

# Principles of INFORMATION SYSTEMS

Twelfth Edition



**Ralph M. Stair | George W. Reynolds**



**Twelfth Edition**

# Principles of Information Systems

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Twelfth Edition**

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WCN: 02-200-203

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Library of Congress Control Number: 2014951130

Student Edition:

ISBN: 978-1-285-86716-8

Instructor's Edition:

ISBN: 978-1-285-86969-8

**Cengage Learning**20 Channel Center Street  
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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

As organizations and entrepreneurs continue to operate in an increasingly competitive and global marketplace, workers in all business areas including accounting, customer service, distribution, finance, human resources, information systems, logistics, marketing, manufacturing, research and development, and sales must be well prepared to make the significant contributions required for success. Regardless of your future role, even if you are an entrepreneur, you need to understand what information systems (IS) can and cannot do and be able to use them to help you achieve personal and organizational goals. You will be expected to discover opportunities to use information systems and to participate in the design and implementation of solutions to business problems employing information systems. 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 recognize and address their impact on co-workers, customers, suppliers, and other key business partners. For these reasons, a course in information systems is essential for students in today's high-tech world.

*Principles of Information Systems, Twelfth 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.

*Principles of Information Systems, Twelfth Edition*, stands proudly at the beginning of the IS curriculum and remains unchallenged in its position as the only IS principles text offering basic IS concepts that every business student must learn to be successful. At one time, instructors of the introductory course faced a dilemma. On one hand, experience in business organizations allows students to grasp the complexities underlying important IS concepts. For this reason, many schools delayed presenting these concepts until students completed a large portion of their core business requirements. On the other hand, delaying the presentation of IS concepts until students have

matured within the business curriculum often forces the one or two required introductory IS courses to focus only on personal computing software tools and, at best, merely to introduce computer concepts.

This text has been written specifically for the introductory course in the IS curriculum. *Principles of Information Systems, Twelfth 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

*Principles of Information Systems, Twelfth 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 twelfth edition, offering a number of benefits to students and instructors. While the fundamental vision of this market-leading text remains unchanged, the twelfth 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 principles 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 presents a solid conceptual foundation and practical IS experience to students.

## GOALS OF THIS TEXT

Because *Principles of Information Systems, Twelfth 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, *Principles of Information Systems, Twelfth 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

*Principles of Information Systems, Twelfth Edition*, although comprehensive, cannot cover every aspect of the rapidly changing IS discipline. The authors, having recognized this, provide students with 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 *Principles of Information Systems, Twelfth 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

*Principles of Information Systems, Twelfth 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 *Principles of Information Systems, Twelfth 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 TWELFTH 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 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 nearly 500 new and current 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 170 new figures and images. 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	Top Three New or Expanded Topics
<b>1</b> <b>An Introduction to Information Systems</b>	31	22	<ul style="list-style-type: none"> <li>• Impact of doubling amount of digital data every two years</li> <li>• 5<sup>th</sup> generation wireless communications</li> <li>• Information literacy</li> </ul>
<b>2</b> <b>Information Systems in Organizations</b>	28	19	<ul style="list-style-type: none"> <li>• Types of innovation</li> <li>• Use of several organizational change models to improve the successful implementation of IS</li> <li>• Financial evaluation of projects using IRR and NPV</li> </ul>
<b>3</b> <b>Hardware: Input, Processing, Output, and Storage Devices</b>	41	18	<ul style="list-style-type: none"> <li>• New solutions for growing storage needs</li> <li>• Infrastructure as a service</li> <li>• Building energy-efficient data centers</li> </ul>
<b>4</b> <b>Software: Systems and Application Software</b>	35	12	<ul style="list-style-type: none"> <li>• Mobile operating systems</li> <li>• Cloud computing services</li> <li>• Types of software licenses</li> </ul>
<b>5</b> <b>Database Systems and Applications</b>	31	9	<ul style="list-style-type: none"> <li>• Big data, Hadoop, and NoSQL databases</li> <li>• In-memory databases</li> <li>• ACID properties of SQL databases</li> </ul>
<b>6</b> <b>Telecommunications and Networks</b>	30	5	<ul style="list-style-type: none"> <li>• Network topologies</li> <li>• Future of municipal Wi-Fi networks and 5G wireless communications</li> <li>• Software defined networking</li> </ul>
<b>7</b> <b>The Internet, Web, Intranets, and Extranets</b>	35	5	<ul style="list-style-type: none"> <li>• Cloud computing</li> <li>• Web services and Web design framework</li> <li>• Social networking within an organization</li> </ul>
<b>8</b> <b>Electronic and Mobile Commerce</b>	39	5	<ul style="list-style-type: none"> <li>• Global growth of e-commerce</li> <li>• E-commerce issues and challenges</li> <li>• Two-factor authentication</li> </ul>



