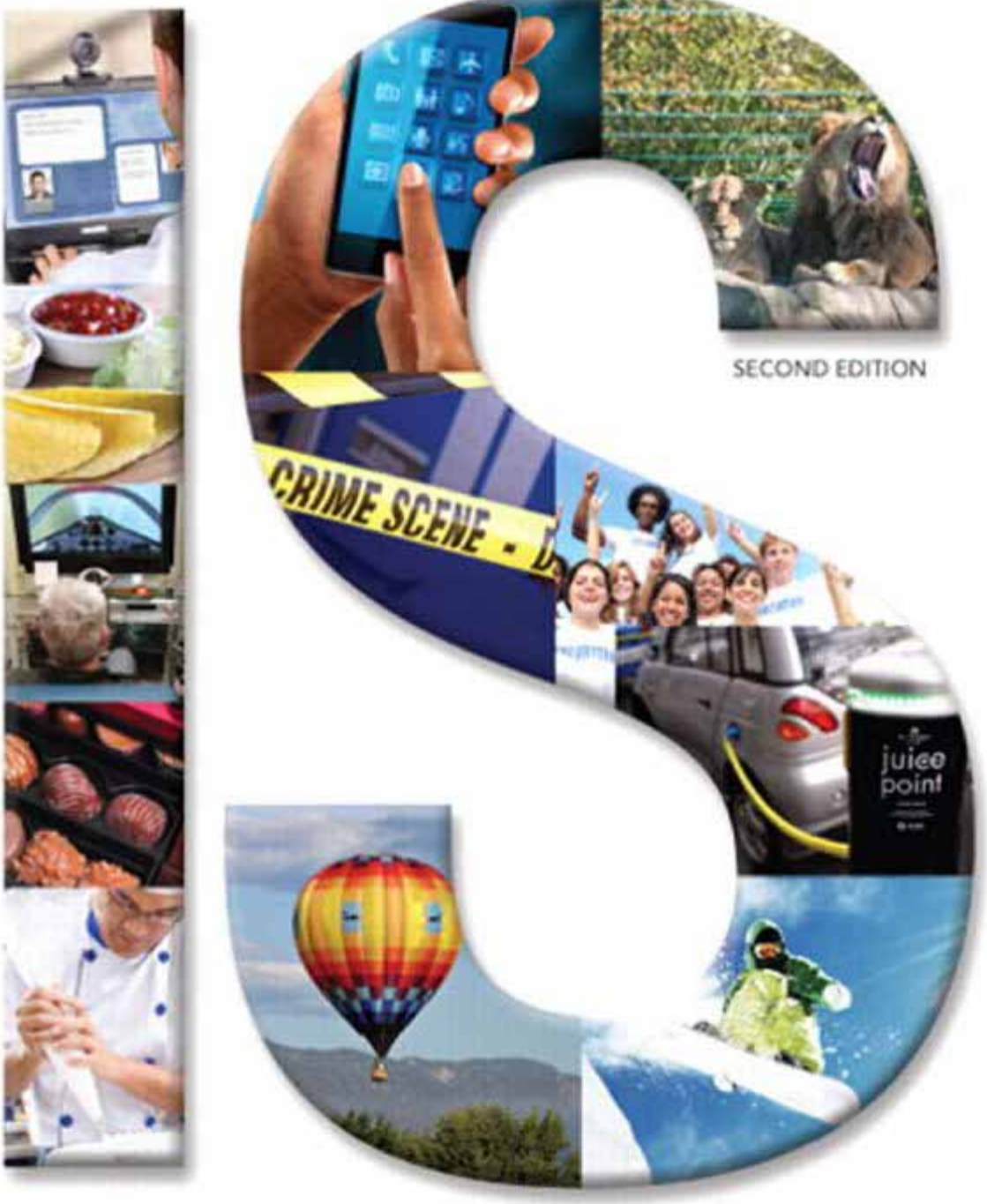
INTRODUCTION TO

INFORMATION SYSTEMS

PATRICIA WALLACE



SECOND EDITION

Introduction to Information Systems

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Second Edition

PATRICIA WALLACE

Johns Hopkins University

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

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About the Author

Patricia Wallace is currently Senior Director for Information Technology and Online Programs at Johns Hopkins University Center for Talented Youth. Before joining JHU, she was Chief, Information Strategies, and Executive Director, Center for Knowledge Management, at the Robert H. Smith School of Business, University of Maryland, College Park. She also teaches technology management courses as Adjunct Professor in the MBA Program of the Graduate School of Management and Technology, University of Maryland University College, where she previously served as CIO for 10 years. Wallace earned her Ph.D. in psychology at the University of Texas at Austin and holds an M.S. in Computer Systems Management. She has published 10 books, including *The Internet in the Workplace: How New Technologies Transform Work* and *The Psychology of the Internet*, several educational software programs, and numerous scholarly and general articles.

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Preface

What's New in the 2nd Edition

The information systems field is fast-moving, and this 2nd edition introduces and updates many important concepts and technologies. We changed the title to *Introduction to Information Systems* to better reflect the contents and the course. This edition includes more figures, graphs, and tables to illustrate topics in visual ways, and the references, examples, data, and case studies are all updated. Larger fonts are used for the tables, and the text portion of each chapter has been shortened, most notably by tightening up the chapter introductions to get into the chapter content more quickly. The online simulations are converted to HTML5 so they are accessible from iPads and iPhones, and the scores go into the gradebook.

Major new features for the 2nd edition include the following:

- Extended coverage of big data and the technologies used to store and analyze it has been added, along with a new "Ethical Factor" box that explores the ethics of big data.
- Expanded discussion of mobile devices and m-commerce is featured in Chapter 6, including a review of evolving mobile payment technologies using near field communications and strategies for mobile-friendly software development.
