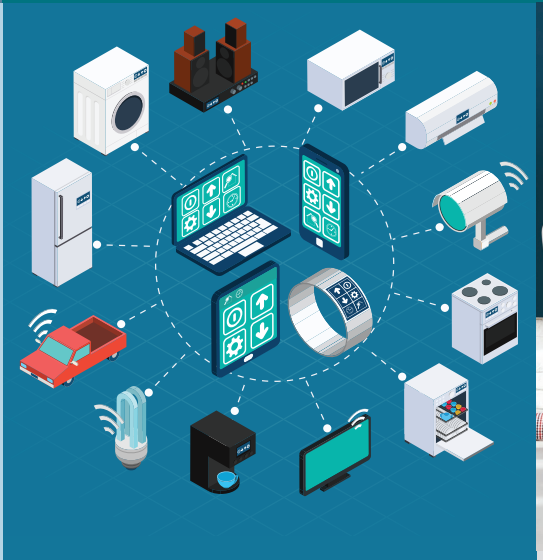
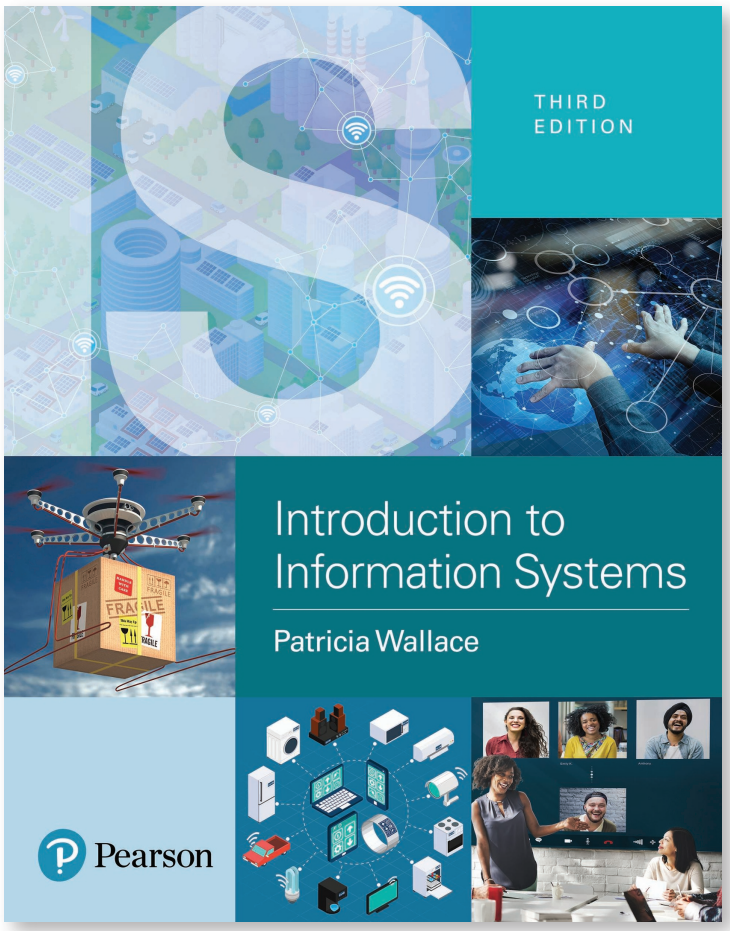
THIRD
EDITION

Introduction to Information Systems

Patricia Wallace

Pearson





The cover images feature important themes in this edition, showing how information systems and emerging technologies continue to break new ground. Some images highlight how their growing power supports globalization and worldwide teamwork, with advanced collaborative technologies and user-friendly interfaces that span great distances and cultural divides. Another image illustrates the surging *Internet of Things*, in which sensors are embedded in everything from medical devices to kitchen appliances. The drone hints at yet another innovation on the horizon—autonomous vehicles—that will create new waves of change in supply chains, traffic conditions, driving habits, and much more. Fully updated, the 3rd edition of *Introduction to Information Systems* engages students in this expanding world, showing the important roles such systems play in business, government, and in each of our lives.

Introduction to Information Systems

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Third Edition

Introduction to Information Systems

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To Callie, Julian, and a bright future
of human–centered computing.

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About the Author

Patricia Wallace's career spans the fields of information technology, business and management, and psychology, and she has held varied positions, including head of information technology, faculty member, academic administrator, and consultant. She recently retired from Johns Hopkins University, where she was Senior Director, IT and Online Programs, at the Center for Talented Youth for 14 years. Before joining Hopkins, Dr. Wallace served as Chief Information Strategies, at the Robert H. Smith School of Business, University of Maryland, College Park. She currently teaches in the Graduate School of the University of Maryland University College, where she also served as the Associate Vice President and Chief Information Officer for ten years. She earned her Ph.D. in psychology at the University of Texas at Austin and holds an M.S. in Computer Systems Management. Dr. Wallace has published 14 books, including *The Internet in the Workplace: How New Technologies Transform Work* (2004) and *The Psychology of the Internet* (2016), several educational software programs, and numerous scholarly articles.

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Preface

What's New in the 3rd Edition

The information systems field is fast-moving, and this 3rd edition features a number of new trends that affect organizations around the world. All chapters and case studies have been fully updated with current information and sources.

