Fundamentals of INFORMATION SYSTEMS

Eighth Edition

Ralph M. Stair | George W. Reynolds

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Fundamentals of Information Systems

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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

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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

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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

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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

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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

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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

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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

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- **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.
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- **Figure Files** Figure files allow instructors to create their own presentations using figures taken directly from the text.

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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

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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.

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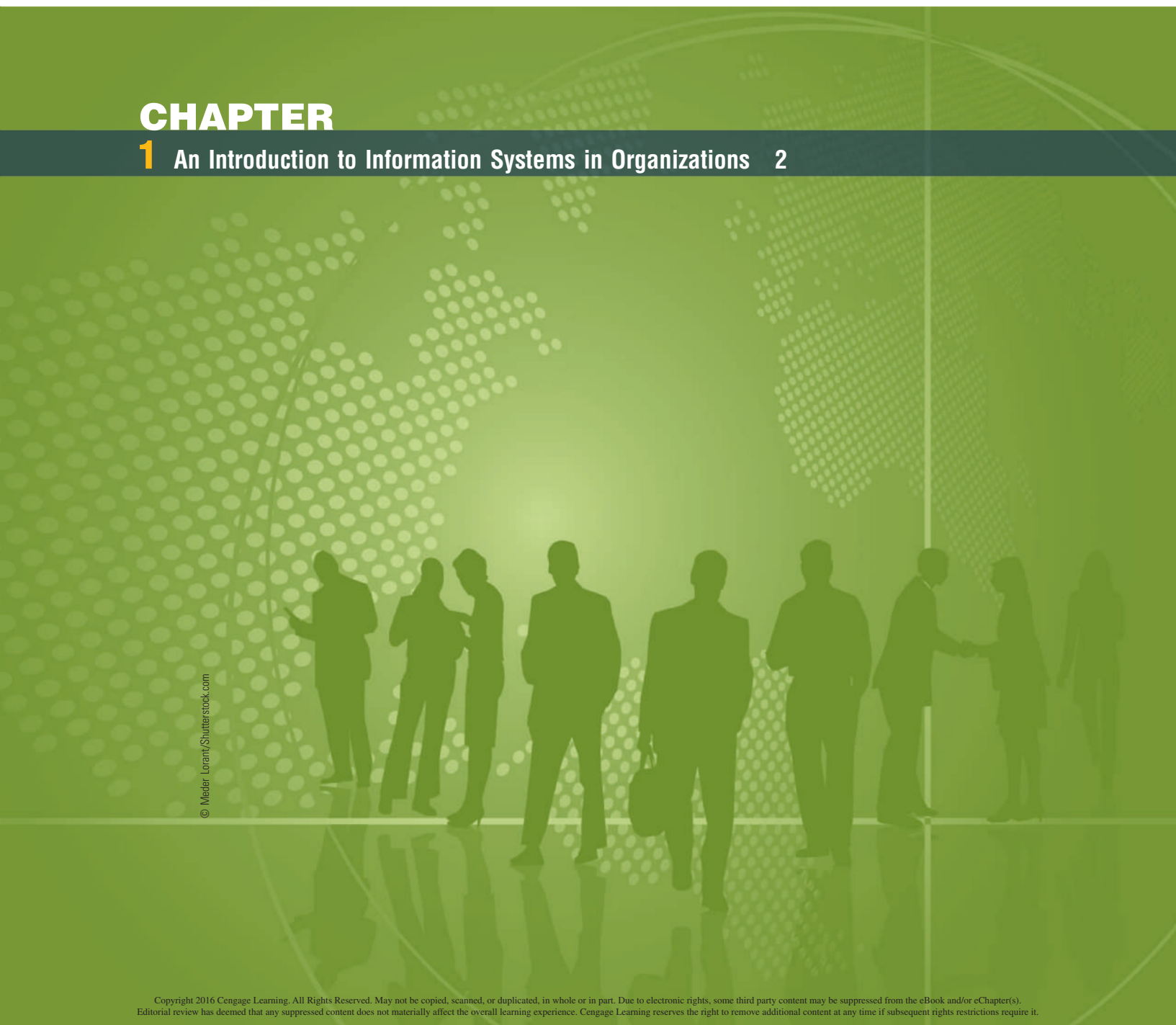
Information Systems in Perspective

CHAPTER

1 An Introduction to Information Systems in Organizations 2



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1 An Introduction to Information Systems in Organizations

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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.

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Information Systems in the Global Economy

WILLSON, CANADA

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

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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.

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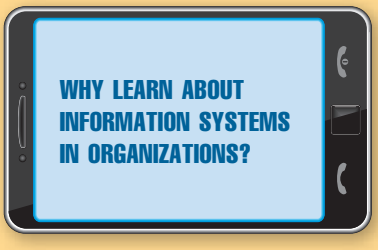
Through these ongoing and continuous improvement efforts, Willson has been able to attain its ultimate goal—to improve customer service and to prove that a ninety-plus year old company can still be innovative.

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?



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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.