Chapter	New Company Examples	New Figures	Top Three New or Expanded Topics
9 Enterprise Systems	30	5	<ul style="list-style-type: none"> <li>• Emergence of Tier I, II, and III ERP vendors</li> <li>• Product lifecycle management strategies and systems including CAD, CAE, and CAM</li> <li>• Overcoming the challenges of implementing enterprise systems</li> </ul>
10 Information and Decision Support Systems	33	8	<ul style="list-style-type: none"> <li>• Structured, semistructured, and unstructured decisions</li> <li>• Activities supported by marketing MIS</li> <li>• Decision-making approaches including Delphi, brainstorming, group consensus, nominal group, and multivoting</li> </ul>
11 Knowledge Management and Specialized Information Systems	35	11	<ul style="list-style-type: none"> <li>• Communities of practice</li> <li>• Assistive technology systems</li> <li>• Informatics</li> </ul>
12 Systems Development: Investigation, Analysis, and Design	25	18	<ul style="list-style-type: none"> <li>• Focuses strictly on systems planning, investigation, analysis, and design phases, their tasks, and associated techniques</li> <li>• JAD and functional decomposition</li> <li>• Project steering committee and project sponsor</li> </ul>
13 Systems Development: Construction, Integration and Testing, Implementation, Operation and Maintenance, and Disposal	29	9	<ul style="list-style-type: none"> <li>• Leadership required to overcome resistance to change and achieve a successful system introduction</li> <li>• Prototype, Agile, mobile app, end user development</li> <li>• Tips to avoid project failure</li> </ul>
14 The Personal and Social Impact of Computers	53	15	<ul style="list-style-type: none"> <li>• Hacking of smartphones</li> <li>• Use of computers to recover stolen property, monitor criminals, and assess crime risk</li> <li>• Current strategies and tools to prevent computer crime including identity theft</li> </ul>

## ONLINE SOLUTIONS

### MindTap™

MindTap for Stair/Reynolds *Principles of Information Systems, 12e*, 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 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 *Principles of Information Systems, Twelfth Edition*, please contact us through your local representative.

**PART 1**

**PART 2**

**PART 3**

**PART 4**

**PART 5**

# Overview

## CHAPTERS

**1** An Introduction to Information Systems 2

**2** Information Systems in Organizations 54

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# 1 An Introduction to Information Systems

Principles	Learning Objectives
<ul style="list-style-type: none"><li>• The value of information is directly linked to how it helps decision makers achieve the organization's goals.</li></ul>	<ul style="list-style-type: none"><li>• Discuss why it is important to study and understand information systems.</li><li>• Distinguish data from information and describe the characteristics used to evaluate the quality of data.</li></ul>
<ul style="list-style-type: none"><li>• Computers and information systems help make it possible for organizations to improve the way they conduct business.</li></ul>	<ul style="list-style-type: none"><li>• Name the components of an information system and describe several system characteristics.</li></ul>
<ul style="list-style-type: none"><li>• Knowing the potential impact of information systems and having the ability to put this knowledge to work can result in a successful personal career and in organizations that reach their goals.</li></ul>	<ul style="list-style-type: none"><li>• List the components of a computer-based information system.</li><li>• Identify the basic types of business information systems and discuss who uses them, how they are used, and what kinds of benefits they deliver.</li></ul>
<ul style="list-style-type: none"><li>• System users, business managers, and information systems professionals must work together to build a successful information system.</li></ul>	<ul style="list-style-type: none"><li>• Identify the major steps of the systems development process and state the goal of each.</li></ul>
<ul style="list-style-type: none"><li>• Information systems must be applied thoughtfully and carefully so that society, businesses, and industries around the globe can reap their enormous benefits.</li></ul>	<ul style="list-style-type: none"><li>• Describe some of the threats that information systems and the Internet can pose to security and privacy.</li><li>• Discuss the expanding role and benefits of information systems in business and industry.</li></ul>



