms, spyware, etc.) has reached epidemic proportions. As a result of the increasing threat of malware, most computer users and organizations have installed **antivirus programs** on their computers. See Figure 9.20. Such software runs in the background to protect your computer from dangers lurking on the Internet and other possible sources of infected files. The latest virus definitions are downloaded automatically when you connect to the Internet, ensuring that your PC's protection is current. To safeguard your PC and prevent it from spreading malware to your friends and coworkers, some antivirus software scans and cleans both incoming and outgoing email messages. Table 9.3 lists the top-rated antivirus software for 2014.[62,63,64]

TABLE 9.3 Top-rated antivirus software

For Windows systems	For Mac systems
Webroot Secure Anywhere Antivirus ($19.99)	Kromtech MacKeeper ($59.95)
Norton Antivirus ($49.99)	Intego Mac Internet Security ($39.95)
Bitdefender Antivirus Plus ($39.95)	Kaspersky Internet Security for Mac ($39.95)
Kaspersky Antivirus ($34.95)	Norton Antivirus (free)
AVG Antivirus (free)	Avira Free MacSecurity (free)
Malwarebytes Anti-Malware 2.0 (free)	

FIGURE **9.20**

Antivirus software

Antivirus software should be used and updated often.

Proper use of antivirus software requires the following steps:

1. **Install antivirus software and run it often**. Many of these programs automatically check for viruses each time you boot up your computer or insert a disk or CD, and some even monitor all email, file transmissions, and copying operations.
2. **Update antivirus software often**. New viruses are created all the time, and antivirus software suppliers are constantly updating their software to detect and take action against these new viruses.
3. **Scan all removable media, including CDs, before copying or running programs from them**. Hiding on disks or CDs, viruses often move between systems. If you carry document or program files on removable media between computers at school or work and your home system, always scan them.
4. **Install software only from a sealed package or secure Web site of a known software company**. Even software publishers can unknowingly distribute viruses on their program disks or software downloads. Most scan their own systems, but viruses might still remain.
5. **Follow careful downloading practices**. If you download software from the Internet or a bulletin board, check your computer for viruses immediately after completing the transmission.
6. **If you detect a virus, take immediate action.** Early detection often allows you to remove a virus before it does any serious damage.

Many email services and ISP providers offer free antivirus protection. For example, AOL and MWEB (one of South Africa's leading ISPs) offer free antivirus software from McAfee.

Computer Scams

The following is a list of tips to help you avoid becoming a victim of a computer scam:

- Don't agree to anything in a high-pressure meeting or seminar. Insist on having time to think it over and to discuss your decision with someone you trust. If a company won't give you the time you need to check out an offer and think things over, you don't want to do business with it. A good deal now will be a good deal tomorrow; the only reason for rushing you is if the company has something to hide.
- Don't judge a company based on appearances. Flashy Web sites can be created and published in a matter of days. After a few weeks of taking money, a site can vanish without a trace in just a few minutes. You might find that the perfect money-making opportunity offered on a Web site was a money maker for the crook and a money loser for you.
- Avoid any plan that pays commissions simply for recruiting additional distributors. Your primary source of income should be your own product sales. If the earnings are not made primarily by sales of goods or services to consumers or sales by distributors under you, you might be dealing with an illegal pyramid scheme.
- Beware of shills—people paid by a company to lie about how much they've earned and how easy the plan was to operate. Check with an independent source to make sure that the company and its offers are valid.
- Beware of a company's claim that it can set you up in a profitable home-based business but that you must first pay up front to attend a seminar and buy expensive materials. Frequently, seminars are high-pressure sales pitches, and the material is so general that it is worthless.
- If you are interested in starting a home-based business, get a complete description of the work involved before you send any money. You might find that what you are asked to do after you pay is far different from what was stated in the ad. You should never have to pay for a job description or for needed materials.
- Get in writing the refund, buy-back, and cancellation policies of any company you deal with. Do not depend on oral promises.
- Do your homework. Check with the Better Business Bureau, your state attorney general, and the National Fraud Information Center (NFIC) before getting involved, especially when the claims about a product or potential earnings seem too good to be true.

If you need advice about an Internet or online solicitation, or if you want to report a possible scam, use the Online Reporting Form or Online Question & Suggestion Form features on the Web site for the National Fraud Information Center at *http://fraud.org* or call the NFIC hotline at 1-800-876-7060.

PRIVACY ISSUES

Privacy is an important social issue related to information systems. In 1890, U.S. Supreme Court Justice Louis Brandeis stated that the "right to be left alone" is one of the most "comprehensive of rights and the most valued by civilized man." Basically, the issue of privacy deals with this right to be left alone or to be withdrawn from public view. With information systems, privacy deals with the collection and use or misuse of data. Data is constantly being collected and stored on each of us. This data is often distributed over easily accessed networks and without our knowledge or consent. Concerns of privacy regarding

this data must be addressed. A difficult question to answer is "Who owns this information and knowledge?" If a public or private organization spends time and resources to obtain data on you, does the organization own the data, and can it use the data in any way it desires? Government legislation answers these questions to some extent for federal agencies, but the questions remain unanswered for private organizations. Today, many businesses have to handle many requests from law enforcement agencies for information about its employees, customers, and suppliers. Indeed, some phone and Internet companies have employees whose full-time role it is to deal with information requests from local, state, and federal law enforcement agencies.

Privacy and the Federal Government

The federal government has implemented many laws addressing personal privacy, which are summarized in Table 9.4. However, a number of recent revelations of previously clandestine federal government data collection programs have raised concerns and debate between those who favor data collection as a means to increased security and those who view such programs as a violation of rights guaranteed by the Constitution and Bill of Rights.

TABLE 9.4 Key federal privacy laws and their provisions

Law	Provisions
Fair Credit Reporting Act of 1970 (FCRA)	Regulates operations of credit-reporting bureaus, including how they collect, store, and use credit information
Family Education Privacy Act of 1974	Restricts collection and use of data by federally funded educational institutions, including specifications for the type of data collected, access by parents and students to the data, and limitations on disclosure
Tax Reform Act of 1976	Restricts collection and use of certain information by the Internal Revenue Service
Right to Financial Privacy Act of 1978	Restricts government access to certain records held by financial institutions
Foreign Intelligence Surveillance Act of 1978	Defines procedures to request judicial authorization for electronic surveillance of persons engaged in espionage or international terrorism against the United States on behalf of a foreign power
Electronic Communications Privacy Act of 1986	Defines provisions for the access, use, disclosure, interception, and privacy protections of electronic communications
Computer Matching and Privacy Act of 1988	Regulates cross-references between federal agencies' computer files (e.g.to verify eligibility for federal programs)
Cable Act of 1992	Regulates companies and organizations that provide wireless communications services, including cellular phones
Gramm-Leach-Bliley Act of 1999	Requires all financial institutions to protect and secure customers' nonpublic data from unauthorized access or use
USA Patriot Act of 2001	Requires Internet service providers and telephone companies to turn over customer information, including numbers called, without a court order, if the FBI claims that the records are relevant to a terrorism investigation
E-Government Act of 2002	Requires federal agencies to post machine-readable privacy policies on their Web sites and to perform privacy impact assessments on all new collections of data of ten or more people
Fair and Accurate Credit Transactions Act of 2003	Designed to combat the growing crime of identity theft; allows consumers to get free credit reports from each of the three major consumer credit-reporting agencies every 12 months and to place alerts on their credit histories under certain circumstances
Foreign Intelligence Surveillance Act Amendments Act of 2008	Renews the U.S. government's authority to monitor electronic communications of foreigners abroad and authorizes foreign surveillance programs by the NSA like PRISM and some earlier data collection activities

- The NSA began the collection of metadata (the phone numbers of the parties involved in the call, call duration, call location, time and date of the call, and other data) from millions of telephone calls soon after the September 11, 2001 attacks on the United States. The data enables the NSA to create a network of associations for every caller. A provision known as Section 215 of the Patriot Act provided all the legal justification needed for many proponents of data gathering. That the data was being used to help the government "connect the dots" between overseas terrorists and coconspirators within the United States provided them with sufficient moral justification. See Figure 9.21.[65]

Reuters/Landov

FIGURE **9.21**

NSA Data Center in Utah

This data center, code-named Bumblehive, is the first Intelligence Community Comprehensive National Cybersecurity Initiative (IC CNCI) data center designed to support the intelligence community's efforts to monitor, strengthen, and protect the nation. The data center is designed to cope with the vast increases in digital data that have accompanied the rise of the global network.

- PRISM is a tool used by the NSA and the FBI to collect private electronic data belonging to users of major Internet services such as AOL, Apple, Facebook, Google, Microsoft, Skype, Yahoo!, YouTube, and others. PRISM enables the NSA to access the servers of these organizations to collect material, including search history, the content of email messages, videos, photos, file transfers, and live chats. Unlike the collection of telephone call records, this surveillance includes the content of communications and not just the metadata. With PRISM, the NSA can obtain targeted communications without having to request them from the service providers and without having to obtain individual court orders.[66]
- Another NSA program called "MYSTIC" is used to intercept and record all telephone conversations in Afghanistan, the Bahamas, Mexico, Kenya, and the Philippines.[67, 68] Because there is no practical way to exclude them, the conversations include those of Americans who make calls to or from the targeted countries.[69]

Privacy at Work

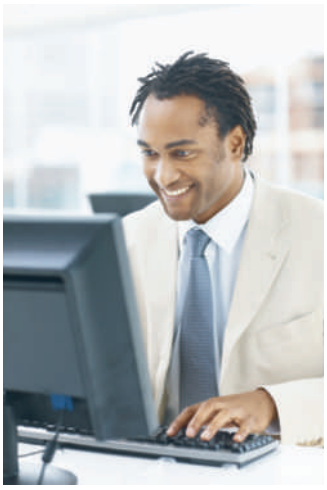
The right to privacy at work is also an important issue. Employers are using technology and corporate policies to manage worker productivity and protect the use of IS resources. Employers are mostly concerned about inappropriate Web surfing, with over half of employers monitoring the Web activity of their employees. Organizations also monitor employees' email, with more than half retaining and reviewing messages. Statistics such as these have raised employee

privacy concerns. In many cases, workers claim their right to privacy trumps their companies' rights to monitor employee use of IS resources. However, most employers today have a policy that explicitly eliminates any expectation of privacy when an employee uses any company-owned computer, server, or email system. The courts have ruled that, without a reasonable expectation of privacy, there is no Fourth Amendment protection for the employee. A California appeals court ruled in *Holmes v Petrovich Development Company* that emails sent by an employee to her attorney on the employer's computer were not "confidential communications between a client and lawyer." An Ohio federal district court in *Moore v University Hospital Cleveland Medical Center* ruled that an employee could be terminated for showing coworkers sexually explicit photos on his employer's computer. The court stated that the employee could have no expectation of privacy when accessing a hospital computer situated in the middle of a hospital floor within easy view of both patients and staff.[70]

The European Union (EU) has developed strict regulations to enforce data privacy standards across all members of the organization. Under these regulations, personal data can only be gathered legally under strict conditions and only for reasonable purposes. Furthermore, persons or organizations that collect and manage individuals' personal information must protect it from misuse and must respect certain rights of the data owners, which are guaranteed by EU law. These regulations affect virtually any company doing business in Europe.[71]

Privacy and Email

Email also raises some interesting issues about work privacy. See Figure 9.22. Federal law permits employers to monitor email sent and received by employees. Furthermore, email messages that have been erased from hard disks can be retrieved and used in lawsuits because the laws of discovery demand that companies produce all relevant business documents. On the other hand, the use of email among public officials might violate "open meeting" laws. These laws, which apply to many local, state, and federal agencies, prevent public officials from meeting in private about matters that affect the state or local area.



© iStockphoto.com/Daniel Laflor

FIGURE **9.22**

Email and work privacy

Email has changed how workers and managers communicate in the same building or around the world. Email, however, can be monitored and intercepted. As with other services, such as cell phones, the convenience of email must be balanced with the potential of privacy invasion.