- The "Internet of Things" is highlighted in several chapters because of its growing impact on network architecture and bandwidth, and its rapidly increasing role in data collection, analysis, privacy, and surveillance.
- The 2nd edition expands the discussion of cloud computing, personal clouds, mobility, and the BYOD (bring your own device) trend, especially as they affect strategic planning for the organization.
- A new comprehensive case study at the end of the text charts Apple's disruptive innovations, and encourages students to predict the company's future business strategy.
- Twitter's role in social TV and the "multiscreening" phenomenon are featured in a new case study about Nielsen's program rating system, so students see how tweeting fits into the entertainment industry's strategies.

Chapter-Specific Changes

CHAPTER 1: INFORMATION SYSTEMS AND *PEOPLE*

- Apple's Siri and competitive advantage
- New self-quiz on student's use of technology: "How Productive Are You?"
- New "Productivity Tip" on digital footprints
- Revised case study on Nasdaq OMX to include Facebook's botched public opening
- Five new figures

CHAPTER 2: INFORMATION SYSTEMS AND *STRATEGY*

- Updated examples of disruptive innovations
- Examples of new government policies affecting strategy (e.g., Internet tax)
- New "Productivity Tip" on personal cloud use
- Updated IT expenditure benchmarks
- App.net, example of an ad-free social network
- Case on GameStop updated with new data

- Case on Net Neutrality updated with new events and lawsuits
- Four new figures and several charts updated with recent data

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

- New QR code figure for students to read with smartphone app
- In-memory computing is introduced and described as a key term
- New "Did You Know?" anecdote on detection of gestures without contact with the screen
- Expanded discussion on why businesses should be concerned with operating system market shares, especially for mobile devices
- Updated figures and charts on operating system market shares
- Simplified discussion of last mile
- Added 802.11 currently in draft (802.11ac and 802.11ad)
- Six new or updated figures
- New Case Study #1: Google Glass and Wearable Technologies
- Updated Case Study #2 on Sprint Nextel

CHAPTER 4: DATABASES AND DATA WAREHOUSES

- Improved discussion of relational databases
- New figure showing data definitions in Access
- Updated statistics in figures
- Updated "Productivity Tips"
- New figure describing characteristics of big data
- Expanded section on data warehouses to include big data technologies
- Data scientist described
- Updated case studies