## Information Systems in the Global Economy

### CATERPILLAR, INC.

#### Advent of Autonomous Vehicles



Reprinted Courtesy of Caterpillar Inc.

Imagine one day that you are driving along a highway, and when you glance at a vehicle passing by, you notice with horror that no one is in the driver seat. Does that seem like a scene from a freaky science fiction movie? Actually, that day is not that far away—and it doesn't look that scary.

Autonomous vehicles, or vehicles that drive on their own, will likely provide many benefits. Ideally, their use will reduce vehicle accidents, thus saving lives and avoiding billions of dollars in repair bills. They will enable the blind and other disabled people to be more mobile. Autonomous vehicles can also decrease manufacturing and shipping costs by reducing the need for truck drivers to deliver supplies, raw materials, and finished products.

In the trucking industry, which suffers from periodic underemployment, autonomous vehicles are already on the roads—in the Australian outback. In 2013, Australia's largest mining companies deployed large fleets of autonomous trucks. Rio Tinto, a world leader in iron ore, aluminum, copper, coal, diamond, and uranium mining, began with a handful of driverless trucks at three mining sites in 2012, and then announced it was increasing its order to 150. Meanwhile, BHP Billiton, a multinational mining and petroleum company, has taken advantage of Caterpillar's line of high-tech autonomous vehicles, ordering both haulers and dozers.

Caterpillar has been working with Carnegie Mellon University for over 20 years to produce the advances in information systems and other technology needed to create autonomous trucks. These trucks have to plan routes, detect obstacles, and avoid them. Timely and correct interpretation of data is critical. Caterpillar's product manager Ed McCord explains, "Any autonomous vehicle has to take in sensor data, then process it fast enough to plan a route and make adjustments."

Like a driver, these trucks need to interpret exceptions. "We must be able to manage exceptions with the software. For example, if an operator hears a strange noise, he'll take preventive action, such as reporting it to maintenance," explains McCord. "Likewise, an operator can see a flat tire on the truck ahead of him, so we are developing technologies that are able to monitor tires."

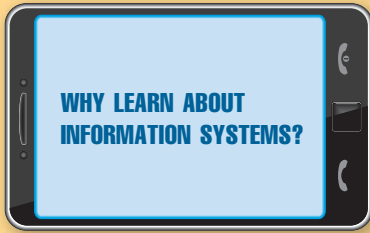
To meet the need to interpret exceptions, Caterpillar and Carnegie Mellon have developed unique information management systems, robotics, high-precision global position system (GPS) guidance and control systems, machine health monitoring system, and wireless communication systems.

Truck manufacturers are not the only companies moving into this emerging industry. Audi tested its autonomous cars on public roads in Nevada in 2013. It developed miniaturized laser sensor arrays and a single motherboard that controlled the power train, infotainment, traction, and all other electronic systems. Like Volvo, Nissan, and other automobile companies, Audi stresses that self-driving cars won't necessarily be driverless—at least in the near future. Rather, they will be used to relieve drivers during traffic jams and long trips and aid in parallel parking. They will also help avoid accidents by detecting road edges, animals, and pedestrians and by communicating from one vehicle to another. Yet, once governments have created the policy and developed the infrastructure needed to accommodate autonomous vehicles, some or all of the almost 6 million truck drivers, chauffeurs, and cab drivers on the road today may find themselves without work.