In July 2013, the city council in Glendale, Arizona, voted to approve a complicated, $225 million-dollar deal that pays the Phoenix Coyotes hockey team to stay at Jobing.com Arena for at least five years.[72] However, a year later, allegations arose that some council members may have violated Arizona's Open Meeting Law and if proven, could potentially void Glendale's deal with the team. It is alleged that prior to the vote, some council members

met separately, held cell phone discussions, and circulated an email discussing arena parking, tax-exempt municipal bonds, and an escape clause that would allow the city to evict the Coyotes.[73]

Privacy and Instant Messaging

Using instant messaging (IM) to send and receive messages, files, and images introduces the same privacy issues associated with email. As with email, federal law permits employers to monitor instant messages sent and received by employees. Employers' major concern involves IMs sent by employees over their employer's IM network or using employer-provided phones. To protect your privacy and your employer's property, do not send personal or private IMs at work. The following are a few other tips:

- Choose a nonrevealing, nongender-specific, unprovocative IM screen name (Sweet Sixteen, 2hot4u, UCLAMBA, all fail this test).
- Don't send messages you would be embarrassed to have your family members, colleagues, or friends read.
- Do not open files or click links in messages from people you do not know.
- Never send sensitive personal data such as credit card numbers, bank account numbers, or passwords via IM.

Privacy and Personal Sensing Devices

RFID tags, essentially microchips with antenna, are embedded in many of the products we buy, from medicine containers, clothing, and books to computer printers, car keys, and tires. RFID tags generate radio transmissions that, if appropriate measures are not taken, can lead to potential privacy concerns. Once these tags are associated with the individual who purchased the item, someone can potentially track individuals by the unique identifier associated with the RFID chip.

A handful of states have reacted to the potential for abuse of RFID tags by passing legislation prohibiting the implantation of RFID chips under people's skin without their approval. Still, advocates for RFID chip implantation argue their potential value in tracking children or criminals and their value in carrying an individual's medical records.

Mobile crowd sensing (MCS) is a means to acquire data (i.e., location, noise level, traffic conditions, and pollution levels) through sensor-enhanced mobile devices and share this data with individuals, healthcare providers, utility firms, and local, state, and federal government agencies for decision making.

Privacy and the Internet

Some people assume that there is no privacy on the Internet and that you use it at your own risk. Others believe that companies with Web sites should have strict privacy procedures and be held accountable for privacy invasion. Regardless of your view, the potential for privacy invasion on the Internet is huge. People wanting to invade your privacy could be anyone from criminal hackers to marketing companies to corporate bosses. Your personal and professional information can be seized on the Internet without your knowledge or consent. Email is a prime target, as discussed previously. Sending an email message is like having an open conversation in a large room—people can listen to your messages. When you visit a Web site on the Internet, information about you and your computer can be captured. When this information is combined with other information, companies can find out what you read, what products you buy, and what your interests are.

Most people who buy products on the Web say it's very important for a site to have a policy explaining how personal information is used, and the

policy statement must make people feel comfortable and be extremely clear about what information is collected and what will and will not be done with it. However, many Web sites still do not prominently display their privacy policy or implement practices completely consistent with that policy. The real issue that Internet users need to be concerned with is what do content providers want to do with that personal information? If a site requests that you provide your name and address, you have every right to know why and what will be done with it. If you buy something and provide a shipping address, will it be sold to other retailers? Will your email address be sold on a list of active Internet shoppers? And if so, you should realize that this email list is no different from the lists compiled from the orders you place with catalog retailers. You have the right to be taken off any mailing list.

The Children's Online Privacy Protection Act (COPPA) was passed by Congress in October 1998. This act was directed at Web sites catering to children, requiring site owners to post comprehensive privacy policies and to obtain parental consent before they collect any personal information from children under 13 years of age. Web site operators who violate the rule could be liable for civil penalties of up to $11,000 per violation. COPPA has made an impact in the design and operations of Web sites that cater to children. For example, the Web site Skid-e-kids violated the act by collecting personal information from some 5,600 children without obtaining prior parental consent. The Federal Trade Commission, responsible for enforcing the act, required that the information be deleted.[74]

A social network service employs the Web and software to connect people for whatever purpose. There are thousands of such networks, which have become popular among teenagers. Some of the more popular social networking Web sites include Facebook, Twitter, LinkedIn, Pinterest, Google Plus, Tumblr, and Instagram—all have over 100 million unique monthly visitors.[75] Most of these sites allow you to easily create a user profile that provides personal details, photos, and even videos that can be viewed by other visitors. Some of the sites have age restrictions or require that a parent register his or her preteen by providing a credit card to validate the parent's identity. Teens can provide information about where they live, go to school, their favorite music, and their interests in hopes of meeting new friends. Unfortunately, they can also meet ill-intentioned strangers at these sites. Many documented encounters involve adults masquerading as teens attempting to meet young people for illicit purposes. Parents are advised to discuss potential dangers, check their children's profiles, and monitor their activities at such Web sites.

Facebook holds a startling amount of information about its more than 900 million members. In addition, many members are not discrete and reveal such information as their health conditions and treatments; where they will be on a certain day (helpful to potential burglars); personal details of members of their family; their sexual, racial, religious, and political affiliations and preferences; and other personal information about their friends and family. Facebook receives a notice every time you visit a Web site with a "Like" button whether or not you click the "Like" button, log on to Facebook, or are a Facebook user. Users and observers have raised concerns about how Facebook treats this sometimes very personal information. For example, should law enforcement officials file a subpoena for your Facebook information, they could obtain all these details as well as records of your postings, photos you have uploaded, photos in which you have been tagged, and a list of all your Facebook friends. Under what conditions can Facebook provide this information to third parties for marketing or other purposes?

Privacy and Internet Libel Concerns

Libel involves publishing an intentionally false written statement that is damaging to a person's or organization's reputation. Examples of Internet libel include

an ex-husband posting lies about his wife on a blog, a disgruntled former employee posting lies about a company on a message board, and a jilted girlfriend posting false statements to her former boyfriend's Facebook account. A Hong Kong court even ruled that a local billionaire can sue Google for libel over its autocomplete search results, which suggest that he is connected to organized crime. The tycoon filed the lawsuit after Google refused to remove autocomplete suggestions, such as "triad" (in China, this is another name for an organized crime gang), which appear with searches on his name. The billionaire maintains that his reputation has been "gravely injured" and wants recompense.[76]

Individuals can post information on the Internet using anonymous email accounts or screen names. This anonymity makes it more difficult, but not impossible, to identify the libeler. The offended party can file what is known as a John Doe lawsuit and use the subpoena power it grants to force the ISP to provide whatever information it has about the anonymous poster, including IP address, name, and street address. (Under Section 230 of the Communications Decency Act, ISPs are not usually held accountable for the bad behavior of their subscribers.)

Brian Burke, the current general manager (GM) and president of the National Hockey League's (NHL) Calgary Flames, and former GM of several other NHL teams filed a lawsuit in the Supreme Court of British Columbia against 18 individuals who allegedly made defamatory statements regarding Burke on various Internet message boards and blogs.[77]

Privacy and Fairness in Information Use

Selling information to other companies can be so lucrative that many companies will continue to store and sell the data they collect on customers, employees, and others. When is this information storage and use fair and reasonable to the people whose data is stored and sold? Do people have a right to know about data stored about them and to decide what data is stored and used? As shown in Table 9.5, these questions can be broken down into four issues that should be addressed: knowledge, control, notice, and consent.

TABLE 9.5 The right to know and the ability to decide federal privacy laws and regulations

Fairness Issues	Database Storage	Database Usage
The right to know	Knowledge	Notice
The ability to decide	Control	Consent
Knowledge. Should people know what data is stored about them? In some cases, people are informed that information about them is stored in a corporate database. In others, they do not know that their personal information is stored in corporate databases.		
Control. Should people be able to correct errors in corporate database systems? This ability is possible with most organizations, although it can be difficult in some cases.		
Notice. Should an organization that uses personal data for a purpose other than the original purpose notify individuals in advance? Most companies don't do this.		
Consent. If information on people is to be used for other purposes, should these people be asked to give their consent before data on them is used? Many companies do not give people the ability to decide if such information will be sold or used for other purposes.		

Privacy and Filtering and Classifying Internet Content

filtering software: Software that screens Internet content.

To help parents control what their children see on the Internet, some companies provide **filtering software** to help screen Internet content. Many of these screening programs also prevent children from sending personal information over email or through chat groups. These programs stop children

from broadcasting their name, address, phone number, or other personal information over the Internet. The 2014 top-rated Internet filtering software for both Windows and Mac systems is presented in Table 9.6.[78,79]

TABLE 9.6 Top-rated Internet filters

Windows Systems	Mac Systems
NetNanny ($28.99)	Net Nanny ($29.99)
McAfee Family Protection ($49.99)	Safe Eyes ($49.95)
PureSight PC ($59.90)	Spector Pro ($99.95)

Organizations also implement filtering software to prevent employees from visiting Web sites not related to work, particularly those involving gambling and those containing pornographic or other offensive material. Before implementing Web site blocking, the users must be informed about the company's policies and why they exist. To increase compliance, it is best if the organization's Internet users, management, and IS organization work together to define the policy to be implemented. The policy should be clear about the repercussions to employees who attempt to circumvent the blocking measures.

The U.S. Congress has made several attempts to limit children's exposure to online pornography, including the Communications Decency Act (enacted 1996) and the Child Online Protection Act (enacted 1998). Within two years of being enacted, the U.S. Supreme Court found that both these acts violated the First Amendment (freedom of speech) and ruled them to be unconstitutional. The Children's Internet Protection Act (CIPA) was signed into law in 2000 and later upheld by the Supreme Court in 2003. Under CIPA, schools and libraries subject to CIPA do not receive the discounts offered by the E-Rate program unless they certify that they have certain Internet safety measures in place to block or filter "visual depictions that are obscene, child pornography, or are harmful to minors." (The E-Rate program provides many schools and libraries support to purchase Internet access and computers.)

In the past few decades, significant laws have been passed regarding a person's right to privacy. Others relate to business privacy rights and the fair use of data and information. The following sections briefly discuss corporate privacy policies and individual efforts to protect privacy.

Corporate Privacy Policies

Even though privacy laws for private organizations are not very restrictive, most organizations are sensitive to privacy issues and fairness. They realize that invasions of privacy can hurt their business, turn away customers, and dramatically reduce revenues and profits. Consider a major international credit card company. If the company sold confidential financial information on millions of customers to other companies, the results could be disastrous. In a matter of days, the firm's business and revenues could be reduced dramatically. Therefore, most organizations maintain privacy policies, even though they are not required by law. Some companies even have a privacy bill of rights that specifies how the privacy of employees, clients, and customers will be protected. Corporate privacy policies should address a customer's knowledge, control, notice, and consent over the storage and use of information. They can also cover who has access to private data and when it can be used.

The BBB Code of Business Practices (BBB Accreditation Standards) requires that BBB-accredited businesses have some sort of privacy notice on

ETHICAL & SOCIETAL ISSUES

IT Companies Leading Green Initiatives

In 1972, before the idea of corporate social responsibility (CSR) had gained traction, the IT giant IBM established a program of sustainability. In response to environmental disasters during the late 1960s, IBM instituted a program of hazardous waste management for itself and its contractors. In 1976, the Love Canal disaster created national concern when babies born nearby had birth defects and chromosomal disorders, and people developed leukemia. An area of 900 houses had to be abandoned due to chemical pollution.

At that time, IBM produced mainframe computers, adding machines, typewriters, telephone routing systems, and most of the advanced information technology of the age. They were the one of the largest corporations in the world. However, their component manufacturing processes produce large amounts of benzene-based materials that tend to be carcinogenic. In an effort to take the lead in corporate responsibility, they established one of the first environmental programs of its kind.

The three-pronged program attempted to track waste from creation to disposal and to reduce both its reliance on toxic chemicals and the amount of toxic waste released during the manufacturing process. IBM incrementally reduced toxic waste. In 1987, the company produced 220,500 tons in toxic waste. By 2011, the company was down to 7,700 metric tons—a gargantuan achievement. IBM accomplished this in part by the recycling of 44 percent of the hazardous chemicals used in the manufacturing process. They have also changed manufacturing processes and substituted nonhazardous materials for toxic chemicals.

Throughout the late 20th century, IBM proactively identified potential environmental problems and took the lead in ameliorating them. In the 1980s, scientists noticed a hole in the ozone layer of the stratosphere over Antarctica during the summer months. This layer protects the earth from harmful ultraviolet radiation. In 1989, IBM led the IT world in its repudiation of the use of ozone-depleting chemicals, such as chlorofluorocarbons.

Today, the corporation has expanded its initiative beyond toxic waste management. Its programs now seek to reduce energy use, conserve water resources, create energy efficient products, spearhead safety in the use of nanotechnology, and combat climate change. IBM has also devoted itself to the use of environmentally preferable substances and materials. IBM continues to attempt to reduce or eliminate reliance on heavy metals and carcinogens. The company recently reduced greenhouse gas emissions by 3.2 percent.