CHAPTER 5: INFORMATION SYSTEMS FOR THE *ENTERPRISE*

- Added discussion of machine-readable financial data to improve transparency
- New figure on paperless workflow
- Discussion of supply chain fundamentals and collaboration made more concise
- Updated discussion of virtual worlds for CRM
- Expanded discussion of mobile CRM strategies
- New figure describing portals into an ERP for higher education
- Improved organization of ERP section with subtitles
- Deleted Supply Chain Operations Reference (SCOR) from key terms
- Updated case studies with recent information

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

- Expanded discussion of how infomediaries take advantage of the growing amount of information in XML format
- Updated discussion on HTML 5 and its features
- New discussion of social commerce (s-commerce) relying on social networks
- New figure comparing mobile apps and mobile-friendly websites
- New figures illustrating mobile-friendly design, and a list of tips to achieve it
- Updated discussion of search engine marketing, including Facebook's Graph Search
- Updated examples of crowdsourcing
- New key terms: *mobile commerce (m-commerce), near field communications*
- Updated Case Study #3 on mobile payments and the digital wallet
- Updated Case Study #2 on Pandora
- Clarified steps in E-Project #1

CHAPTER 7: BUSINESS INTELLIGENCE AND DECISION MAKING

- Updated discussion of data mining to include predictive analytics
- Expanded discussion of data visualization with new figure of interactive map

- New "Did You Know?" anecdote about the use of text mining
- Expanded discussion of AI and data from sensors
- New figure on website metrics drawn from online simulation (Chocolate Lovers Unite)
- Key term deleted: executive information system
- Key term added: predictive analytics
- New Case Study #1, "Cracking Fraud with Government's Big Data"
- New E-Project #2: "Analyzing Nielsen TV Ratings with Excel," with downloadable TV ratings data for analysis
- New "Productivity Tip" on managing your own big data

CHAPTER 8: COLLABORATING WITH *TECHNOLOGY*

- New figure showcasing top corporate blogs
- New figure on reasons for taking a break from Facebook
- Discussion of recently introduced collaborative technologies such as Vine and Instagram
- Revised section on unified communications to feature critical capabilities
- Major revision of Case Study #1, now called "'Telepresence Robots' Support Remote Collaboration"
- New Case Study #2, "Yahoo! Bans Telecommuting: Was It the Right Move?"

CHAPTER 9: KNOWLEDGE MANAGEMENT AND *E-LEARNING*

- Expanded discussion about incentives for knowledge sharing
- New discussion on technologies to prevent cheating in e-learning courses
- New "Did You Know?" anecdote about telepresence robots who attend classes
- New discussion about *massive open online courses* (MOOCs), also added as a key term
- New "Productivity Tip" about taking an online course
- New Case Study #1, "Lynda.com: How an E-Learning Entrepreneur Rides Waves of Change"
- Updated Case Study #2, "Diplopedia: Managing State Department Knowledge with a Wiki"

CHAPTER 10: ETHICS, PRIVACY, AND *SECURITY*

- New discussion of Apple's unique approach to music piracy with iTunes Match
- New figure on recent software piracy survey
- New discussion on an emerging "right to be forgotten" law, to ensure people can erase their digital footprints
- New details added to discussion of encryption strategies
- Expanded discussion of mobile devices and security
- New Case Study #1: "Zynga Kills Petville and Angers Virtual Pet Owners"
- Updated Case Study #2 to include recent massive DDoS on Spamhaus
- Revised and simplified E-Project #1

CHAPTER 11: SYSTEMS DEVELOPMENT AND *PROCUREMENT*

- New "Did You Know?" anecdote on smartphone app
- Updated examples of feasibility studies
- New "Productivity Tip" about clarifying the scope of work to avoid disagreements
- Updated examples on consulting
- Updated Case Study #2 with recent research findings on agile methods