Major new features include the following:

- Extended coverage of the **Internet of Things** throughout, discussing the explosive increase in connected devices and the data they manage
- Updated Chapter 3 to introduce recent technologies and trends in enterprise architectures
- Revised Chapters 6 and 7 to expand coverage of social media, social and mobile marketing, and digital analytics
- Added several new case studies:
  - *How eBay Scales Its Database Architecture with SQL and NoSQL* (Chapter 4)
  - Salesforce.com*: Taking CRM to the Cloud* (Chapter 5)
  - *LinkedIn: The Social Network and E-Marketplace for Profess*ionals (Chapter 6)
  - *Enabling the Sharing Economy: The Case of Uber Technologies* (End-of-book comprehensive case)

Chapter-Specific Changes

CHAPTER 1: INFORMATION SYSTEMS AND *PEOPLE*

- New key term introduces the **Internet of Things**, a subject that receives expanded attention in this edition
- Updated tables showing social network usage
- Updated table showing important MIS research topics
- New information on Google's Project Loon, to bring Internet access to developing countries
- Updated information on recent data breaches
- Updated case studies on Nasdaq and Twitter with current information and recent sources

CHAPTER 2: INFORMATION SYSTEMS AND *STRATEGY*

- Updated figure showing net profit margins of selected industries
- New examples of recent disruptive innovations and strategic enablers, such as ride-hailing services, 3-D printing, and self-driving vehicles
- Improved figure illustrating cloud computing
- Updated graphs showing average IT spending by industry and per employee
- Updated cases on GameStop and net neutrality using current information and recent sources

CHAPTER 3: INFORMATION AND COMMUNICATIONS TECHNOLOGIES: *THE ENTERPRISE ARCHITECTURE*

- Added **infrastructure as a service (IaaS)** and **platform as a service (PaaS)** as new key terms with discussion
- Updated figures showing market share data for operating systems
- Added recently released 802.11 standards to table

- Added new productivity tips on using speech recognition technology to handle routine tasks, and taking advantage of personal cloud computing
- Reorganized Section 3 on networks and telecommunications to improve flow
- Added discussion of "cord-cutting" to highlight strategic challenges in the telecom industry
- Described software-defined networks in discussion of trends in virtualization
- Updated cases about wearable technologies and Sprint drawing on current information and recent sources
- Deleted older technologies as key terms (WiMax and circuit-switched networks)

CHAPTER 4: DATABASES AND *DATA WAREHOUSES*

- Added **NoSQL DBMS** as new key term, with expanded discussion
- Added new case study "How Ebay Scales Its Database Architecture with SQL and NoSQL," replacing the case study on Colgate-Palmolive
- Add new table to illustrate a "pets" entity for a veterinarian's database
- Updated table showing jobs related to databases with average salaries

CHAPTER 5: INFORMATION SYSTEMS FOR THE *ENTERPRISE*

- Updated discussion of requirements for financial systems
- New "Did You Know" box about Netflix's supply chain for streaming video
- Added discussion of drones in supply chains
- Added new case study, "Salesforce.com: Taking CM to the Cloud," which replaces the case study about CRM in government agencies

CHAPTER 6: THE WEB, SOCIAL MEDIA, *E-COMMERCE,* AND *M-COMMERCE*

- Revised title and chapter contents to add more emphasis to social media
- Added new "Did You Know?" box about cybersquatting on valuable domain names
- Added two new bullets to the features of mobile computing: location awareness and their role in the Internet of Things
- Expanded the digital marketing section to include discussion of social and mobile marketing
- Added new "Did You Know?" box about MOOCs and crowdsourcing
- Added **Bluetooth low-energy (BLE) beacon** as new key term, with discussion of the technology's role in marketing
- Added new case study about LinkedIn, replacing the case study on Pandora Internet Radio

CHAPTER 7: BUSINESS INTELLIGENCE AND *DECISION MAKING*

- Added sections describing different types of metrics used to evaluate websites, social media, and e-commerce applications
- Expanded discussion of artificial intelligence to include emerging technologies
- Added new "Did You Know?" about Microsoft's misguided AI experiment with a chat bot
- Added new table showing sample metrics for mobile apps
- Updated case studies with new information and current sources

CHAPTER 8: COLLABORATING WITH *TECHNOLOGY*

- Added new section on group conversation software, such as Slack
- Added new productivity tip about software to support team projects
- Added new productivity tip about using open source media to enliven student presentations
- Revised and updated data on social networking usage patterns
- Added new "Did You Know?" describing how companies monitor social media for warning signs

- Updated section on virtual reality technology, such as the Oculus Rift headset
- Revised and updated case studies with new information and recent sources

CHAPTER 9: KNOWLEDGE MANAGEMENT AND *E-LEARNING*

- Added new "Did You Know?" box on using knowledge management techniques to combat the Zika virus
- Updated section on organizing knowledge, emphasizing **enterprise content management**, a new key term that describes how organizations manage all types of content through the life cycle
- Deleted expert location system as key term, as these capabilities are embedded in other software
- Added new section on **serious games**, including new key term
- Added brief discussion of the specification called Learning Tools Interoperability (LTI) and the use of badges in learning management systems

CHAPTER 10: ETHICS, PRIVACY, AND *SECURITY*

- New figure summarizing data about organizational policies about software piracy
- New figure and productivity tip advising students to check their own digital footprints occasionally
- Added section on **ransomware,** including new key terms **(ransomware** and **bitcoins)**
- Added new data on the prevalence of insider attacks
- Added new productivity tip suggesting that students adopt multifactor authentication whenever services they use offer this capability
- Updated table on recent events involving information leakage
- Updated case studies on Zynga and Spamhaus using new data and recent sources

CHAPTER 11: SYSTEMS DEVELOPMENT AND *PROCUREMENT*

- Added new section on **application programming interfaces (API)**, including new key term and a discussion of the ways in which APIs improve software development
- Reorganized and revised section on the role of senior managers in procurement, discussing the need to develop policies about software implemented outside of IT departments
- Added new "Did You Know?" about software bugs in computer chips
- Deleted unified modeling language as key term, since its use is declining

CHAPTER 12: PROJECT MANAGEMENT AND *STRATEGIC PLANNING*

- Added new table that compares different IT funding models
- Added brief discussion of disaster recovery as a service
- Updated discussion of technology and industry trends, with revised table showing emerging trends
- Updated case study on Gartner's predictions, using new figure showing recent hype cycle entries with current sources
- Updated case study on JetBlue and WestJet with recent financial figures and current sources

End-of-Book Comprehensive Case Studies

- New case study #2, "Enabling the Sharing Economy: The Case of Uber Technologies" (replaces case on the Red Cross supply chain)
- Facebook case updated and revised to include recent usage and financial data and discussion of "interest-based ads"
- Apple case updated with recent statistics and strategic moves, including self-driving cars
- Federal Government IT case updated with recent examples and data and discussion of changing strategies to manage the immense portfolio