Other large IT companies have followed suit, launching green initiatives. HP, for example, has a product return and recycling program in 70 countries and territories. The company recycles more than 75 percent of their ink cartridges and 24 percent of their laser toner cartridges. The company also runs a remanufacturing program for servers, storage, networking products, and other IT hardware to reduce the waste from the disposal of outdated products. With remanufacturing, used HP products are fully restored to like-new standards by trained and qualified remanufacturing teams in factories owned and managed by HP. HP also offers trade-in and return-for-cash programs that have allowed them to recover 3.8 billion pounds of HP product since 1987.

Dell also has a major green initiative that has achieved noteworthy results. It has recovered 230.9 million pounds of used electronics and is on track to reach a goal of 2 billion pounds by 2020. Dell has been able to reduce the average energy intensity of its product line by 23 percent compared to 2012. Operational emissions have been reduced by 10 percent. Dell has used more than 10 million pounds of post-consumer recycled plastics in its products.

Discussion Questions

1. Why did IBM instigate its sustainability programs in the 1970s?
2. What goals should IT companies and large corporations include in their green initiatives?

Critical Thinking Questions

1. What major achievements have IBM, HP, and Dell made with their green initiatives?
2. What impact has IBM had on other companies both inside and outside of the IT industry?

SOURCES: "IBM and the Environment Report,"*www.ibm.com/ibm/environment/annual/IBMEnvReport_2013.pdf*, accessed August 28, 2014; "Corporate Responsibility Summary," IBM, *www.ibm.com/ibm/responsibility/2013/*, access August 28, 2014; "Product Return and Recycling," HP Web site, *www8.hp.com/us/en/hp-information/environment/product-recycling.html#.U_TbsMVdUrU*, accessed August 20, 2014; "Environment," Dell Web site, *www.dell.com/learn/us/en/uscorp1/dell-environment*, accessed August 21, 2014.

their Web site. See Figure 9.23. BBB recommends that a privacy notice includes the following elements:[80]

- **Policy** (what personal information is being collected on the site)
- **Choice** (what options the customer has about how/whether his or her data is collected and used)
- **Access** (how a customer can see what data has been collected and change/correct it if necessary)
- **Security** (state how any data that is collected is stored/protected)
- **Redress** (what a customer can do if the privacy policy is not met)
- **Updates** (how policy changes will be communicated)

Multinational companies face an extremely difficult challenge in implementing data collection and dissemination processes and policies because of the multitude of differing country or regional statutes. For example, Australia requires companies to destroy customer data (including backup files) or make it anonymous after it's no longer needed. Firms that transfer customer and personnel data out of Europe must comply with European privacy laws that allow customers and employees to access data about themselves and let them determine how that information can be used.

Web sites for a few corporate privacy policies are shown in Table 9.7.

A good database design practice is to assign a single unique identifier to each customer so each has a single record describing all relationships with the company across all its business units. That way, the organization can apply customer privacy preferences consistently throughout all databases. Failure to do so can expose the organization to legal risks—aside from upsetting customers who opted out of some collection practices. Again, the 1999 Gramm-Leach-Bliley Financial Services Modernization Act requires all financial service institutions to communicate their data privacy rules and honor customer preferences.

Individual Efforts to Protect Privacy

Although numerous state and federal laws deal with privacy, the laws do not completely protect individual privacy. In addition, not all companies have privacy policies. As a result, many people are taking steps to increase their own

Privacy Notice

This privacy notice discloses the privacy practices for (Web site address). This privacy notice applies solely to information collected by this web site. It will notify you of the following:

1. What personally identifiable information is collected from you through the web site, how it is used and with whom it may be shared.
2. What choices are available to you regarding the use of your data.
3. The security procedures in place to protect the misuse of your information.
4. How you can correct any inaccuracies in the information.

Information Collection, Use, and Sharing
We are the sole owners of the information collected on this site. We only have access to/collect information that you voluntarily give us via email or other direct contact from you. We will not sell or rent this information to anyone.

We will use your information to respond to you, regarding the reason you contacted us. We will not share your information with any third party outside of our organization, other than as necessary to fulfill your request, e.g. to ship an order.

Unless you ask us not to, we may contact you via email in the future to tell you about specials, new products or services, or changes to this privacy policy.

Your Access to and Control Over Information
You may opt out of any future contacts from us at any time. You can do the following at any time by contacting us via the email address or phone number given on our Web site:

- See what data we have about you, if any.
- Change/correct any data we have about you.
- Have us delete any data we have about you.
- Express any concern you have about our use of your data.

Security
We take precautions to protect your information. When you submit sensitive information via the Web site, your information is protected both online and offline.

Wherever we collect sensitive information (such as credit card data), that information is encrypted and transmitted to us in a secure way. You can verify this by looking for a closed lock icon at the bottom of your web browser, or looking for "https" at the beginning of the address of the web page.

While we use encryption to protect sensitive information transmitted online, we also protect your information offline. Only employees who need the information to perform a specific job (for example, billing or customer service) are granted access to personally identifiable information. The computers/servers in which we store personally identifiable information are kept in a secure environment.

If you feel that we are not abiding by this privacy policy, you should contact us immediately via telephone at XXX YYY-ZZZZ or via email.

Source: The Better Business Bureau

FIGURE **9.23**

Sample privacy notice

The BBB provides this sample privacy notice as a guide to businesses to post on their Web sites.

TABLE 9.7 Corporate privacy policies

Company	URL
Intel	www.intel.com/sites/sitewide/en_US/privacy/privacy.htm
Starwood Hotels & Resorts	www.starwoodhotels.com/corporate/privacy_policy.html
TransUnion	www.transunion.com/corporate/privacyPolicy.page
United Parcel Service	www.ups.com/content/corp/privacy_policy.html
Visa	http://usa.visa.com/legal/privacy-policy/index.jsp
Walt Disney Internet Group	https://disneyprivacycenter.com/

privacy protection. Some of the steps that you can take to protect personal privacy include the following:

- **Find out what is stored about you in existing databases**. Call the major credit bureaus to get a copy of your credit report. You are entitled to a free credit report every 12 months (see *www.freecreditreport.com*). You can also obtain a free report if you have been denied credit in the last 60 days. The major companies are Equifax (800–685-1111, *www.equifax.com*), TransUnion (800–916-8800, *www.transunion.com*), and Experian (888–397-3742, *www.experian.com*). You can also submit a Freedom of Information Act request to a federal agency that you suspect might have information stored on you.
- **Be careful when you share information about yourself**. Don't share information unless it is absolutely necessary. Every time you give information about yourself through an 800, 888, or 900 call, your privacy is at risk. Be vigilant in insisting that your doctor, bank, or financial institution not share information about you with others without your written consent.
- **Be proactive to protect your privacy**. You can get an unlisted phone number and ask the phone company to block caller ID systems from reading your phone number. If you change your address, don't fill out a change-of-address form with the U.S. Postal Service; you can notify the people and companies that you want to have your new address. Destroy copies of your charge card bills and shred monthly statements before disposing of them in the garbage. Be careful about sending personal email messages over a corporate email system. You can also get help in avoiding junk mail and telemarketing calls by visiting the Direct Marketing Association Web site at *www.thedma.org*. Go to the site and look under Consumer Help-Remove Name from Lists.
- **Take extra care when purchasing anything from a Web site.** Make sure that you safeguard your credit card numbers, passwords, and personal information. Do not do business with a site unless you know that it handles credit card information securely. (Look for a seal of approval from organizations such as the Better Business Bureau Online or TRUSTe. When you open the Web page where you enter credit card information or other personal data, make sure that the Web address begins with *https* and check to see if a locked padlock icon appears in the Address bar or status bar). Do not provide personal information without reviewing the site's data privacy policy. Many credit card companies issue single-use credit card numbers on request. Charges appear on your usual bill, but the number is destroyed after a single use, eliminating the risk of stolen credit card numbers.

WORK ENVIRONMENT

The use of computer-based information systems has changed the makeup of the workforce. Jobs that require IS literacy have increased, and many less-skilled positions have been eliminated. Corporate programs, such as reengineering and continuous improvement, bring with them the concern that, as business processes are restructured and information systems are integrated within them, the people involved in these processes will be removed. Even the simplest tasks have been aided by computers, making customer checkout faster, streamlining order processing, and allowing people with disabilities to participate more actively in the workforce. As computers and other IS components drop in cost and become easier to use, more workers will benefit from the increased productivity and efficiency provided by computers. Yet, despite

these increases in productivity and efficiency, information systems can raise other concerns.

Health Concerns

Organizations can increase employee productivity by paying attention to the health concerns in today's work environment. For some people, working with computers can cause occupational stress. Anxieties about job insecurity, loss of control, incompetence, and demotion are just a few of the fears workers might experience. In some cases, the stress can become so severe that workers avoid taking training to learn how to use new computer systems and equipment. Monitoring employee stress can alert companies to potential problems. Training and counseling can often help the employee and deter problems.

Heavy computer use can affect one's physical health as well. A job that requires sitting at a desk and using a computer for many hours a day qualifies as a sedentary job. Such work can double the risk of seated immobility thromboembolism (SIT), the formation of blood clots in the legs or lungs. People leading a sedentary lifestyle are also likely to experience an undesirable weight gain, which can lead to increased fatigue and greater risk of type 2 diabetes, heart problems, and other serious ailments.

Repetitive strain injury (RSI) is an injury or disorder of the muscles, nerves, tendons, ligaments, or joints caused by repetitive motion. RSI is a very common job-related injury. Tendonitis is inflammation of a tendon due to repetitive motion on that tendon. Carpal tunnel syndrome (CTS) is an inflammation of the nerve that connects the forearm to the palm of the wrist. CTS involves wrist pain, a feeling of tingling and numbness, and difficulty grasping and holding objects.

Avoiding Health and Environmental Problems

Two primary causes of computer-related health problems are a poorly designed work environment and failure to take regular breaks to stretch the muscles and rest the eyes. The computer screen can be hard to read because of glare and poor contrast. Desks and chairs can also be uncomfortable. Keyboards and computer screens might be fixed in place or difficult to move. The hazardous activities associated with these unfavorable conditions are collectively referred to as *work stressors*. Although these problems might not be of major concern to casual users of computer systems, continued stressors such as repetitive motion, awkward posture, and eye strain can cause more serious and long-term injuries. If nothing else, these problems can severely limit productivity and performance.

ergonomics: The science of designing machines, products, and systems to maximize the safety, comfort, and efficiency of the people who use them.

The science of designing machines, products, and systems to maximize the safety, comfort, and efficiency of the people who use them, called **ergonomics**, has suggested some approaches to reducing these health problems. Ergonomic experts carefully study the slope of the keyboard, the positioning and design of display screens, and the placement and design of computer tables and chairs. Flexibility is a major component of ergonomics and an important feature of computer devices. People come in many sizes, have differing preferences, and require different positioning of equipment for best results. Some people, for example, want to place the keyboard in their laps; others prefer it on a solid table. Because of these individual differences, computer designers are attempting to develop systems that provide a great deal of flexibility. See Figure 9.24.

It is never too soon to stop unhealthy computer work habits. Prolonged computer use under poor working conditions can lead to carpal tunnel

FIGURE **9.24**

Ergonomics

Developing certain ergonomically correct habits can reduce the risk of adverse health effects when using a computer.

syndrome, bursitis, headaches, and permanent eye damage. Strain and poor office conditions cannot be left unchecked. Unfortunately, at times, we are all distracted by pressing issues such as the organization's need to raise productivity, improve quality, meet deadlines, and cut costs. We become complacent and fail to pay attention to the importance of healthy working conditions. Table 9.8 lists some common remedies for heavy computer users.

TABLE 9.8 Avoiding common discomforts associated with heavy use of computers

Common Discomforts Associated with Heavy Use of Computers	Preventative Action
Red, dry, itchy eyes	Change your focus away from the screen every 20 or 30 minutes by looking into the distance and focusing on an object for 20 to 30 seconds
	Make a conscious effort to blink more often
	Consider the use of artificial tears
	Use an LCD screen that provides a much better viewing experience for your eyes by virtually eliminating flicker while still being bright without harsh incandescence.
Neck and shoulder pain	Use proper posture when working at the computer
	Stand up, stretch, and walk around for a few minutes every hour
	Shrug and rotate your shoulders occasionally
Pain, numbness, or tingling sensation in hands	Use proper posture when working at the computer
	Do not rest your elbows on hard surfaces
	Place a wrist rest between your computer keyboard and the edge of your desk.
	Take an occasional break and spread fingers apart while keeping your wrists straight
	Taken an occasional break with your arms resting at your sides and gently shake your hands

Source: Pekker, Michael, "Long Hours at Computer: Health Risks and Prevention Tips," *http://webfreebies4u.blogspot.com/2011/01/long-hours-at-computer-health-risks-and.html*, January 4, 2011.