The development of information systems to interpret data and respond to it is key to the emergence of the autonomous vehicle industry. Caterpillar has converted what may seem like a futuristic vision into an economic opportunity today.

As you read this chapter, consider the following:

- Why are information systems that can interpret data critical to the development of autonomous vehicles?
- What types of data do autonomous vehicles need to interpret?
- What are the potential advantages and disadvantages of autonomous vehicles?



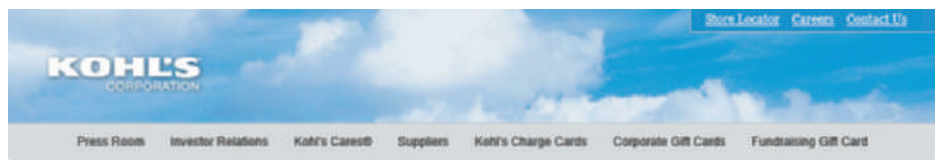
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Information systems are used by workers and managers in all lines of business. Entrepreneurs and small business owners use information systems to market their goods and services and to interact with customers around the world. Sales representatives use information systems to advertise products, communicate with customers and suppliers, and forecast sales and inventory levels. Managers use them to make multimillion-dollar decisions, such as whether to build a new manufacturing plant or dedicate more money to research on a new drug. Financial advisors use information systems to advise their clients as they save for retirement or their children’s education. From a small neighborhood music store to huge multinational companies, businesses of all sizes cannot survive without information systems to support accounting, marketing, management, finance, production, and similar 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.

This chapter presents an overview of information systems, with each section getting full treatment in subsequent chapters. We start by exploring the basics of information systems.

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

People and organizations use information systems every day. An **information system (IS)** is a set of interrelated components that collect, process, store, and disseminate data and information and provide a feedback mechanism to meet an objective. The feedback mechanism is critical to help organizations achieve their goals, such as increasing profits or improving customer service. 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.<sup>1</sup>



**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.

<p><b>our web sites</b></p> <ul style="list-style-type: none"> <li>• Kohl's.com</li> <li>• Kohl's Careers</li> <li>• Advancing Environmental Solutions</li> <li>• Kohl's Real Estate</li> </ul>	<p><b>our press</b></p> <ul style="list-style-type: none"> <li>• Event Calendar</li> <li>• Email Alerts</li> <li>• Online Investor Kit</li> </ul>	<p><b>our locations</b></p> <ul style="list-style-type: none"> <li>• New Stores</li> <li>• Directions to our Corporate Office</li> <li>• Find a Local Store</li> </ul>	<p><b>our careers</b></p> <ul style="list-style-type: none"> <li>• Corporate</li> <li>• Store</li> <li>• Distribution Center</li> <li>• New York Office of Design</li> <li>• Kohl's on Campus</li> </ul>
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www.kohls.com/corporation.com

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 increasingly 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.

## 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 the number of units produced on a production line.

**information:** A collection of data 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. For example, 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.<sup>2</sup>

**TABLE 1.1** Types of data

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

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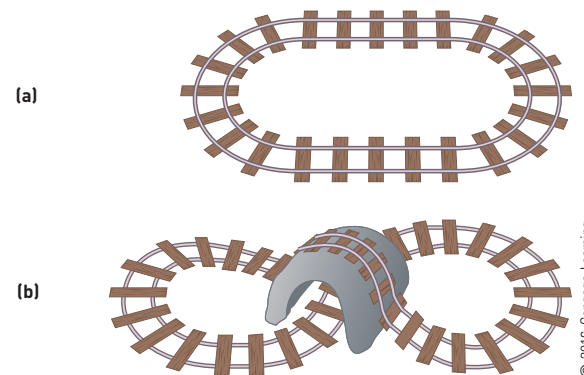
Data represents real-world things. Hospitals and healthcare organizations, for example, maintain patient medical data, which represents facts about actual patients with specific health situations. Today, hospitals and other healthcare organizations are investing millions of dollars in developing electronic health record programs to store and use the vast amount of medical data generated each year. Medical record systems often store critical health-related data, which can be used to create valuable information capable of saving money and lives. For example, researchers collected data from patient records, hospital discharge forms, and prescription records to study almost 400,000 pregnancies. Using sophisticated data analysis, the researchers determined the key risk factors for blood clots in pregnant women.<sup>3</sup> 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 different email marketing campaigns each month 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.”<sup>4</sup>

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.