To the Student

Any college student thinking about the job market can't help but notice how valuable it is to have skills related to information systems. In this course you will learn what information systems are all about and why they are so fundamental to business and society. It will be an exciting journey, filled with revelations about business strategies, technology trends and innovations, and also tips that will help you work smarter as a student. Here are the main features of this text and its supplements:

Learn by Doing: The Interactive, Online Role-Playing Simulations

A course on information systems should tap their power for active, experiential learning. This text includes interactive role-playing simulations in MyMISLab™ (mymislab.com) in which students can apply their knowledge and actually experience what each chapter is about, not just memorize key terms and concepts. You will enter realistic and often tense situations, interacting with the characters via a simulated smartphone or laptop, and using email, text messaging, web conferencing, video chat, voicemail, dashboards, ordering screens, and other applications. Each simulation is scored and students receive extensive feedback on the choices they make. Each one also includes key terms from the chapter (with rollover definitions) so you see how they are used in context, which will help you more easily remember their meanings.

The simulations bring the chapter alive, as you enter authentic settings in which people struggle to solve a problem involving information systems. Some examples:

- In World of Mammals (Chapter 1), you help the harried director of a wild animal preserve interview candidates for the CIO position, after the former CIO leaves abruptly. What skills does a CIO need? What kind of experience would fit best?
- Chocolate Lovers Unite (Chapter 7) challenges you to resolve a heated debate over which online marketing pitch works best by conducting tests, analyzing the results, and drawing on data-driven decision making.
- In Green Wheeling, the simulation on software development and procurement (Chapter 11), you join a task force charged with replacing a college's obsolete fund-raising system. You and your team members weigh the pros and cons of "build" or "buy," and you will see how the outcome can change based on your decisions.
- Vampire Legends drops you into a fast-paced, tense situation in which the material in Chapter 10 (Ethics, Privacy, and Security) comes to life in an online game company that is racing to launch a sequel. When troubling things begin happening that involve the company's data center and information security, you will have difficult choices to make.

I've done research on games and simulations in education, and have led several projects to create software that draws on the compelling features of these environments for learning. While online flash cards, Q&A games, and other interactive applications can help students memorize terms or review the chapter contents, simulations that immerse students in a relevant and authentic case can do more. Research shows they create engagement, improve learning outcomes, and build critical thinking skills through active, student-centered involvement. You will find it much easier to learn and remember the material in the textbook when you can engage in simulations like this.

The Human Element in Information Systems

In addition to the simulations, this text brings a fresh perspective to the introductory course in information systems that combines comprehensive and up-to-date coverage with a stronger focus on the human element in businesses, nonprofits, and other organizations. It covers all the major topics for the course in a rigorous way, without skimping on any of the fundamentals. But it enriches those topics with probing discussions about the roles people play in building, shaping, implementing, and sometimes obstructing information systems.

In Chapter 8 on collaborative technologies, for example, students learn how different channels affect the tone of human communications, and how to choose the best technologies for

each task to support virtual teamwork, management, negotiation, and leadership. Chapter 12 on project management and strategic planning for information systems shows how human biases can creep into the process.

The text also stresses the processes and policies that people devise to manage information systems. Why do some high-tech companies ban telecommuting, even though employees have well-equipped home offices? Why do organizations implement surveillance?

Exploring Technology Battlegrounds

Grand battles over technology directions help students understand the close links between competitive business strategies and information systems. The stakes are very high in debates about topics such as net neutrality, 4G standards, wireless spectrum auctions, cloud computing, programming languages, mobile operating systems, mobile payment systems, and social network privacy. Billions of dollars are on the line for winners and losers. Yet most people know little about these battlegrounds because the underlying technology issues are out of reach. After reading this text, students will look at online ads, privacy policies, social networks, and their own smartphones with a new appreciation for the fierce business competitions unfolding before their eyes.

Reaching a Changing Student Body

The text recognizes the growth in the number of women, minorities, international students, online students, and nontraditional students who enroll in this course, drawing on examples and settings that will resonate with them. Devon, for instance, is starting her own web design business, and students learn about relational databases by helping her build one for her small business (Chapter 4). International student Prakash is the cofounder of *Leveling UP!,* a smartphone app that is the centerpiece for the interactive role-playing simulation on business strategy (Chapter 2). In the chapter on knowledge management and e-learning (Chapter 9), Sally takes an online course in nonprofit management as she nears retirement and helps her own company build an e-learning course for the coworkers she's leaving behind.

Balancing Coverage of Business, Government, and Nonprofits

This text broadens the coverage about information systems to include all the varied settings in which students work (or will work). It draws on timely examples from multinational corporations, nonprofits, government agencies, midsized businesses, start-ups, charities, volunteer organizations, student clubs, and other settings. The text highlights how these different organizations launch information systems to fulfill their missions, whether that means generating profits, attracting donations, or serving citizens.

The strategies that underlie cell-phone marketing, for instance, work as effectively for nonprofits that want to mobilize citizens as they do for businesses that tempt new customers with discount coupons. And competitive advantage is not just for business. Charities compete for volunteers and donations, and they benefit from customer relationship management systems.

Changing Student Roles

Just as students are gaining employment in a wide variety of organizations, they are taking on more varied roles within them. Though some will become information systems managers, many more will become consultants, business analysts, accountants, marketing professionals, talent development specialists, volunteers, virtual team leaders, forensic experts, legal advisors, and project managers. The text introduces emerging professions, as well, such as data scientist.

Examples in the text, case studies, and simulations feature all these different roles, showing how successful information systems emerge from a broad base of stakeholders with different perspectives and specialties. Carlos, for instance, is the instructional designer on a corporate e-learning development team, adding his knowledge of usability and accessibility

for people with disabilities (Chapter 9). In Chapter 11, Lily is a senior manager for an online grocery who comes up with a clever website to capture a valuable market—busy singles who forgot to buy groceries.