The following is a useful checklist to help you determine if you are properly seated at a correctly positioned keyboard:[81]

- Your elbows are near your body in an open angle to allow circulation to the lower arms and hands
- Your arms are nearly perpendicular to the floor
- Your wrists are nearly straight
- The height of the surface holding your keyboard and mouse is 1 or 2 inches above your thighs
- Center the keyboard in front of your body.
- The monitor is about one arm's length (20 to 26 inches) away
- The top of your monitor is at eye level
- Your chair has a backrest that supports the curve of your lower (lumbar) back

ETHICAL ISSUES IN INFORMATION SYSTEMS

code of ethics: A code that states the principles and core values that are essential to a set of people and that, therefore, govern these people's behavior.

As you've seen throughout this book in the "Ethical and Societal Issues" boxes, ethical issues deal with what is generally considered right or wrong. Laws do not provide a complete guide to ethical behavior. Just because an activity is defined as legal does not mean that it is ethical. As a result, practitioners in many professions subscribe to a **code of ethics** that states the principles and core values that are essential to their work and, therefore, govern their behavior. The code can become a reference point for weighing what is legal and what is ethical. For example, doctors adhere to varying versions of the 2000-year-old Hippocratic Oath, which medical schools offer as an affirmation to their graduating classes.

Some IS professionals believe that their field offers many opportunities for unethical behavior. They also believe that unethical behavior can be reduced by top-level managers developing, discussing, and enforcing codes of ethics. Various IS-related organizations and associations promote ethically responsible use of information systems and have developed useful codes of ethics. Founded in 1947, the Association for Computing Machinery (ACM) is the oldest computing society and boasts more than 100,000 members in more than 100 countries.[82] The ACM has a code of ethics and professional conduct that includes eight general moral imperatives that can be used to help guide the actions of IS professionals. These guidelines can also be used for those who employ or hire IS professionals to monitor and guide their work. These imperatives are outlined in the following list:[83] As an ACM member I will …

1. contribute to society and human well-being.
2. avoid harm to others.
3. be honest and trustworthy.
4. be fair and take action not to discriminate.
5. honor property rights including copyrights and patents.
6. give proper credit for intellectual property.
7. respect the privacy of others.
8. honor confidentiality.

The mishandling of the social issues discussed in this chapter—including waste and mistakes, crime, privacy, health, and ethics—can devastate an organization. The prevention of these problems and recovery from them are important aspects of managing information and information systems as critical corporate assets. More organizations are recognizing that people are the most important component of a computer-based information system and that long-term competitive advantage can be found in a well-trained, motivated, and knowledgeable workforce that adheres to a set of principles and core values that help guide that workforce's actions.

SUMMARY

Principle:

Policies and procedures must be established to avoid waste and mistakes associated with computer usage.

Computer waste is the inappropriate use of computer technology and resources in both the public and private sectors. Computer mistakes relate to errors, failures, and other problems that result in output that is incorrect and without value. At the corporate level, computer waste and mistakes impose unnecessarily high costs for an information system and drag down profits. Waste often results from poor integration of IS components, leading to duplication of efforts and overcapacity. Inefficient procedures also waste IS resources, as do thoughtless disposal of useful resources and misuse of computer time for games and personal use. Inappropriate processing instructions, inaccurate data entry, mishandling of IS output, and poor systems design all cause computer mistakes.

Preventing waste and mistakes involves establishing, implementing, monitoring, and reviewing effective policies and procedures. Companies should develop manuals and training programs to avoid waste and mistakes. Changes to critical tables, HTML, and URLs should be tightly controlled.

Principle:

Computer crime is a serious and rapidly growing area of concern requiring management attention.

Some crimes use computers as tools. For example, a criminal can use a computer to manipulate records, counterfeit money and documents, commit fraud via telecommunications networks, and make unauthorized electronic transfers of money.

Criminals can gain pieces of information to help break into computer systems by dumpster diving and social engineering techniques.

A cyberterrorist is someone who intimidates or coerces a government or organization to advance his political or social objectives by launching computer-based attacks against computers, networks, and the information stored on them.

Identity theft is a crime in which an imposter obtains key pieces of personal identification information to impersonate someone else. The information is then used to obtain credit, merchandise, and services in the name of the victim or to provide the thief with false credentials.

The computer is also used as a tool to fight crime. The LeadsOnline Web-based system helps law enforcement officers recover stolen property. JusticeXchange provides law enforcement officials with fast, easy access to information about former and current offenders held in participating jails. Offender Watch tracks registered sex offenders. Law enforcement agencies use GPS tracking devices and software to monitor the movement of registered sex offenders. Law enforcement agencies use crime-related data and powerful analysis techniques, coupled with GIS systems, to better understand and even diminish crime risks.

A criminal hacker, also called a "cracker," is a computer-savvy person who attempts to gain unauthorized or illegal access to computer systems to steal passwords, corrupt files and programs, and even transfer money. Script bunnies are crackers with little technical savvy. Insiders are employees, disgruntled or otherwise, working solo or in concert with outsiders to compromise corporate systems. The greatest fear of many organizations is the potential harm that can be done by insiders who know system logon IDs, passwords, and company procedures.

Computer crimes target computer systems and include illegal access to computer systems by criminal hackers, alteration and destruction of data and programs by viruses, and simple theft of computer resources.

"Malware" is a general term for software that is harmful or destructive. There are many forms of malware, including viruses, variants, worms, Trojan horses, logic bombs, and rootkits. Spyware is software installed on a personal computer to intercept or take partial control over the user's interactions with the computer without knowledge or permission of the user. A password sniffer is a small program hidden in a network or computer system that records identification numbers and passwords.

Digital rights management refers to the use of any of several technologies to enforce policies for controlling access to digital media.

Software piracy might represent the most common computer crime. The U.S. recording industry loses about $12.5 billion in revenue from music piracy each year. Patent infringement is also a major problem for computer software and hardware manufacturers.

Computer-related scams, including phishing, vishing, and smishing, have cost people and companies thousands of dollars. Computer crime is an international issue.

A fundamental concept of good internal controls is the careful separation of duties associated with key processes so that they are spread among more than one person.

Use of an intrusion detection system (IDS) provides another layer of protection in the event that an intruder gets past the outer security layers—passwords, security procedures, and corporate firewall. An IDS monitors system and network resources and notifies network security personnel when it senses a possible intrusion. Many small and mid-sized organizations are outsourcing their network security operations to managed security service providers (MSSPs), which monitor, manage, and maintain network security hardware and software.

Security measures, such as using passwords, identification numbers, and data encryption, help to guard against illegal computer access, especially when supported by effective control procedures. Virus-scanning software identifies and removes damaging computer programs. Organizations can use a security dashboard to provide a comprehensive display of vital data related to its security defenses and threats. Organizations and individuals can use antivirus software to detect the presence of all sorts of malware.

Principle:

Privacy is an important social issue related to information systems.

Balancing the right to privacy versus the need for additional monitoring to protect against terrorism and cyberattacks is an especially challenging problem.

Privacy issues are a concern with email, instant messaging, and personal sensing devices.

The federal government has implemented many laws addressing personal privacy; however, data collection programs have raised concerns and debate between those who favor data collection as a means to increased security and those who view such programs as a violation of their rights.

Employers use technology and corporate policies to manage worker productivity and protect the use of IS resources. This activity includes monitoring of employees' Web surfing, email, and instant messaging. Most employers today have a policy that explicitly eliminates any expectation of privacy when an employee uses any company-owned computer, server, or email system.

A business should develop a clear and thorough policy about privacy rights for customers, including database access. That policy should also address the rights of employees, including electronic monitoring systems and

email. Fairness in information use for privacy rights emphasizes knowledge, control, notice, and consent for people profiled in databases. People should know the data that is stored about them and be able to correct errors in corporate database systems. If information on people is to be used for other purposes, individuals should be asked to give their consent beforehand. Each person has the right to know and to decide.

Principle:

Jobs, equipment, and working conditions must be designed to avoid negative health effects from computers.

Jobs that involve heavy use of computers contribute to a sedentary lifestyle, which increases the risk of health problems. Some critics blame computer systems for emissions of ozone and electromagnetic radiation.

The study of designing and positioning computer equipment, called "ergonomics," has suggested some approaches to reducing these health problems. Ergonomic design principles help to reduce harmful effects and increase the efficiency of an information system. RSI (repetitive strain injury) prevention includes keeping good posture, not ignoring pain or problems, performing stretching and strengthening exercises, and seeking proper treatment.

Principle:

Practitioners in many professions subscribe to a code of ethics that states the principles and core values that are essential to their work.

A code of ethics states the principles and core values that are essential to the members of a profession or organization. Ethical computer users define acceptable practices more strictly than just refraining from committing crimes; they also consider the effects of their IS activities, including Internet usage, on other people and organizations. The Association for Computing Machinery developed guidelines and a code of ethics. Many IS professionals join computer-related associations and agree to abide by detailed ethical codes.

KEY TERMS

antivirus programs
code of ethics
cracker
criminal hacker
cyberterrorism
cyberterrorist
digital rights management (DRM)
dumpster diving
ergonomics
filtering software
hacker
identity theft
insiders
Internet Crime Computer Center (IC3)
intrusion detection system (IDS)
malware
managed security service providers (MSSPs)
password sniffer
phishing
script bunnies
security dashboard
separation of duties
smishing
social engineering
software piracy
spyware
United States Computer Emergency Readiness Team (US-CERT)
vishing

CHAPTER 9: SELF-ASSESSMENT TEST

Policies and procedures must be established to avoid waste and mistakes associated with computer usage.

1. The Government Accounting Office (GAO) found a total of _____ spent in a six-year period on information system projects that duplicated other efforts.
   a. $80 billion
   b. $3.2 billion
   c. $320 million
   d. $80 million
2. Preventing waste and mistakes involves establishing, implementing, monitoring, and _____ policies and procedures.
3. Few companies have found it necessary to limit employee access to nonwork-related Web sites. True or False?

Computer crime is a serious and rapidly growing area of concern requiring management attention.

4. The _____ is an alliance between the White Collar Crime Center and the Federal Bureau of Investigation that provides a central site for Internet crime victims to report and to alert appropriate agencies of crimes committed.
5. Convincing someone to divulge his or her logon name and critical computer password is an example of _____.
6. It is thought that the United States and _____ collaborated to develop Stuxnet, computer malware designed to attack industrial Programmable Logic Controllers.
   a. IBM
   b. Israel
   c. British Secret Intelligence Service (also known as MI6)
   d. Turkey
7. Child identity theft is a rapidly growing area of computer crime. True or False?
8. It is estimated that over _____ U.S. taxpayers were affected by identity theft in 2013.
   a. 16 million
   b. 160,000
   c. 160 million
   d. 1.6 million
9. The LeadsOnline Web-based service uses Geographic Information System software to map crime and identify problem precincts. True or False?
10. _____ is a type of Trojan horse that executes when specific conditions occur.
11. _____ refers to the use of any of several technologies to enforce policies for controlling access to digital media.
    a. Software piracy
    b. Digital rights management
    c. Copyright
    d. Patent
12. The _____ is a fundamental concept of good internal controls that ensures that the responsibility for the key steps in a process is spread among more than one person.

Privacy is an important social issue related to information systems.

13. As opposed to the European Union, the United States has implemented few laws addressing personal privacy. True or False?
14. _____ is a tool used by the NSA and FBI to access the servers of major Internet services such as Facebook, Google, YouTube, and others to collect the content of emails, video, photos, file transfers, and live chats.

Jobs, equipment, and working conditions must be designed to avoid negative health effects from computers.

15. Heavy computer use can negatively affect one's physical health. True or False?
16. The study of designing and positioning computer equipment is called _____.

Practitioners in many professions subscribe to a code of ethics that states the principles and core values that are essential to their work.

17. Just because an activity is defined as legal does not mean that it is ethical. True or False?
18. Founded in 1977, the Association for Computing Machinery (ACM) is the oldest computing society and boasts more than 200,000 members in more than 120 countries. True or False?