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.



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**FIGURE 1.2**

### Data and information

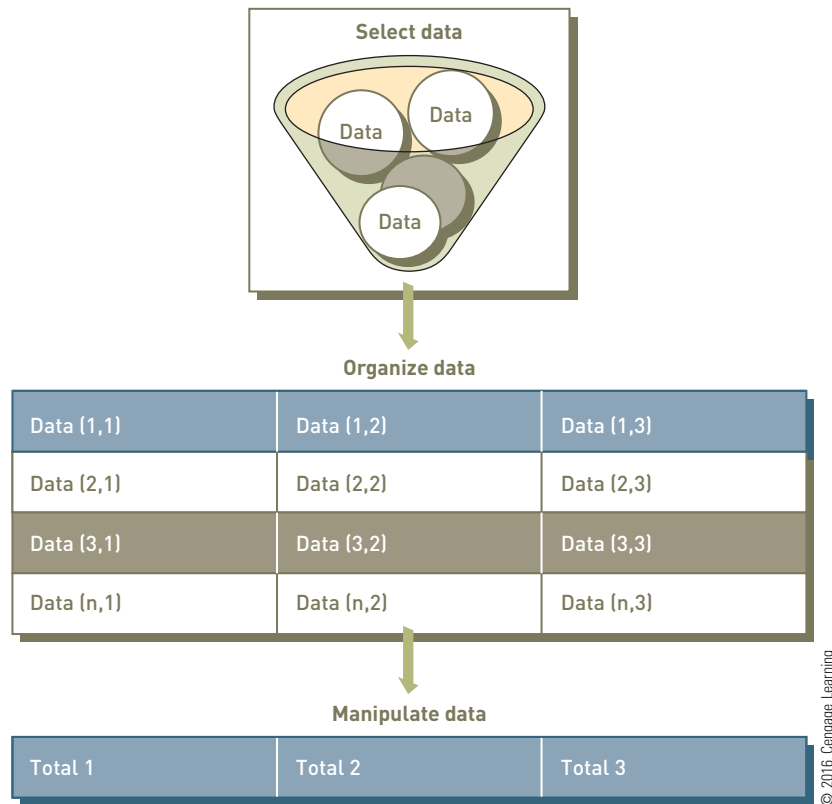
Defining and organizing relationships among data creates information.

**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. 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.

## The Value of 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.<sup>5</sup>

## Characteristics of Quality Information

Fundamental to the quality of a decision is the quality of the information used to reach that decision. Any organization that stresses the use of advanced information systems and sophisticated data analysis before information quality is doomed to make many wrong decisions. Table 1.2 lists characteristics that determine the quality of information to decision makers in the organization. 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 quality information