Emphasizing Ethics

Ethical concerns weave throughout the text, touching on very human ethical dilemmas such as the one Wikipedia founder Jimmy Wales faced when asked to delete any posts that mentioned the name of a journalist kidnapped by the Taliban. That action was directly opposed to his site's fervent commitment to free speech, and Wales raised a firestorm within the Wikipedia community when he had to make a choice.

A special feature in each chapter titled "The Ethical Factor" explores timely ethical issues such as corporate responsibility in extended supply chains (Chapter 5), or the ethics of massive surveillance and collection of big data by governments and corporations (Chapter 3). In Chapter 10 on ethics, privacy, and security, students take a survey to learn more about how they judge situations that touch on information ethics. The online simulation for that chapter immerses students in a tense situation in which security is compromised and they face some difficult ethical dilemmas.

Here is a list of all the "Ethical Factor" boxes:

1. Ethical Issues Surrounding Information Systems, p. 22
2. Ethical Responsibility in an Extended Value Chain, p. 44
3. Ethical Implications of Big Data, p. 70
4. Ethical Issues in Database Design: The Case of Ethnic Identification, p. 110
5. Ethics and Talent Management, p. 138
6. Website Accessibility: Why Is Progress So Slow? p. 175
7. The Ethics of Tagging Faces in Photos, p. 204
8. Flash Mobs and Free Speech: Should Police Block Mobile Messaging Services? p. 246
9. Knowledge Sharing in Fast-Paced Industries: The Case of Formula One Racing, p. 273
10. Ethical Dilemmas in a Distributed Denial of Service Attack, p. 309
11. Developing Systems That Promote Ethical Decision Making and Social Responsibility, p. 340
12. Code of Ethics for Project Managers, p. 366

Working Smarter, Not Harder: Productivity Tips for Students

Every chapter includes several "Productivity Tips" that suggest ways students can improve their own productivity by applying what they've learned.

In Chapter 2 on information systems and strategy, for instance, a tip invites students to check out the software trial versions that came preinstalled on their computers to see how companies leverage this valuable product positioning, and then remove them to save space and improve the computer's performance. A tip in the section on neural networks in Chapter 7 advises students to alert their credit card companies before traveling abroad because a neural net may trigger a very ill-timed block on the card. Another tip points to solid productivity gains for people who use two monitors, which is especially helpful for students with laptops.

These tips are not only immediately useful. They help you learn chapter material by applying it so you can work smarter, not harder.

Highlighting Globalization and International Contexts

Information systems play a key role in globalization, especially through the Internet and all the creative destruction it unleashed. Examples abound throughout the text, highlighting how Baidu captured the search engine market in China (Chapter 2) or how Ikea manages a global supply chain (Chapter 5). The global financial crises underscore the important work of the International Accounting Standards Board—to promote transparent and enforceable financial reporting for companies around the world using XBRL tags—from the XML family of standards (Chapter 5). The international emphasis also unfolds in working relationships across

national borders. For example, the chapter on collaboration (Chapter 8) discusses virtual teams with members from different countries, and offers tips on strategies to use collaborative technologies effectively.

Inspiring Students to Pursue Promising Careers

Finally, an important goal of this text and its supplements is to convey the sheer excitement and limitless potential of this field, with an eye toward inspiring students to go further. Inside are countless examples of how savvy men and women leverage information systems to transform organizations of all stripes, and even build new empires. The text includes many job descriptions, job growth rates, and projected salaries, as well.

Some of the excitement comes from groundbreaking technological advances. The disruptive innovations that topple some industries and open star-studded paths for others are also part of the excitement. GPS dealt a crushing blow to map makers, and the Internet did the same to print newspapers. The ride-hailing services and their mobile apps have shaken up the transportation industry. But all these events opened up vast new territory for innovative start-ups.

To further stimulate interest, each chapter includes short "Did You Know?" snippets to highlight an engaging or amusing application of the chapter's topic. For example, the chapter on hardware, software, and networks (Chapter 3) features a coffee shop whose zany owner constantly renames the free wireless network to different messages, such as "BuyAnotherCupYouCheapskate."

If students catch some of this energy and enthusiasm, they may decide to pursue this field. Those who do will have outstanding career prospects in the private and public sectors, and they'll never be bored.

Supplements

The following supplements are available at the Online Instructor Resource Center, -accessible through www.pearsonhighered.com/wallace:

Instructor's Manual

The Instructor's Manual, assembled by John Hupp, includes a list of learning objectives and answers to all end-of-chapter questions.

Test Item File

The Test Item File, prepared by ANSR Source, Inc., contains more than 1,300 questions, including multiple choice, true/false, and essay. Each question is followed by the correct answer, the learning objective it ties to, a course learning objective, and difficulty rating. In addition, certain questions are tagged to the appropriate AACSB category.

Powerpoint Presentations

The Instructor PowerPoints, prepared by John Hupp, highlight text learning objectives and key topics and serve as an excellent aid for classroom presentations and lectures.

Image Library

This collection of the figures and tables from the text offers another aid for classroom presentations and PowerPoint slides.

TestGen

Pearson Education's test-generating software is available from www.pearsonhighered.com/irc. The software is PC/MAC compatible and preloaded with all of the Test Item File questions.

You can manually or randomly view test questions and drag-and-drop to create a test. You can add or modify test-bank questions as needed. Our TestGens are converted for use in BlackBoard, WebCT, Moodle, D2L, and Angel. These conversions can be found on the Instructor's Resource Center. The TestGen is also available in Respondus and can be found on www.respondus.com.

Alternate Electronic Versions

Pearson is proud to offer alternate versions for students seeking an electronic version of the Wallace text. VitalSource (www.vitalsource.com) provides one option, where students simply select their eText by title or author and purchase immediate access to the content for the duration of the course using a major credit card. Students can also find eBooks through Barnes & Noble, Kindle versions on Amazon, and more through various other eBook retailers.