CHAPTER 9: SELF-ASSESSMENT TEST ANSWERS

1. c
2. reviewing
3. False
4. Internet Crime Computer Center
5. social engineering
6. b
7. True
8. d
9. False
10. Logic bomb

11. b
12. separation of duties
13. False
14. PRISM
15. True
16. ergonomics
17. True
18. False

REVIEW QUESTIONS

1. What issues and problems are raised by the use of unintegrated information systems?
2. What is US-CERT and what does it do?
3. Define the term "cyberterrorism." For how long has the threat of cyberterrorism been considered serious by the U.S. government?
4. What is a managed security service provider? What sort of services does such an organization provide?
5. What is social engineering? What is dumpster diving?
6. Why might some people consider a contractor to be a serious threat to their organization's information systems?
7. Give two reasons that smartphones are such a ripe target for hackers.
8. How do you distinguish between a hacker and a criminal hacker?
9. What measures can you take to avoid becoming a victim of identity theft?
10. What is a security dashboard? How is it used?
11. What is smishing? What actions can you take to reduce the likelihood that you will be a victim of this crime?
12. What is filtering software? Why would organizations use such software? What objections might be raised against the use of this software?
13. What does intrusion detection software do? What are some of the issues with the use of this software?
14. What is ergonomics? How can it be applied to office workers?
15. What is digital rights management?
16. What is a code of ethics? Give an example.

DISCUSSION QUESTIONS

1. Identify and briefly discuss several measures that a private organization might take to reduce the amount of company resources and time employees waste in nonproductive use of information system resources.
2. Identify and briefly discuss four specific information systems that are used to fight crime.
3. Briefly discuss software piracy. What is it, how widespread is it, and who is harmed by it?
4. Imagine that you are starting a dating Web site to help match compatible couples. What sort of personal data might you need to gather? What measures might need to be taken to protect this sensitive data? What key statements might potential users wish to see in the privacy statement of this Web site?
5. Outline an approach, including specific techniques (e.g., dumpster diving, phishing, social engineering) that you could employ to gain personal data about the members of your class.
6. Your 12-year-old niece shows you a dozen or so innocent photos of herself and a brief biography, including address and cell phone number that she plans to post on Facebook. What advice might you offer her about posting personal information and photos?
7. What measures can you suggest to beef up the security of ATM machines to insulate them from malware?
8. Briefly discuss the potential for cyberterrorism to cause a major disruption in your daily life. What are some likely targets of a cyberterrorist? What sort of action could a cyberterrorist take against these targets?
9. What is meant by the separation of duties? When does this concept come into play? Provide a business situation where separation of duties is important.
10. What measures must one take to avoid being a victim of a smartphone hacker?
11. Do you think that there is a difference between acting ethically and acting legally? Explain.

PROBLEM-SOLVING EXERCISES

1. Do research to identify the latest findings on the negative effects of sitting for long hours working at a computer. Prepare a brief presentation that summarizes your findings and identifies what can be done to offset these negative effects.
2. Access the Web site for the Motion Picture Association of America (MPAA) and other Web sites to find estimates of the dollar amount of movie piracy worldwide for at least the past five years. Use spreadsheet software and appropriate

forecasting methods and assumptions to develop a forecast for the amount of movie piracy for the next three years. Document any assumptions you make in developing your forecast.

3. Visit the Internet Crime Complaint Center at *www.ic3.gov/default.aspx*. Develop a brief presentation that identifies and briefly describes the most frequently encountered Internet computer crimes.

TEAM ACTIVITIES

1. Imagine that your team has been hired to conduct a review of the information system policies and procedures at your school or university. Develop a list of at least 10 specific questions that your team would use to assess the effectiveness of these policies and procedures in reducing waste and costs.
2. Have each member of your team access six different Web sites and summarize their findings in terms of the existence of data privacy policy statements. Did each site have such a policy? Was it easy to find? Did it seem complete and easy to understand? Does it adequately cover any concerns you might have as a visitor to that site?

WEB EXERCISES

1. Do research on the Web to find recent examples of cyberterrorism around the world. Is it your opinion that cyberterrorism has reached the level of a serious international problem? Why or why not? Prepare a brief report summarizing your findings and conclusions.
2. Visit the Web site of the Electronic Frontier Foundation (EFF) at *https://www.eff.org/* and learn about its purpose. Do research to document its position on the NSA's collection of phone call and Internet communications data. Do you agree with EFF's position? Why or why not? Prepare a set of slides that documents your position and that of the EFF.
3. Request a current copy of your credit report from TransUnion, Equifax, or Experian. (This should be available for free.) Review the report carefully for any inaccuracies. Follow the necessary steps to remove these inaccuracies.

CAREER EXERCISES

1. You have been approached by the NSA to work in an information systems group that will use high-powered computers and advanced analytic techniques to study phone call metadata and other data in an attempt to identify terrorists and stop impending terrorist acts. Obviously, you will not be able to talk to anyone about your work; however, your total compensation will be more than 10 percent greater than any position for which you have applied. Would you accept this position? Why or why not?
2. Do research to find any professional organization or code of ethics associated with your current or desired future career. What might be the benefits of joining such a professional organization? How might a code of ethics help guide you in career-related decision making?

CASE STUDIES

Case One

Net Neutrality in the EU and the United States

On April 3, 2014, the European Parliament voted to unequivocally support net neutrality, the principle that all data streaming across the Internet is treated equally regardless of content, user, site, platform, or mode of communication. In the past, Internet service providers (ISPs) had blocked or slowed down Skype and Netflix data as it flowed across their pipeline, affecting approximately 100 million users. The new European Union (EU) regulation only allows ISPs to slow down or block pipelines when they are protecting network security, relieving temporary congestion, or adhering to a court order.

Advocates of net neutrality share numerous concerns. If ISPs and telecommunications companies are allowed to block or interfere with data transmission at will, they could potentially block competition, hike up prices, and hurt both consumers and the free market. Some people, however, oppose net neutrality, or at least they object to placing tough limits on charging third parties for faster network access.

In 2007, Comcast—today the largest broadband provider—blocked Internet content coming from file-sharing networks, such as BitTorrent. Although the company served as

a means for users to share copyrighted movies and music, BitTorrent also provided a way to disseminate illegal content. When users tried to upload or download files, Comcast sent a message to each PC that looked like it came from the other PC and that the users could not see. The message commanded the other PC to stop communicating. Comcast likely took this step to prevent this peer-to-peer technology from slowing down its network. Some criticized Comcast's decision as a breach of net neutrality, and Comcast voluntarily ended the practice. Comcast, however, has argued against placing too many restrictions on telecommunications companies. The company points out that unfair legal restrictions might deter IT companies from investing in infrastructure to increase speed, extend services, and improve efficiency.

In 2011, however, when Comcast merged with media content conglomerate NBC Universal, many people worried that the merger would destroy the online video market. They feared the giant Comcast-NBC Universal company would be tempted to block content or favor its own content. By the early months of 2014, indeed, Netflix saw streaming speeds for its online video rentals decline by 27 percent. The company reluctantly agreed to sign a "mutually beneficial interconnection agreement" with Comcast. Netflix had wanted to connect to Comcast's broadband network without compensating the company for the heavy traffic level generated by Netflix users.

The EU law would not bar such agreements, as it allows ISPs to offer a short list of specialized services at a higher price. But these services are limited to video on-demand, data-intensive cloud applications, and other high-load activities. Many hope that the EU decision will reverberate across the Atlantic where the Federal Communications Commission (FCC) is reformulating its net neutrality rules. The EU legislation demands that any interference to relieve temporary network congestion must be "transparent, nondiscriminatory and proportionate." As a result, a telecommunications giant such as Comcast would have to come out in the open about slowing down data transmitted from a particular site or application. The intent of the EU legislation is to allow the Internet to continue to drive economic growth, technological innovation, and social development.

Discussion Questions

1. What is net neutrality, and what does it mean for Internet users, small start-ups, and large telecommunications companies?
2. What does net neutrality mean for governments? Which types of governments would you expect to embrace net neutrality and which would not?

Critical Thinking Questions

1. Is the agreement of Comcast and Netflix in the best interest of consumers? Why or why not?
2. Is Comcast's purported practice of surreptitiously slowing or stopping the flow of data to sites that hog bandwidth ethnical? Why or why not?

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Case Two

Protecting Health Care Privacy

The U.S. Health Insurance Portability and Accountability Act (HIPAA) addresses (among other things) the privacy of health information. Its Title 2 regulates the use and disclosure of protected health information (PHI), such as billing services, by healthcare providers, insurance carriers, employers, and business associates.

Email is often the best way for a hospital to communicate with off-site specialists and insurance carriers about a patient. Unfortunately, standard email is insecure. It allows eavesdropping, later retrieval of messages from unprotected backups, message modification before it is received, invasion of the sender's privacy by providing access to information about the identity and location of the sending computer, and more. Since healthcare provider email often carries PHI, healthcare facilities must be sure their email systems meet HIPAA privacy and security requirements.

Children's National Medical Center (CNMC) of Washington, D.C., "The Nation's Children's Hospital," is especially aware of privacy concerns because all such concerns are heightened with children. CNMC did what many organizations do when faced with a specialized problem: rather than try to become specialists or hire specialists for whom the hospital has no long-term full-time need, it turned to a specialist firm.

CNMC chose Proofpoint of Sunnyvale, California, for its Security as a Service (SaaS) email privacy protection service. Matt Johnston, senior security analyst at CNMC, says that children are "the highest target for identity theft. A small kid's record is worth its weight in gold on the black market. It's not the doctor's job to protect that information. It's *my* job."

Johnston explains that he likes several things about the Proofpoint service:

- "I don't have to worry about backups." Proofpoint handles those.
- "I don't have to worry about if a server goes down. [If it was a CNMC server, I would have to] get my staff ramped up and bring up another server. Proofpoint does that for us. It's one less headache."
- "We had a product in-house before. It required several servers which took a full FTE [full-time employee] just to manage this product. It took out too much time."
- "Spam has been on the rise. Since Proofpoint came in, we've seen a dramatic decrease in spam. It takes care of itself. The end user is given a digest daily."
- Email can be encrypted or not, according to rules that the end user need not be personally concerned with.
- "Their tech support has been great."

Proofpoint is not the only company that provides healthcare providers with email security services. LuxSci of

Cambridge, Massachusetts, also offers HIPAA-compliant email hosting services, as do several other firms. They all provide the same basic features: user authentication, transmission security (encryption), logging, and audit. Software that runs on the provider's computers can also deliver media control and backup. Software that runs on a user organization's server necessarily relies on that organization to manage storage; for example, deleting messages from the server after four weeks as HIPAA requires.

As people become more aware of the privacy risks associated with standard email, the use of secure solutions such as these will undoubtedly become more common in the future.

Discussion Questions

1. What privacy concerns does transmitting healthcare information via email raise?
2. What requirement does HIPAA institute to safeguard patient privacy?

Critical Thinking Questions

1. Universities use email to communicate private information. For example, an instructor might send you an email explaining what you must do to raise your grade. The regulations about protecting that information under the Family Educational Rights and Privacy Act (FERPA) are not as strict as those under HIPAA. Do you think they should be as strict as HIPAA's requirements? Why or why not?
2. How does Proofpoint safeguard patient privacy? Could Proofpoint do the same for university and corporate emails? Why or why not?

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Questions for Web Case

See the Web site for this book to read about the Altitude Online case for this chapter. Following are questions concerning this Web case.

Altitude Online: The Personal and Social Impact of Computers

Discussion Questions

1. Why do you think extending access to a corporate network beyond the business's walls dramatically elevates the risk to information security?
2. What tools and policies can be used to minimize that risk?

Critical Thinking Questions

1. Why does information security usually come at the cost of user convenience?
2. How do proper security measures help ensure information privacy?

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Glossary

A

accounting MIS An information system that provides aggregate information on accounts payable, accounts receivable, payroll, and many other applications.

ad hoc DSS A DSS concerned with situations or decisions that come up only a few times during the life of the organization.

agile development An iterative system development process that develops the system in "sprint" increments lasting from two weeks to two months.

antivirus program Software that runs in the background to protect your computer from dangers lurking on the Internet and other possible sources of infected files.

application program interface (API) An interface that allows applications to make use of the operating system.

arithmetic/logic unit (ALU) The part of the CPU that performs mathematical calculations and makes logical comparisons.

ARPANET A project started by the U.S. Department of Defense (DoD) in 1969 as both an experiment in reliable networking and a means to link the DoD and military research contractors, including many universities doing military-funded research.

artificial intelligence (AI) A field in which the computer system takes on the characteristics of human intelligence.

artificial intelligence system The people, procedures, hardware, software, data, and knowledge needed to develop computer systems and machines that can simulate human intelligence processes, including learning (the acquisition of information and rules for using the information), reasoning (using rules to reach conclusions), and self-correction (using the outcome from one scenario to improve its performance on future scenarios).

assistive technology systems A wide range of assistive, adaptive, and rehabilitative devices to help people with disabilities perform tasks that they were formerly unable to accomplish or had great difficulty accomplishing.

attribute A characteristic of an entity.

auditing Provides an objective appraisal of the accounting, financial, and operational procedures and information of an organization.