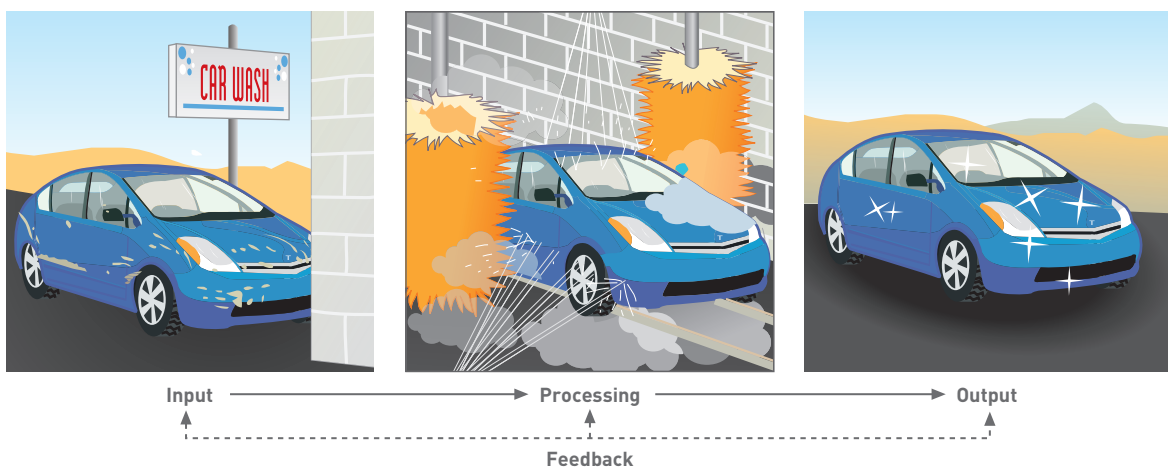
Characteristics	Definitions
Accessible	Information should be easily accessible by authorized users so they can obtain it in the right format and at the right time to meet their needs.
Accurate	Accurate information is error free. In some cases, inaccurate information is generated because inaccurate data 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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## SYSTEM CONCEPTS

**system:** A set of elements or components that interact to accomplish goals.

Like information, another central concept of this book is that of a system. A **system** is a set of elements or components that interact to accomplish goals. Systems have inputs, processing mechanisms, outputs, and feedback. See Figure 1.4. For example, consider an automatic car wash. Tangible *inputs* for



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**FIGURE 1.4**  
**Components of a system**

A system's four components consist of input, processing, output, and feedback.

the process are a dirty car, water, and various cleaning ingredients. Time, energy, skill, and knowledge also serve as inputs to the system because they are needed to operate it. Skill is the ability to successfully operate the liquid sprayer, foaming brush, and air dryer devices. Knowledge is used to define the steps in the car wash operation and the order in which the steps are executed.

The *processing mechanisms* consist of first selecting the cleaning option you want (wash only, wash with wax, wash with wax and hand dry, etc.) and communicating that to the operator of the car wash. A *feedback mechanism* is your assessment of how clean the car is. Liquid sprayers shoot clear water, liquid soap, or car wax depending on where your car is in the process and which options you selected. The *output* is a clean car. As in all systems, independent elements or components (the liquid sprayer, foaming brush, and air dryer) interact to create a clean car.

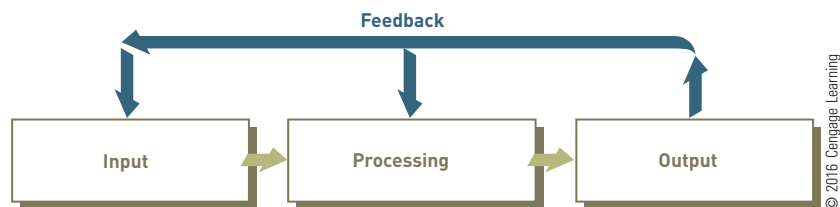
## WHAT IS AN INFORMATION SYSTEM?

As mentioned earlier, an information system is a set of interrelated components that collect, process, store, and disseminate data and information and provide a feedback mechanism to meet an objective. We interact with information systems every day, both in our personal and professional lives. We use automated teller machines at banks, access information over the Internet, select information from kiosks with touch screens, and scan the barcodes on our purchases at self-checkout lanes. At work, we collaborate with project members and coworkers using email. We collect all manner of up-to-the minute corporate data about sales, orders, purchases, and inventory levels for use in decision making via our smartphone or computer. We create business presentations and useful charts using personal computer software. Knowing the potential of information systems and putting this knowledge to work can help you enjoy a successful career and help organizations reach their goals. See Figure 1.5.

**FIGURE 1.5**

### 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 rate of pay. 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.