Available in MyMISLab

- MIS Video Exercises – Videos illustrating MIS concepts, paired with brief quizzes
- Interactive Online Role-Playing Simulations – Require students to apply their knowledge and actually experience what each chapter is about, not just memorize key terms and concepts
- Auto-Graded writing exercises – taken from the end of chapter
- Assisted-Graded writing exercises – taken from the end of chapter, with a rubric provided
- Chapter Warm Ups, Chapter Quizzes – objective-based quizzing to test knowledge
- Discussion Questions – taken from the end of chapter
- Dynamic Study Modules – on the go adaptive quizzing, also available on a mobile phone
- Learning Catalytics – bring-your-own-device classroom response tools
- Enhanced eText – an accessible, mobile-friendly eText
- Excel & Access Grader Projects – live in the application auto-graded Grader projects provided inside MyMISLab to support classes covering Office tools

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And finally, thanks to Julian and Callie, and also Keiko, Lili, and Marlene, a list that includes my very supportive human family and our four-footed companions.

Your Feedback Is Welcome

To all of you who are using this book, as professors, teaching assistants, and students, I welcome your thoughts and feedback. Please email your comments, questions, and suggestions, and I'll be eager to hear how your course goes.

Patricia Wallace, Ph.D.
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Introduction to Information Systems

CHAPTER

1

Information Systems and *People*

MyMISLab™

- Online Simulation: The World of Mammals: A Role-Playing Simulation on Choosing a New CIO for an Animal Preserve
- Discussion Questions: #1-1, #1-2, #1-3
- Writing Assignments: #1-9, #1-14

LEARNING OBJECTIVES

1. Describe the main roles that information systems play in organizations.
2. Compare the terms *data, information,* and *knowledge,* and describe three characteristics that make information valuable.
3. Describe the four main components of an information system and the role that each plays.
4. Identify several research areas in the discipline of management information systems (MIS).
5. Provide examples of how business, nonprofit, and government managers, as well as information technology departments, depend on information systems knowledge.
6. Explain how information systems present both promises and perils, and pose ethical questions.

An online, interactive decision-making simulation that reinforces chapter contents and uses key terms in context can be found in MyMISLab™.

INTRODUCTION

AT THE HEART OF EVERY ORGANIZATION IS ITS INFORMATION SYSTEMS, and that is what this course is all about. Google, Twitter, Microsoft, and Facebook are all popular companies on the cutting edge of technology, and their innovations and competitive battles make front page news. But even organizations that don't seem very high tech—from a family-owned restaurant to a fitness gym—can hardly do without information systems or without people who know how to build and manage them.

Consider The World of Mammals, for example, the animal preserve featured in the interactive simulation for this chapter. Director Yolanda Whalen is a veterinarian, but she knows very well that this preserve won't succeed without top-notch information systems and a qualified person to provide leadership. She is asking you, as an enthusiastic volunteer and a student learning about information systems, to help interview potential candidates and join the team that will decide who is best suited for this role. What skills, knowledge, and abilities should this person have—beyond managing payroll and ticket sales—to take advantage of innovative technologies that will make The World of Mammals the most successful preserve in the country?

This opening chapter highlights information systems in action, the nature of information itself, and the four main components of every information system. You will see how the information systems (IS) discipline is changing

MyMISLab
Online Simulation

THE WORLD OF MAMMALS

A Role-Playing Simulation on Choosing a New CIO for an Animal Preserve

and growing and why a solid understanding of this subject will give you a critical edge, regardless of your major or career path. Finally, the chapter examines the promises and perils of information systems and the many ethical issues that arise with the phenomenal power within everyone's reach.

Information is an organization's most important asset. Creating, capturing, organizing, storing, retrieving, analyzing, and acting on information are fundamental activities in every organization. The skill with which you carry out those tasks will be the deciding factor not just for your company's success but for your own as well. This book is about information and the systems that people develop and manage to perform all those tasks and more.

You will see how these systems work, why they are created, how they have become the organization's central nervous system, and why they sometimes fail. You will also learn to tap the power of information systems to help your company compete or your organization become more effective. Finally, you will become more productive yourself—working smarter, not harder—in college, in your career, at home, and throughout your life.

Like the information they manage, information systems cover a very broad scope and contribute to many different activities in an organization. What roles do they play, and how do they transform work? The next section shows the enormous variety of settings in which innovative information systems play a role, well beyond the very useful Google searches.

Describe the main roles that information systems play in organizations.

1 Information Systems in Action

- *Dancing with the Stars* became a smash reality TV hit by engaging millions of viewers in judging the contestants. Hopeful celebrity couples compete each week with a novel dance routine, and audience members cast a vote for their favorite by phoning, sending text messages, or logging into the show's website. An information system on the back end tallies the results, which count for half the couple's score. The system must be able to handle enormous incoming volume in a very short time period to get accurate tallies.
- Hurricane Sandy arrived just before the November 2012 elections in the United States, and many voters could not make it to the polls. Officials in New Jersey decided to let people vote by email, but county clerks were overwhelmed by the volume in their inboxes. Although glitches and security concerns are not uncommon with electronic voting, information systems are playing a more important role every year. Disabled voters, for instance, can now use tablets to vote, eliminating the need for expensive custom-made voting machines.
- Walmart, with more than $485 billion in net sales in 2015, pioneered the globe's most efficient information system to track shipments as they move from supplier factories to warehouses to retail stores. Tags attached to pallets transmit information wirelessly, so Walmart execs know exactly where merchandise is in the supply chain and can spot trouble immediately.

When those bulky computers first entered company basements in the 1970s, the term *information system* brought up images of payroll programs, general ledgers, invoice tracking, and inventory management. Those back-office functions are still critically important, but today's information systems have migrated into every facet of an organization, touching every employee from the mail clerk to the CEO. They also extend well beyond the company's boundaries, reaching out to customers, clients, suppliers, partners, citizens, and all kinds of stakeholders. Their hardware might be as vast as Google's data centers or far smaller than Walmart's pallet tags. And their connections could be the thick fiber-optic cables on the ocean floor or electromagnetic waves in the air around you.