B

batch processing system A form of data processing whereby business transactions are accumulated over a period of time and prepared for processing as a single unit or batch.

big data The term used to describe data collections that are so large and complex that traditional data management software, hardware, and analysis processes are incapable of dealing with them.

blade server A server that houses many individual computer motherboards that include one or more processors, computer memory, computer storage, and computer network connections.

Bluetooth A wireless communications specification that describes how cell phones, computers, faxes, printers, and other electronic devices can be interconnected over distances of 10 to 30 feet at a rate of about 2 Mbps.

brainstorming A decision-making approach that consists of members offering ideas "off the top of their heads," fostering creativity and free thinking.

broadband communications A relative term but generally means a telecommunications system that can exchange data very quickly.

bus A bus is a set of physical connections (such as cables and printed circuits) that can be shared by multiple hardware components so they can communicate with one another.

business intelligence (BI) A broad range of technologies and applications that enable an organization to transform mostly structured data obtained from information systems to perform analysis, generate information, and improve the decision making of the organization.

bus network A network in which network devices are connected to a common backbone that serves as a shared communications medium.

business-to-business (B2B) e-commerce A subset of e-commerce in which all the participants are organizations.

business-to-consumer (B2C) e-commerce A form of e-commerce in which customers deal directly with an organization and avoid intermediaries.

byte (B) Eight bits that together represent a single character of data.

C

Cascading Style Sheet (CSS) A markup language for defining the visual design of a Web page or group of pages.

cash flow Takes into account all the increases and decreases in cash flow associated with the project.

central processing unit (CPU) The part of the computer that consists of three associated elements: the arithmetic/logic unit, the control unit, and the register areas.

centralized processing An approach to processing wherein all processing occurs in a single location or facility.

certificate authority (CA) A trusted third-party organization or company that issues digital certificates.

certification A process for testing skills and knowledge, which results in a statement by the certifying authority that confirms an individual is capable of performing particular tasks.

channel bandwidth The rate at which data is exchanged, usually measured in bits per second (bps).

character A basic building block of most information, consisting of uppercase letters, lowercase letters, numeric digits, or special symbols.

chief knowledge officer (CKO) The individual who presents the organization's knowledge management vision with clarity and effectiveness, strives mightily to achieve that vision, provides executive level leadership to implement and sustain KM, and is the ultimate focal point for knowledge creation, sharing, and application.

choice stage The third stage of decision making, which requires selecting a course of action.

client/server architecture An approach to computing wherein multiple computer platforms are dedicated special functions, such as database management, printing, communications, and program execution.

clock speed A series of electronic pulses produced at a predetermined rate that affects machine cycle time.

cloud computing A computing environment in which software and data storage are accessed over the Internet ("the cloud"); the services are run on another organization's computer hardware and both software and data are easily accessed.

code of ethics A code that states the principles and core values that are essential to a set of people and that, therefore, govern these people's behavior.

command-based user interface A user interface that requires you to give text commands to the computer to perform basic activities.

community of practice (COP) A group of people with common interests who come together to create, store, and share knowledge of a specific topic.

compact disc read-only memory (CD-ROM) A common form of optical disc on which data cannot be modified once it has been recorded.

competitive advantage A significant and ideally long-term benefit to a company over its competition.

competitive intelligence One aspect of business intelligence and encompasses information about competitors and the ways that knowledge affects strategy, tactics, and operations.

computer program A sequence of instructions for the computer.

computer-based information system (CBIS) A single set of hardware, software, databases, telecommunications, people, and procedures that are configured to collect, manipulate, store, and process data into information.

computer-integrated manufacturing (CIM) Using computers to link the components of the production process into an effective system.

computer network The communications media, devices, and software needed to connect two or more computer systems or devices.

concurrency control A method of dealing with a situation in which two or more users or applications need to access the same record at the same time.

consumer-to-consumer (C2C) e-commerce A subset of e-commerce that involves electronic transactions between consumers using a third party to facilitate the process.

contactless payment card A card with an embedded chip that only needs to be held close to a terminal to transfer its data; no PIN number needs to be entered.

content streaming A method for transferring large media files over the Internet so that the data stream of voice and pictures plays more or less continuously as the file is being downloaded.

control unit The part of the CPU that sequentially accesses program instructions, decodes them, and coordinates the flow of data in and out of the ALU, the registers, the primary storage, and even secondary storage and various output devices.

cost center A division within a company that does not directly generate revenue.

counterintelligence The steps an organization takes to protect information sought by "hostile" intelligence gatherers.

criminal hacker (cracker) A computer-savvy person who attempts to gain unauthorized or illegal access to computer systems to steal passwords, corrupt files and programs, or even transfer money.

critical path Activities that, if delayed, would delay the entire project.

customer relationship management (CRM) software Automates and integrates the functions of sales, marketing, and service in an organization.

cybermall A single Web site that offers many products and services at one Internet location.

cyberterrorism The intimidation of government or civilian population by using information technology to disable critical national infrastructures (e.g., energy, transportation, telecommunications, banking and finance, law enforcement, and emergency response) to achieve political, religious, or ideological goals.

cyberterrorist Someone who intimidates or coerces a government or organization to advance his or her political or social objectives by launching computer-based attacks against computers, networks, and the information stored on them.

D

dashboard A data visualization tool that displays the current status of the key performance indicators (KPIs) for an organization.

data Raw facts, such as an employee number, total hours worked in a week, inventory part numbers, or sales orders.

data administrator A nontechnical position responsible for defining and implementing consistent principles for a variety of data issues.

data center A climate-and-access-controlled building or a set of buildings that houses the computer hardware that deliver an organization's data and information services.

data cleansing (data cleaning or data scrubbing) The process of detecting and then correcting or deleting incomplete, incorrect, inaccurate, irrelevant records that reside in a database.

data collection Capturing and gathering all data necessary to complete the processing of transactions.

data correction The process of reentering data that was not typed or scanned properly.

data definition language (DDL) A collection of instructions and commands used to define and describe data and relationships in a specific database.

data dictionary A detailed description of all the data used in the database.

data editing The process of checking data for validity and completeness.

data-flow diagram (DFD) A diagram used during both the analysis and design phases to document the processes of the current system or to provide a model of a proposed new system.

data-flow line A line that includes arrows showing the direction of data movement.

data item The specific value of an attribute.

data manipulation language (DML) A specific language, provided with a DBMS, which allows users to access and modify the data, to make queries, and to generate reports.

data mart A subset of a data warehouse that is used by small and medium-sized businesses and departments within large companies to support decision making.

data mining An information-analysis tool that involves the automated discovery of patterns and relationships in a data warehouse.

data model A diagram of data entities and their relationships.

data processing The process of performing calculations and other data transformations related to business transactions.

data storage The process of updating one or more databases with new transactions.

data store A symbol that reveals a storage location for data.

data warehouse A large database that collects business information from many sources in the enterprise, covering all aspects of the company's processes, products, and customers, in support of management decision making.

database An organized collection of facts and information, typically consisting of two or more related data files.

database administrators (DBAs) Skilled and trained IS professionals who hold discussions with users to define their data needs; apply database programming languages to craft a set of databases to meet those needs; test and evaluate databases; implement changes to improve their performance; and assure that data are secure from unauthorized access.

database approach to data management An approach to data management where multiple information systems share a pool of related data.

database management system (DBMS) A group of programs that manipulate the database and provide an interface between the database and the user of the database and other application programs.

decentralized processing An approach to processing wherein processing devices are placed at various remote locations.

decision-making phase The first part of problem solving, including three stages: intelligence, design, and choice.

decision room A room that supports decision making, with the decision makers in the same building, and that combines face-to-face verbal interaction with technology to make the meeting more effective and efficient.

decision support system (DSS) An organized collection of people, procedures, software, databases, and devices used to support problem-specific decision making.

delphi approach A structured, interactive, iterative decision-making method that relies on input from a panel of experts.

demand report A report developed to give certain information at someone's request rather than on a schedule.

design stage The second stage of decision making in which you develop alternative solutions to the problem and evaluate their feasibility.

desktop computer A relatively small, inexpensive, single-user computer that is highly versatile.

dialogue manager A user interface that allows decision makers to easily access and manipulate the DSS and to use common business terms and phrases.

diffusion of innovation theory A theory developed by E.M. Rogers to explain how a new idea or product gains acceptance and diffuses (or spreads) through a specific population or subset of an organization.

digital camera An input device used with a PC to record and store images and video in digital form.

digital certificate An attachment to an email message or data embedded in a Web site that verifies the identity of a sender or Web site.

digital rights management (DRM) Refers to the use of any of several technologies to enforce policies for controlling access to digital media, such as movies, music, and software.

digital video disc (DVD) A storage medium used to store software, video games, and movies.

direct access A retrieval method in which data can be retrieved without the need to read and discard other data.

direct access storage device (DASD) A device used for direct access of secondary storage data.

disk mirroring A process of storing data that provides an exact copy that protects users fully in the event of data loss.

distributed processing An approach to processing wherein processing devices are placed at remote locations but are connected to each other via a network.

document production The process of generating output records, documents, and reports.

domain The range of allowable values for a data attribute.

domain expert The person or group with the expertise or knowledge the expert system is trying to capture (domain).

drill-down report A report providing increasingly detailed data about a situation.

dumpster diving Going through the trash of an organization to find secret or confidential information, including information needed to access an information system or its data.

E

economic order quantity (EOQ) The quantity that should be reordered to minimize total inventory costs.

electronic business (e-business) Using information systems and the Internet to perform all business-related tasks and functions.

electronic commerce (e-commerce) Any business transaction executed electronically between companies (business-to-business), companies and consumers (business-to-consumer), consumers and other consumers (consumer-to-consumer), business and the public sector, and consumers and the public sector; conducting business activities (e.g., distribution, buying, selling, marketing, and servicing of products or services) electronically over computer networks.

e-government The use of information and communications technology to simplify the sharing of information, speed formerly paper-based processes, and improve the relationship between citizens and government.

electronic cash An amount of money that is computerized, stored, and used as cash for e-commerce transactions.

electronic exchange An electronic forum where manufacturers, suppliers, and competitors buy and sell goods, trade market information, and run back-office operations.

electronic product environmental assessment tool (EPEAT) A system that enables purchasers to evaluate, compare, and select electronic products based on a total of 51 environmental criteria.

electronic retailing (e-tailing) The direct sale of products or services by businesses to consumers through electronic storefronts, typically designed around the familiar electronic catalog and shopping cart model.

end-user systems development The creation, modification, or extension of software by people who are nonprofessional software developers.

enterprise data modeling Data modeling done at the level of the entire enterprise.

enterprise resource planning (ERP) system A set of integrated programs that manages the vital business operations for an entire multisite, global organization.

enterprise system A system central to the organization that ensures information can be shared across all business functions and all levels of management to support the running and managing of a business.

entity A person, place, or thing for which data is collected, stored, and maintained.

entity-relationship (ER) diagrams Data models that use basic graphical symbols to show the organization of and relationships between data.

entity symbol A symbol that shows either the source or destination of the data.

ergonomics The science of designing machines, products, and systems to maximize the safety, comfort, and efficiency of the people who use them.

exception report A report automatically produced when a situation is unusual or requires management action.

executive dashboard A diagram that presents a set of key performance indicators about the state of a process at a specific point in time to enable managers make better real-time decisions.

expert system A system that gives a computer the ability to make suggestions and function like an expert in a particular field.

explanation facility Component of an expert system that allows a user or decision maker to understand how the expert system arrived at certain conclusions or results.

Extensible Markup Language (XML) The markup language designed to transport and store data on the Web.

external auditing Auditing performed by an outside group.

extranet A network based on Web technologies that allows selected outsiders, such as business partners and customers, to access authorized resources of a company's intranet.

extreme programming (XP) An approach to writing code that promotes incremental development of a system using short development cycles to improve productivity and to accommodate new customer requirements.

F

feasibility analysis Assessment of the technical, economic, legal, operational, and schedule feasibility of a project.

feedback Information from the system that is used to make changes to input or processing activities.

field Typically a name, number, or combination of characters that describes an aspect of a business object or activity.

file A collection of related records.