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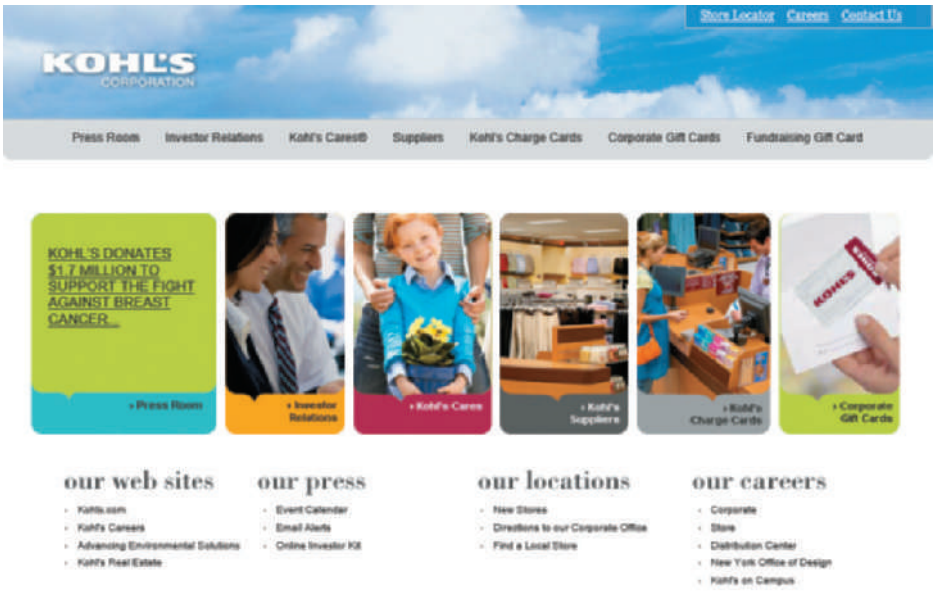

www.kohlscorporation.com

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

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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

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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.

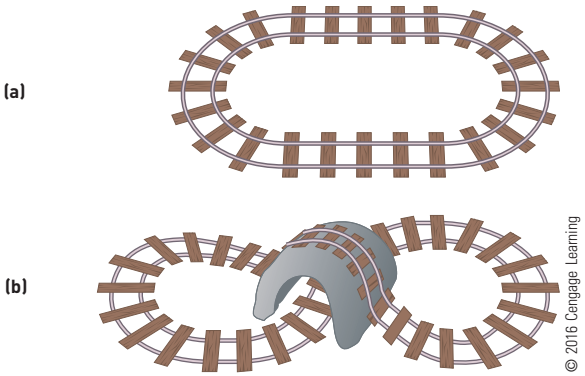

FIGURE **1.2**

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,

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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.

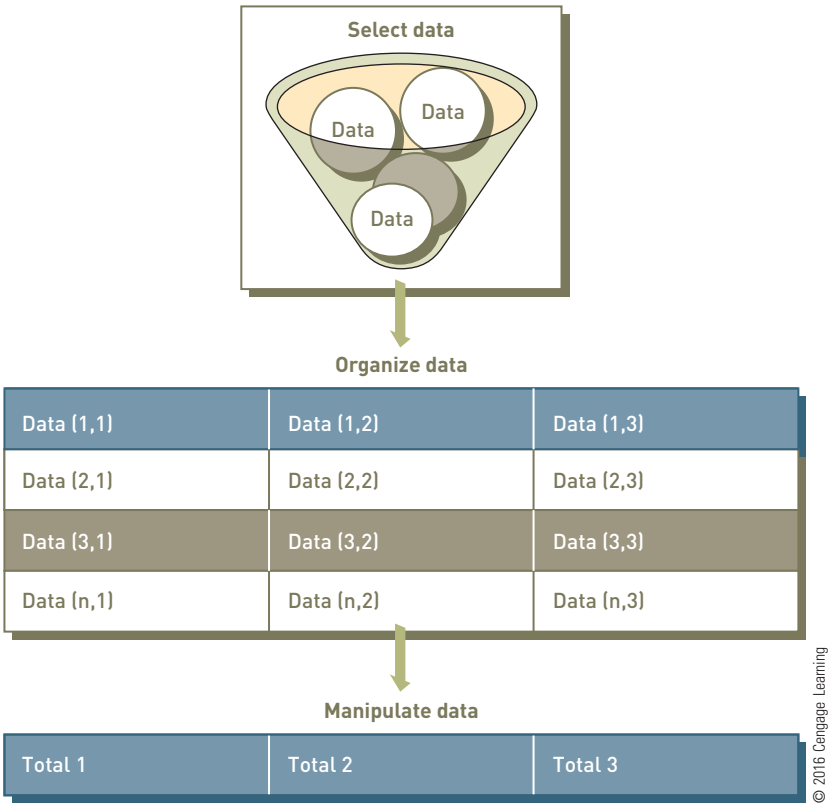

FIGURE **1.3**

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]

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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.

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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.

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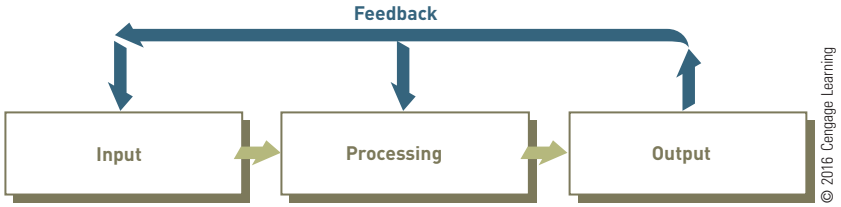

FIGURE **1.4**

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!

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