Multinational firms, small businesses, nonprofits, governments, volunteer organizations, self-employed entrepreneurs, universities, and other organizations rely on information systems for a host of reasons, and they continue to adapt, expand, and interconnect them to achieve their strategic objectives. These systems play critical roles in six major areas (Figure 1-1).

Managing Operations

Every successful organization must excel at **operations management**, which involves the design, operation, and improvement of the systems and processes the organization uses to deliver its goods and services. Some of these deal with several very basic functions that are part of every business. Information systems are crucial for tracking employee payroll, taxes, benefits, and timesheets. Accounting information systems are essential to track accounts receivable, to process transactions, to procure goods and services, and to pay the suppliers. Organizations also must manage their assets and inventories, from the computers and the desks they sit on to the massive factories and equipment located in far corners of the globe. Eric Schmidt, former CEO of Google, once remarked that he had no idea how many data centers Google actually managed. He might not have known, but his back-office information systems certainly did.

Information systems designed to handle the processes involved in these functions must also meet compliance standards set by governments and other regulatory agencies, which may change from time to time and also vary by country or state. Reports must be filed, audits passed, and changing regulations followed. Extensive regulations put into place after the global financial crisis of 2009, for example, set tighter standards for accounting practices—particularly in banking—and demanded more transparent reporting.

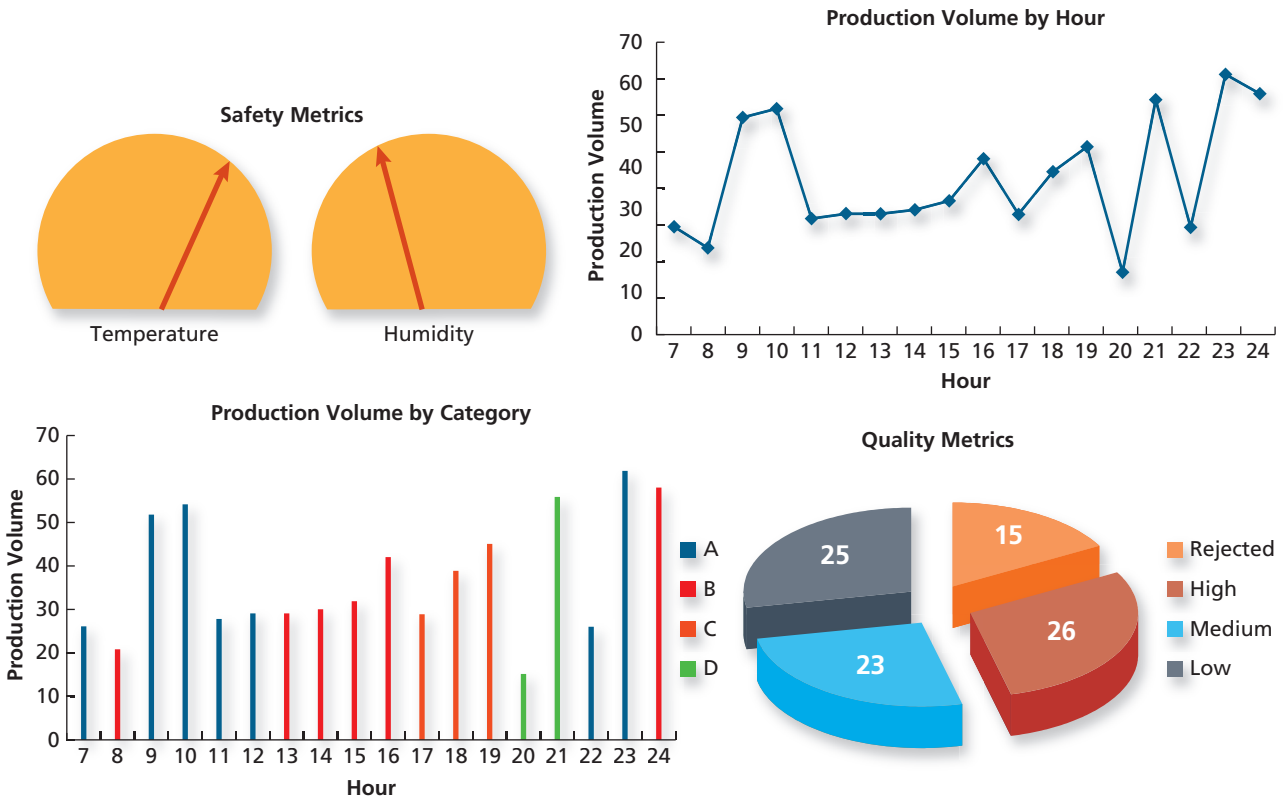
FIGURE 1-1
The major roles of information systems in organizations.

Many organizations choose commercially produced information systems to handle their back-office information needs, relying on software packages such as SAP, Oracle, NetSuite, or QuickBooks. Some organizations are moving these functions to service providers or even outsourcing them entirely. India became known as the world's "back office" because so many companies moved these applications there,[1] and now the Philippines is becoming the world's biggest operator of call centers.[2]

Depending on their missions, organizations also need information systems to manage industry-specific operations, such as these:

- Manufacturers need systems to manage assembly lines, product quality, production schedules, and just-in-time supply deliveries (Figure 1-2).
- Colleges and universities need systems to manage student academic records, class scheduling, faculty assignments, and student financial aid (Figure 1-3).

FIGURE 1-2
Manufacturing information system displaying production volumes and other metrics.



MyCollege MyTools MyClasses MyProfile

Update contact info
View schedules
Submit request
View requirements
Register for courses

Course	Days	Time	Location
Bus 111	MW	14:00–15:00	Macintyre
Bus 111	MW	15:00–16:00	Doyle
Bus 112	T-TH	9:00–10:45	Student Services
Bus 112	-	-	Online
Bus 112	M	9:00–11:45	Garcia
Bus 113	W	1:00–2:45	Doyle

FIGURE 1-3
Student information system with online services for students and faculty.

operations management
The area of management concerned with the design, operation, and improvement of the systems and processes the organization uses to deliver its goods and services.