File Transfer Protocol (FTP) A protocol that provides a file transfer process between a host and a remote computer and allows users to copy files from one computer to another.

filtering software Software that screens Internet content.

financial audit A thorough assessment of the reliability and integrity of the organization's financial information and the methods used to process it.

financial MIS An information system that provides financial information for workers who need to make better decisions on a daily basis.

five-forces model A widely accepted model that identifies five key factors that can lead to attainment of competitive advantage, including (1) the rivalry among existing competitors, (2) the threat of new entrants, (3) the threat of substitute products and services, (4) the bargaining power of buyers, and (5) the bargaining power of suppliers.

flexible manufacturing system (FMS) An approach that allows manufacturing facilities to rapidly and efficiently change from making one product to making another.

forecasting Predicting future events to avoid problems.

functional decomposition A technique used during the investigation, analysis, and design phases to define the business processes included within the scope of the system.

G

game theory A mathematical theory for developing strategies that maximize gains and minimize losses while adhering to a given set of rules and constraints.

Gantt chart A graphical tool used for planning, monitoring, and coordinating projects.

genetic algorithm An approach to solving problems based on the theory of evolution and the survival of the fittest as a problem-solving strategy.

geographic information system (GIS) A computer system capable of assembling, storing, manipulating, and displaying geographic information, that is, data identified according to its location.

gigahertz (GHz) Billions of cycles per second, a measure of clock speed.

graphical user interface (GUI) An interface that displays pictures (icons) and menus that people use to send commands to the computer system.

green computing A program concerned with the efficient and environmentally responsible design, manufacture, operation, and disposal of IS-related products.

grid computing The use of a collection of computers, often owned by multiple individuals or organizations, to work in a coordinated manner to solve a common problem.

group consensus approach A group decision-making process that seeks the consent of all participants.

group decision support system (GSS) Software application that consists of most of the elements in a DSS, plus software to provide effective support in group decision-making settings; also called *group support system* or *computerized collaborative work system*.

H

hacker A person who enjoys computer technology and spends time learning and using computer systems.

handheld computer A compact-sized computing device that is small enough to hold comfortably in one hand, and typically includes a display screen with stylus and/or touch screen input along with a compact keyboard or numeric keypad.

hard disk drive (HDD) A direct access storage device used to store and retrieve data from rapidly rotating disks coated with magnetic material.

hardware Computer equipment used to perform input, processing, storage, and output activities.

heuristics Commonly accepted guidelines or procedures that usually find a good solution.

hierarchy of data Bits, characters, fields, records, files, and databases.

HTML tags Codes that tell the Web browser how to format text—as a heading, as a list, or as body text—and whether images, sound, and other elements should be inserted.

human resource MIS (HRMIS) An information system that is concerned with activities related to previous, current, and potential employees of an organization, also called a personnel MIS.

hyperlink Highlighted text or graphics in a Web document that, when clicked, opens a new Web page containing related content.

Hypertext Markup Language (HTML) The standard page description language for Web pages.

I

identify theft A crime in which an imposter obtains key pieces of personal identification information, such as Social Security or driver's license numbers, to impersonate someone else.

IF-THEN statement A rule that suggests certain conclusions.

implementation stage A stage of problem solving in which a solution is put into effect.

inference engine Part of the expert system that seeks information and relationships from the knowledge base and provides answers, predictions, and suggestions similar to the way a human expert would.

information system (IS) A set of interrelated components that collect, manipulate, store, and disseminate data and information and provide a feedback mechanism to meet an objective.

informatics The combination of information technology with traditional disciplines such as medicine or science while considering the impact on individuals, organizations, and society.

information A collection of facts organized and processed so that it has additional value beyond the value of the individual facts.

information systems planning The identification of those information systems development initiatives needed to support organizational strategic goals.

in-memory database A database management system that stores the entire database in Random Access Memory (RAM).

input The activity of gathering and capturing raw data.

insider An employee, disgruntled or otherwise, working solo or in concert with outsiders to compromise corporate systems.

instant messaging A method that allows two or more people to communicate online in real time using the Internet.

institutional DSS A DSS that handles situations or decisions that occur more than once, usually several times per year or more. It is used repeatedly and refined over the years.

integration testing Testing that involves linking all of the individual components together and testing them as a group to uncover any defects between individual components.

intelligence stage The first stage of decision making in which you identify and define potential problems or opportunities.

intelligent agent Programs and a knowledge base used to perform a specific task for a person, a process, or another program; also called an *intelligent robot* or *bot*.

intelligent behavior The ability to learn from experiences and apply knowledge acquired from those experiences; to handle complex situations; to solve problems when important information is missing; to determine what is important and to react quickly and correctly to a new situation; to understand visual images, process and manipulate symbols, be creative and imaginative; and to use heuristics.

internal auditing Auditing performed by individuals within the organization.

internal rate of return The rate of return that makes the net present value of all cash flows (benefits and costs) generated by a project equal to zero.

Internet The world's largest computer network, consisting of thousands of interconnected networks, all freely exchanging information.

Internet backbone One of the Internet's high-speed, long-distance communications links.

Internet censorship The control or suppression of the publishing or accessing of information on the Internet.

Internet Crime Complaint Center (IC3) An alliance between the White Collar Crime Center and the Federal Bureau of Investigation that provides a central site for Internet crime victims to report and to alert appropriate agencies of crimes committed.

Internet Protocol (IP) A communication standard that enables computers to route communications traffic from one network to another as needed.

Internet service provider (ISP) Any organization that provides Internet access to people.

intranet An internal network based on Web technologies that allows people within an organization to exchange information and work on projects.

intrusion detection system (IDS) Monitors system and network resources and traffic and notifies network security personnel when it senses a possible intrusion.

IP address A 64-bit number that identifies a computer on the Internet.

J

Java An object-oriented programming language from Sun Microsystems based on the C++ programming language, which allows applets to be embedded within an HTML document.

joining Manipulating data to combine two or more tables.

joint application development (JAD) A structured meeting process that can accelerate and improve the efficiency and effectiveness of the investigation, analysis, and design phases of a systems development project.

just-in-time (JIT) inventory An inventory management approach in which inventory and materials are delivered just before they are used in manufacturing a product.

K

key-indicator report A summary of the previous day's critical activities, typically available at the beginning of each workday.

key performance indicators (KPIs) Quantifiable measurements that assess progress toward organizational goals and reflect the critical success factors of an organization.

knowledge The awareness and understanding of a set of information and the ways that information can be made useful to support a specific task or reach a decision.

knowledge acquisition facility Part of the expert system that provides a convenient and efficient means of capturing and storing all the components of the knowledge base.

knowledge base The collection of data, rules, procedures, and relationships that must be followed to achieve value or the proper outcome.

knowledge engineer A person who has training or experience in the design, development, implementation, and maintenance of an expert system.

knowledge user The person or group who uses and benefits from the expert system.

L

laptop computer A personal computer designed for use by mobile users, being small and light enough to sit comfortably on a user's lap.

learning systems A combination of software and hardware that allows a computer to change how it functions or how it reacts to situations based on feedback it receives.

Leavitt's diamond A theory that proposes that every organizational system is made up of four main components: people, tasks, structure, and technology with an interaction among the four components so that any change in one of these elements will necessitate a change in the other three elements.

linking The ability to combine two or more tables through common data attributes to form a new table with only the unique data attributes.

local area network (LAN) A network that connects computer systems and devices within a small area, such as an office, home, or several floors in a building.

long term evolution (LTE) A standard for wireless communications for mobile phones based on packet switching.

M

magnetic disk A direct access storage device, with bits represented by magnetized areas.

magnetic stripe card A type of card that stores a limited amount of data by modifying the magnetism of tiny iron-based particles contained in a band on the card.

magnetic tape A type of sequential secondary storage medium, now used primarily for storing backups of critical organizational data in the event of a disaster.

mainframe computer A large, powerful computer often shared by hundreds of concurrent users connected to the machine via terminals.

make-versus-buy decision The decision regarding whether to obtain the necessary software from internal or external sources.

malware Software programs that when loaded into a computer system will destroy, interrupt, or cause errors in processing.

managed security service providers (MSSPs) Organizations that monitor, manage, and maintain network security for both hardware and software for other organizations.

management information system (MIS) An organized collection of people, procedures, software, databases, and devices that provides routine information to managers and decision makers.

market segmentation The identification of specific markets to target them with tailored advertising messages.

marketing The process of determining the needs and wants of consumers and creating, communicating, and delivering products that satisfy those needs and wants.

marketing MIS A system that uses data gathered from both internal and external sources to provide reporting and aid decision making in all areas of marketing (market research, product design, pricing, media selection, advertising, selling, channel distribution, and product distribution).

massively parallel processing system A form of multiprocessing that speeds processing by linking hundreds or thousands of processors to operate at the same time, or in parallel, with each processor having its own bus, memory, disks, copy of the operating system, and applications.

mesh network A network that uses multiple access points to link a series of devices that speak to each other to form a network connection across a large area.

metropolitan area network (MAN) A telecommunications network that connects users and their computers in a geographical area that spans a campus or city.

middleware Software that allows various systems to communicate and exchange data.

mobile commerce (m-commerce) The use of mobile, wireless devices to place orders and conduct business.

model base Part of a DSS that allows managers and decision makers to perform quantitative analysis on both internal and external data.

model management software (MMS) Software that coordinates the use of models in a DSS, including financial, statistical analysis, graphical, and project-management models.

monitoring stage The final stage of the problem-solving process in which decision makers evaluate the implementation.

multicore microprocessor A microprocessor that combines two or more independent processors into a single computer so that they share the workload and improve processing capacity.

multimedia Text, graphics, video, animation, audio, and other media that can be used to help an organization efficiently and effectively achieve its goals.

multiprocessing The simultaneous execution of two or more instructions at the same time.

multivoting Any one of a number of voting processes used to reduce the number of options to be considered.

N

natural language processing Involves the computer understanding, analyzing, manipulating, and/or generating "natural" languages such as English.

Near Field Communication (NFC) A very short-range wireless connectivity technology designed for cell phones and credit cards.

nettop computer An inexpensive desktop computer designed to be smaller, lighter, and consume much less power than a traditional desktop computer.

network Computers and equipment that are connected in a building, around the country, or around the world to enable electronic communications.

network-management software Software that enables a manager on a networked desktop to monitor the use of individual computers and shared hardware (such as printers), scan for viruses, and ensure compliance with software licenses.

network operating system (NOS) Systems software that controls the computer systems and devices on a network and allows them to communicate with each other.

network topology The shape or structure of a network that indicates how the communications links and hardware devices of the network are arranged.

neural network A computer system that can recognize and act on patterns or trends in that it detects in large sets of data.

nominal group technique (NGT) A structured method for group brainstorming that encourages contributions from everyone.

nonprogrammed decision A decision that deals with unusual or exceptional situations.

NoSQL database A database designed to store and retrieve data in a manner that does not rigidly enforce the atomic conditions associated with the relational database model in order to provide faster performance and greater scalability.

O

off-the-shelf software Software mass-produced by software vendors to address needs that are common across businesses, organizations, or individuals.

online analytical processing (OLAP) A form of analysis that allows users to explore data from a number of perspectives enabling a style of analysis known as "slicing and dicing."

online transaction processing (OLTP) A form of data processing where each transaction is processed immediately, without the delay of accumulating transactions into a batch.

operational audit An assessment of how well management uses the resources of the organization and how effectively organizational plans are being executed.

optimization model A process to find the best solution, the one that will best help the organization meet its goals.

organization A formal collection of people and other resources established to accomplish a set of goals.

organizational change How for-profit and nonprofit organizations plan for, implement, and handle change.

output Production of useful information, usually in the form of documents and reports.