- Transportation companies rely on information systems equipped with GPS to track their fleets, optimize routes, and conserve gas.
- Companies that buy products from suppliers around the globe need real-time updates on their global supply chains to manage inventories and reduce costs.

Achieving excellence in operations can provide enormous cost savings and competitive advantage, as companies squeeze every ounce of fat out of their processes without sacrificing quality. UPS drivers, for instance, know to avoid left turns on their delivery routes when possible because they take a few seconds longer, wasting time and gas. Systems that support operations are discussed in Chapter 5.

Supporting Customer Interactions

Interactions with customers, clients, students, patients, taxpayers, citizens, and others who come to your organization desiring a product or service are fundamental to success. Your customers pay the bills. **Customer relationship management (CRM) systems**, discussed in Chapter 5, build and maintain relationships and support all the processes that underlie them.

A brick-and-mortar retail store, for example, needs a sales system that identifies each product in the shopper's basket, tallies the total, feeds the data to the inventory system, and accepts various kinds of payment. Shoppers want fast checkouts, and they get annoyed by clumsy, inefficient processes. When an item lacks its barcode, impatient customers may just abandon it rather than wait for a salesclerk to track it down. Strategies to prevent theft, such as the check on weights added to the bag, also anger shoppers when they do not function properly.

Web-based shopping and self-service transform relationships with customers, freeing them from time-consuming phone calls. These web-based processes often mimic the brick-and-mortar versions, with "shopping carts" and "checkouts" clearly labeled. A web application offers many opportunities to build stronger relationships and also better understand the motives and desires of each person who visits.

Scattered throughout *Amazon.com*'s site, for example, are recommendations based on previous purchases, encouragements to "review this book" or "rate this item," special discounts and coupons, storage space for your wish lists and gift ideas, and many other innovative features to map out your preferences and build a stronger relationship. All of this data contributes to Amazon's customer relationship management excellence and the company's understanding of what each customer wants.

Infinite variations in customer interaction exist, from Southwest Airlines's text reminders about your upcoming flight to the Internal Revenue Service's e-file system. Developing these relationships is not just about improving sales and collecting receipts. It is about building long-term loyalty and satisfaction by listening to customers and learning what is most important to them. That also includes sensitivity to their privacy concerns, as we discuss in Chapter 10.

FIGURE 1-4
How do managers answer questions like these?

Source: liza54500/Shutterstock

Making Decisions

How should a restaurant manager make decisions like the ones in Figure 1-4?

Managers make decisions every day, and many rely mainly on their own judgment. In fact, researchers surveyed 250 executives and learned that 40% of major corporate decisions were based on gut instincts.[3] Smart managers, however, know that information systems support **data-driven decision making**, which draws on the billions of pieces of data to reveal important trends and patterns. For example, the sales system will show how much the restaurant makes in the last hour of business, and that data will help the manager make a good decision about closing early.

Business intelligence refers to all the information managers use to make decisions, and it can come from many sources beyond the organization's own information systems. The restaurant manager, for example, might combine customer records with publicly available information about income levels by zip code to help make a smart decision about where to open another branch.

Decision support systems and business intelligence, discussed in Chapter 7, encompass a growing and varied category that blends rapid analysis of information sources with artificial intelligence and human knowledge. For knowledge workers, in particular, the value of knowing how to draw upon those vast mountains of information to make wise decisions is extremely high.

DID YOU KNOW?

Your online behavior is one of the most important sources of business intelligence. The sites you visit and "like," the apps you download, and the links you click reveal your interests and intentions, and marketers track that data closely. Spending for mobile ads, for instance, could reach $250 per user by 2018.[4]

Collaborating on Teams

Collaboration and teamwork have considerable support from innovative information systems that allow people to work together at any time and from any place. Regardless of where they live and work, participants can hold online meetings, share documents and applications, and interact using microphones, video cameras, and whiteboards. **Social networking sites** support online communities of people who create profiles for themselves, form ties with others with whom they share interests, and make new connections based on those ties. These social groups exploded in popularity as people jumped at the chance to share news, photos, videos, and tidbits. Figure 1-5 shows usage rates for the larger social networking sites. Services that target business users, such as Microsoft's SharePoint, offer additional useful services such as shared calendars and group document editing.

Developing information systems for collaboration takes ingenuity and attention to the ways in which people really do work together. The possibilities are endless, and different groups have different preferences. In online university courses, for example, debates about whether students should turn on their webcams during virtual class sessions are common. Many prefer to keep them turned off, valuing the privacy that invisibility creates. (One can doze off in a virtual class with little concern for detection.)

The information systems that support virtual teamwork, discussed in Chapter 8, are in some respects still in their infancy—especially compared with the more mature systems used to manage operations. Expect many improvements as we learn more about what features work best for different people and different situations.

FIGURE 1-5

Estimated usage for major social networking sites.

Social Networking Site	Estimated Unique Monthly Visitors
Facebook	1,100,000,000
Twitter	310,000,000
LinkedIn	255,000,000
Pinterest	250,000,000
Google+	120,000,000
Tumblr	110,000,000
Instagram	100,000,000
VK	80,000,000

Source: Data from http://www.ebizmba.com/articles/social-networking-websites, eBizMBA, © 2016.

customer relationship management (CRM) system
An information system used to build customer relationships, enhance loyalty, and manage interactions with customers.

data-driven decision making
Decision making that draws on the billions of pieces of data that can be aggregated to reveal important trends and patterns.

business intelligence
The information managers use to make decisions, drawn from the company's own information systems or external sources.

social networking sites
Online communities of people who create profiles for themselves, form ties with others with whom they share interests, and make new connections based on those ties.

Gaining Competitive Advantage

Information systems play what could be their most valuable role when they are tied closely to strategy and to the major initiatives that will help achieve competitive advantage—a topic we take up in Chapter 2. **Competitive advantage**, which is anything that gives a firm a lead over its rivals, can be gained through the development and application of innovative information systems. Information systems are a fundamental part of a company's strategic vision. Indeed, the vision itself is often shaped by what these systems can achieve today and what is possible for the future.

Consider how Apple's iPhone got the jump on smartphone competitors with Siri, the intelligent personal assistant. Siri responds to spoken commands such as "Tell my brother I'll be late" and also answers questions like "Any Italian restaurants near here?" Initially, the iPhone's market share rose to more than 50%, in part because no other smartphone had anything like Siri. But competitive advantage can be fleeting. Microsoft entered the market with Cortana, Google launched Google Now, and Amazon followed up with Echo. Time will tell which personal assistant wins the most hearts.[5]

Strategy is equally important to nonprofit organizations and government agencies, and their information systems break new ground by offering handy services to the public, streamlining operations, and improving decision making. For instance, U.S. citizens can apply for Social Security benefits online rather than wait in line. Government strategies to combat terrorism also involve information systems—and analysis of immense volumes of data. Those strategies raise important ethical dilemmas, discussed in Chapters 3 and 10.

Improving Individual Productivity

Tools to help people improve their own productivity abound, from the smartphones that combine voice calls with web browsing, contact databases, email, music, and games to the many software applications that eliminate tedious work. Even word processing has transformed work in every organization, and many students aren't aware of all the ways that software can make them more productive. You can, for example, automatically create and properly format your term paper references by integrating a bibliographic manager such as Zotero, which captures the citation from a web page.

PRODUCTIVITY TIP
Time management experts advise that you process your email inbox to zero, flagging important messages, moving others to appropriate categories, and rerouting some using automated filtering tools. Your email system can do quite a bit of work for you if you take time to configure it.

To improve productivity at work, people can choose from a bewildering variety of computer software and electronic devices, but more is not necessarily better. You should select carefully, with an eye to the functions you need most, ease of use, and short learning curves. No one likes reading thick instruction manuals. Throughout this book, you will see productivity tips in boxes—like the one on this page—that will help you improve your own productivity.

Compare the terms *data, information,* and *knowledge,* and describe three characteristics that make information valuable.

2 The Nature of Information

Except for words like *the, a, and, if,* and *it*, the word *information* was once one of the most common words on the Internet. No wonder people called the net an "information" storehouse. The term *information* is critical to understanding how information systems work, but it can be very slippery.

Facts, data, intelligence, knowledge, and even tips are synonyms for information, and they all touch on characteristics of the "stuff" that information systems can manage. For our purposes, the term **data** refers to individual facts or pieces of information, and **information** refers to data or facts that are assembled and analyzed to add meaning and usefulness. A patient's single high-temperature reading at a 24-hour walk-in clinic in Maryland is one piece of data.

FIGURE 1-6
Examples of the continuum from data to information to knowledge, as meaning and usefulness grow.

Data	Information	Knowledge
Patient's temperature at walk-in clinic on Dec. 15 = 103.9° F.	Table showing flu diagnoses in region during month of December	Worldwide map of flu outbreaks suggesting pandemic
01010011 01001111 01010011	Binary code for SOS	HELP!!!
Microsoft (MSFT) closing stock price	Graph of Microsoft highs and lows for one year	Combined with analysis of other information, leads to broker's recommendation to buy, hold, or sell stock
CWOT	Complete Waste of Time (text messaging abbreviation)	May be interpreted as an insult
GPS coordinates	Map showing location with push pin	Location of Taj Mahal in India
Invoice #259 Total Amount = $139.23	Total Sales for Southern Region in First Quarter = $2,156,232	Fastest growing sales region; consider broader marketing campaign

But entered into the clinic's information system and combined with the patient's other symptoms and previous medical records, it becomes far more valuable as a diagnostic tool.

We gain even more from this one temperature reading by combining it with data from other patients entering all clinics that week. The patterns may warn of a flu outbreak or even a major epidemic. The health staff at the Centers for Disease Control and Prevention in Atlanta, Georgia, draw on data like this to map the spread of diseases and take swift action to protect the public.

Refining, analyzing, and combining information make it more and more useful and meaningful, and the effort adds to our ability to use it to make decisions and take action. The path from data to information, and then to knowledge, is a continuum, and Figure 1-6 shows some examples. No clear dividing lines separate these categories; they blend together and form a continuum as more meaning and usefulness are created through skillful analysis and human insight.

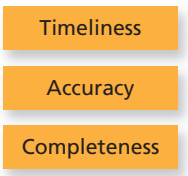
What Makes Information Valuable?

Separating useful information from the trivial is no easy task given the sheer volume of information on the planet. Three characteristics stand out, however, that contribute to making some information very valuable: (1) timeliness, (2) accuracy, and (3) completeness (Figure 1-7).

Timeliness matters a great deal in some settings, and near real-time information often costs more. For example, people pay monthly fees to financial services to get up-to-the minute stock prices rather than the delayed price reports shown on free stock tickers you can add to your own browser. Riswan Khalfan of TD Securities says his system can handle a breathtaking 5 million pieces of data per second, far more than most other banks. He points out that "if you fall behind, you're dealing with stale data and that puts you at a disadvantage." With timely, up-to-date trading data, Khalfan's systems can make quicker decisions, which he argues are better (Figure 1-8).[6]

Accuracy may seem like an obvious feature of valuable information, but there actually are degrees of accuracy. The more accurate you want the information to be, the longer it may take to obtain, making extreme accuracy a trade-off to timeliness. A CEO who wants to know how much competitors charge for a rival product, for example, might wait too long for staff to scour all the distribution channels and assemble the data. An approximate but timely answer is more valuable.

FIGURE 1-7
What makes information valuable?



competitive advantage
Anything that gives a firm a lead over its rivals; it can be gained through the development and application of innovative information systems.

data
Individual facts or pieces of information.

information
Data or facts that are assembled and analyzed to add meaning and usefulness.