P

parallel computing The simultaneous execution of the same task on multiple processors to obtain results faster.

password sniffer A small program hidden in a network or a computer system that records identification numbers and passwords.

payback period Takes into account all the increases and decreases in cash flow associated with the project.

p-card (procurement card or purchasing card) A credit card used to streamline the traditional purchase order and invoice payment processes.

perceptive system A system that approximates the way a person sees, hears, and feels objects.

personal area network (PAN) A network that supports the interconnection of information technology devices close to one person.

phishing A form of computer scam that attempts to get users to gain access to a customer's private information through a fake Web site.

pixel A dot of color on a photo image or a point of light on a display screen.

point-of-sale (POS) device A terminal used to enter data into the computer system.

portable computer A computer small enough to carry easily.

predictive analysis (also called predictive analytics) A form of data mining that combines historical data with assumptions about future conditions to predict outcomes of events, such as future product sales or the probability that a customer will default on a loan.

primary key A field or set of fields that uniquely identifies the record.

primary storage (main memory; memory) Holds program instructions and data, is closely associated with the CPU.

problem solving A process that goes beyond decision making to include the implementation stage.

procedures The strategies, policies, methods, and rules for using a CBIS.

process A set of logically related tasks performed to achieve a defined outcome.

process symbol A symbol that identifies the function being performed.

processing Converting or transforming data into useful outputs.

product lifecycle management (PLM) An enterprise business strategy that creates a common repository of product information and processes to support the collaborative creation, management, dissemination, and use of product and packaging definition information.

product lifecycle management (PLM) software Software that provides a means for managing the data and processes associated with the various phases of the lifecycle of a product including sales and marketing, research and development, concept development, product design, prototyping and testing, process design, production and assembly, delivery and product installation, service and support, and product retirement and replacement.

product owner A person who represents the project stakeholders and is responsible for communicating and aligning project priorities between the stakeholders and development team.

profit center An independent business unit that is treated as a distinct entity enabling its revenues and expenses to be determined and its profitability to be measured.

Program Evaluation and Review Technique (PERT) A formalized approach for developing a project schedule that creates three time estimates for an activity.

programmed decision A decision made using a rule, procedure, or quantitative method.

programmer A specialist responsible for modifying or developing programs to satisfy user requirements.

programming languages Sets of keywords, symbols, and rules for constructing statements that people can use to communicate instructions to a computer.

project deadline The date the entire project should be completed and operational.

project manager The person assigned by the organization doing the work of the project to achieve the project objectives.

project milestone A critical date for the completion of a major part of the project.

project schedule A detailed description of when project activities are performed.

project sponsor A key member and leader of the steering committee who plays such a critical role that lack of this essential individual raises the distinct probability of project failure.

projecting Manipulating data to eliminate columns in a table.

proprietary software One-of-a-kind software designed for a specific application and owned by the company, organization, or person that uses it.

prototype A working model of a system developed to enable users to interact with the system and provide feedback so developers can better understand what is needed.

prototyping An iterative software development approach based on the use of software prototypes.

Q

quality control A process that ensures that the finished product meets the customers' needs.

R

Radio Frequency Identification (RFID) A technology that employs a microchip with an antenna to broadcast its unique identifier and location to receivers.

random access memory (RAM) A form of memory in which instructions or data can be temporarily stored.

rational unified process (RUP) An iterative systems development approach that was developed by IBM and includes a number of tools and techniques that are typically tailored to fit the needs of a specific company or organization.

read-only memory (ROM) A nonvolatile form of memory.

record A collection of data fields all related to one object, activity, or individual.

redundant array of independent/inexpensive disks (RAID) A method of storing data that generates extra bits of data from existing data enabling the system to create a

"reconstruction map" so that if a hard drive fails, the system can rebuild lost data.

register High-speed storage area used to temporarily hold small units of program instructions and data immediately before, during, and after execution by the CPU.

relational model A simple but highly useful way to organize data into collections of two-dimensional tables called relations.

reorder point (ROP) A critical inventory quantity level.

request for proposal (RFP) A formal document that outlines an organization's hardware or software needs and requests vendors to develop a detailed proposal of how they would meet those needs and at what cost.

revenue center An organizational unit that gains revenue from the sale of products or services.

rich Internet application (RIA) Software that has the functionality and complexity of traditional application software but that does not require local installation and runs in a Web browser.

robotics Mechanical or computer devices that perform tasks requiring a high degree of precision or that are tedious or hazardous for humans.

rule A conditional statement that links conditions to actions or outcomes.

S

satisficing model A model that will find a good—but not necessarily the best—solution to a problem.

scheduled report A report produced periodically, such as daily, weekly, or monthly.

schema A description of the entire database.

scope creep The temptation to add more features and functionality to the original scope of the system.

script bunny A derogatory term for inexperienced hackers who download programs called "scripts" that automate the job of breaking into computers.

scrum A method employed to keep the agile system development effort focused and moving quickly.

scrum master The person who coordinates all scrum activities.

search engine A valuable tool that enables you to find information on the Web by specifying words that are key to a topic of interest, known as keywords.

Secure Sockets Layer (SSL) A communications protocol used to secure sensitive data during e-commerce.

security dashboard Software that provides a comprehensive display on a single computer screen of all the vital data related to an organization's security defenses, including threats, exposures, policy compliance and incident alerts.

selecting Manipulating data to eliminate rows according to certain criteria.

semistructured decisions Decisions where only some of the variables can be measured quantitatively.

separation of duties The careful division of the tasks and responsibilities associated with a key process so that they must be performed by more than one person.

sequential access A retrieval method in which data must be accessed in the order in which it is stored.

sequential access storage device (SASD) A device used to sequentially access secondary storage data.

server A computer used by many users to perform a specific task, such as running network or Internet applications.

service-oriented architecture (SOA) A modular method of developing software and systems that allows users to interact with systems and systems to interact with each other.

smart card A credit card–sized device with an embedded microchip to provide electronic memory and processing capability; Credit card embedded with computer chip containing key consumer and account data; cardholders must either enter their pin (chip-and-PIN) or sign (chip-and-sign) for each transaction to be approved.

smishing A scam that attempts to steal an individual's private information by having them respond to a text message.

social engineering Using social skills to get computer users to provide information that allows a hacker to access an information system or its data.

social graph analysis A data visualization technique in which data is represented as networks where the vertices are the individual data points (social network users) and the edges are the connections among them.

software The computer programs that govern the operation of the computer.

Software as a Service (SaaS) A service that allows businesses to subscribe to Web-delivered application software.

software defined networking An emerging approach to networking that allows network administrators to have programmable central control of the network via a controller without requiring physical access to all the network devices.

software piracy The act of unauthorized copying, downloading, sharing, selling, or installing of copyrighted software.

software suite A collection of programs packaged together in a bundle.

source data automation Capturing data at its source and recording it accurately in a timely fashion with minimal manual effort and in an electronic or digital form that it can be directly entered into the computer.

speech-recognition technology Input devices that recognize human speech.

spyware Software that is installed on a personal computer to intercept or take partial control of the user's interaction with the computer without the knowledge or permission of the user.

stakeholders People who ultimately will be affected (for better or worse) by the systems development project.

star network A network in which all network devices connect to one another through a single central device called the hub node.

steering team A small group of senior managers representing the business and IS organizations that provide guidance and support to the project.

storage area network (SAN) A high-speed, special-purpose network that integrates different types of data storage devices (e.g. hard disk drives, magnetic tape, solid state secondary storage devices) into a single storage system and connects that to computing resources across an entire organization.

storage as a service Storage as a service is a data storage model where a data storage service provider rents space to individuals and organizations.

strategic alliance (or strategic partnership) An agreement between two or more companies that involves the joint production and distribution of goods and services.

structured decisions Decisions where the variables that comprise the decision are known and can be measured quantitatively.

supercomputer The most powerful computer system with the fastest processing speed.

supply chain management (SCM) A system that includes planning, executing, and controlling all activities involved in raw material sourcing and procurement, converting raw materials to finished products, and warehousing and delivering finished products to customers.

system construction The phase of systems development that converts the system design into an operational system by acquiring and installing hardware and software, coding and testing software programs, creating and loading data into databases, and performing initial program testing.

system disposal Those activities that ensure the orderly dissolution of the system including those activities required to close-out any contracts in place, dispose of all equipment in an environmentally friendly manner, and to safely migrate information from the system to another system or archive it in accordance to applicable records management policies.

systems analysis This phase of systems development involves gathering data on the existing system, determining the requirements for the new system, considering alternatives within identified constraints, and investigating the feasibility of alternative solutions.

systems analyst A professional who specializes in analyzing and designing business systems.

systems development The activity of creating or modifying information systems.

systems design The stage of systems development that creates a complete set of technical specifications that can be used to construct the information system.

systems implementation Involves successfully introducing an information system into an organization.

systems investigation The purpose of this phase of systems development is to gain a clear understanding of the specifics of the problem to be solved or the opportunity to be addressed.

systems maintenance A stage of systems development that involves changing and enhancing the system to make it more useful in achieving user and organizational goals.

systems operation Use of a new or modified system under all kinds of operating conditions.

T

tablet computer A portable, lightweight computer with no keyboard that allows you to roam the office, home, or factory floor carrying the device like a clipboard.

technology infrastructure All the hardware, software, databases, telecommunications, people, and procedures that are configured to collect, manipulate, store, and process data into information.

telecommunications The electronic transmission of signals for communications that enables organizations to carry out their processes and tasks through effective computer networks.

telecommunications medium Any material substance that carries an electronic signal to support communications between a sending and a receiving device.

thin client A low-cost, centrally managed computer with essential but limited capabilities and no extra drives (such as CD or DVD drives) or expansion slots.

throw-away prototype A prototype that is used to help define the software solution but does not become part of the final solution.

time value of money Takes into account the fact that a dollar today is worth more than a dollar paid in the future.

traditional approach to data management An approach to data management whereby each distinct operational system uses data files dedicated to that system.

traditional systems development life cycle A sequential multistage process where work on the next stage cannot begin until the results of the previous stage are reviewed and approved or modified as necessary.

transaction Any business-related exchange such as payments to employees, sales to customers, and payments to suppliers.

transaction processing cycle The process of data collection, data editing, data correction, data processing, data storage, and document production.

transaction processing system (TPS) An organized collection of people, procedures, software, databases, and devices used to perform and record business transactions.

tunneling The process by which VPNs transfer information by encapsulating traffic in IP packets over the Internet.

U

ultra wideband (UWB) A form of short-range communications that employs extremely short electromagnetic pulses lasting just 50 to 1,000 picoseconds that are transmitted across a broad range of radio frequencies of several gigahertz.

Uniform Resource Locator (URL) A Web address that specifies the exact location of a Web page using letters and words that map to an IP address and a location on the host.

United States Computer Emergency Readiness Team (US-CERT) Part of the Department of Homeland Security that leads U.S. efforts to improve the nation's cybersecurity posture, coordinate cyber information sharing, and proactively manage cyber risks to the nation.

unstructured decisions Decisions where the variables that affect the decision cannot be measured quantitatively.

user interface The element of the operating system that allows people to access and command the computer system.

users People who will regularly interact with the system.

utility program Program that helps to perform maintenance or correct problems with a computer system.

V

value chain A series (chain) of activities that an organization performs to transform inputs into outputs in such a way that the value of the input is increased.

virtual reality An artificial three-dimensional environment created by hardware and software and experienced through sensory stimuli (primarily sight and sound, but sometimes through touch, taste, and smell) and within which an individual can interact to affect what happens in the environment.

virtual reality system A system that enables one or more users to move and react in a computer-simulated environment.

virtual tape A storage device for less frequently needed data so that it appears to be stored entirely on tape cartridges, although some parts of it might actually be located on faster hard disks.

virtual workgroups Teams of people located around the world working on common problems.

vishing A scam that attempts to steal an individual's private information by having them call a phone number and enter personal data.

vision system The hardware and software that permit computers to capture, store, and manipulate visual images.

W

Web Server and client software, the Hypertext Transfer Protocol (HTTP), standards, and mark-up languages that combine to deliver information and services over the Internet.

Web 2.0 The Web as a computing platform that supports software applications and the sharing of information among users.

Web browser Web client software such as Internet Explorer, Firefox, Chrome, and Safari used to view Web pages.

Web log (blog) A Web site that people can create and use to write about their observations, experiences, and opinions on a wide range of topics.

Web portal A Web page that combines useful information and links and acts as an entry point to the Web; portals typically include a search engine, a subject directory, daily headlines, and other items of interest. Many people choose a Web portal as their browser's home page (the first page you open when you begin browsing the Web).

wide area network (WAN) A telecommunications network that connects large geographic regions.

Wi-Fi A medium-range wireless telecommunications technology brand owned by the Wi-Fi Alliance.

working prototype A prototype that starts with an initial prototype that undergoes a series of iterations of demo, feedback, and refinement and eventually evolves into the final software solution.

workstation A more powerful personal computer used for mathematical computing, computer-assisted design, and other high-end processing, but still small enough to fit on a desktop.

Worldwide Interoperability for Microwave Access (WiMAX) A 4G alternative based on a set of IEEE 802.16 metropolitan area network standards that support various types of communications access.

World Wide Web (WWW or Web) A network of links on the Internet to documents containing text, video, and sound.

Subject Index

Note: A boldface page number indicates a key term and the location of its definition in the text.

C

D

E

F

G

H

I

J

K

L

M

N

Q

R

S

T

U

V

W

X

Y

Z

Company Index