CHAPTER 12: PROJECT MANAGEMENT AND *STRATEGIC PLANNING*

- Tightened up discussion of the five project management processes
- New figure showing the top strategic technology trends currently underway
- Updated Case Study #1 with current information on technologies and their location on the hype cycle

- New figure on hype cycle with current technologies
- Updated E-Project #1 with more recent Gartner predictions

End-of-Book Comprehensive Case Studies

- New Case Study #3: "Apple: Can the Company Pull Off Another Disruptive Innovation?" (replaces case on Clearwire)
- Red Cross case updated to include the Safe and Well Website.
- Facebook case updated and revised to include uproar over Instagram's privacy and ownership challenges
- Updated "Managing the Federal Government's IT Project Portfolio" to incorporate recent steps by federal government to get control over IT spending

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 messages, 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 fundraising 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 channel for each task to support virtual teamwork, management, negotiation, and leadership. Chapter 12 on project management and strategic planning 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. 23
2. Ethical Responsibility in an Extended Value Chain, p. 45
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. 174
7. The Ethics of Tagging Faces in Photos, p. 202
8. Flash Mobs and Free Speech: Should Police Block Mobile Messaging Services? p. 244
9. Knowledge Sharing in Fast-Paced Industries: The Case of Formula One Racing, p. 269
10. Ethical Dilemmas in a Distributed Denial of Service Attack, p. 302
11. Developing Systems That Promote Ethical Decision Making and Social Responsibility, p. 331
12. Code of Ethics for Project Managers, p. 356

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) follows a team planning a campaign to launch a string of clubs in several major cities, and the team's members hail from Dallas, Texas, and Hong Kong. As they use collaborative technologies that span the Pacific, this dynamic virtual team works through differences in time zones, communication styles, and culture.

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, such as IBM's "Watson"—the supercomputer that competed on "Jeopardy!" and soundly defeated the game's human champs in a dramatic live broadcast. 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. But both 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 Jollean Sinclaire and 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.

CourseSmart

CourseSmart eTextbooks were developed for students looking to save on required or recommended textbooks. Students simply select their eText by title or author and purchase immediate access to the content for the duration of the course using any major credit card. With a CourseSmart eText, students can search for specific keywords or page numbers, take notes online, print out reading assignments that incorporate lecture notes, and bookmark important passages for later review. For more information or to purchase a CourseSmart eTextbook, visit www.coursesmart.com.

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Many thanks to Bob Horan, my editor, whose commitment to this project has always been unwavering. He eagerly supported the development of the online simulations, even when they were just sample storyboards loaded with branching scripts and "if-then" pseudocode. Bob knows the introductory MIS world better than anyone, and his instincts about what works for students and faculty are right on target.

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.
pwallace@jhu.edu

Introduction to Information Systems

CHAPTER

1 Information Systems and *People*

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

MyMISLab | ***Online Simulation***

The World of Mammals

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

components of every information system. You will see how the information systems (IS) discipline is changing 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 for not just 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.

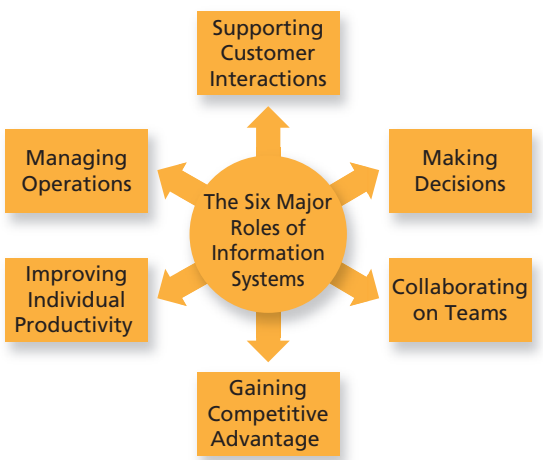
Like the information they manage, information systems cover a very broad scope and contribute to many different activities in an organization. What roles do they play and how do they transform work? The next section shows the enormous variety of settings in which innovative information systems play a 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 some $446 billion in net sales in 2012, 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.

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



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.

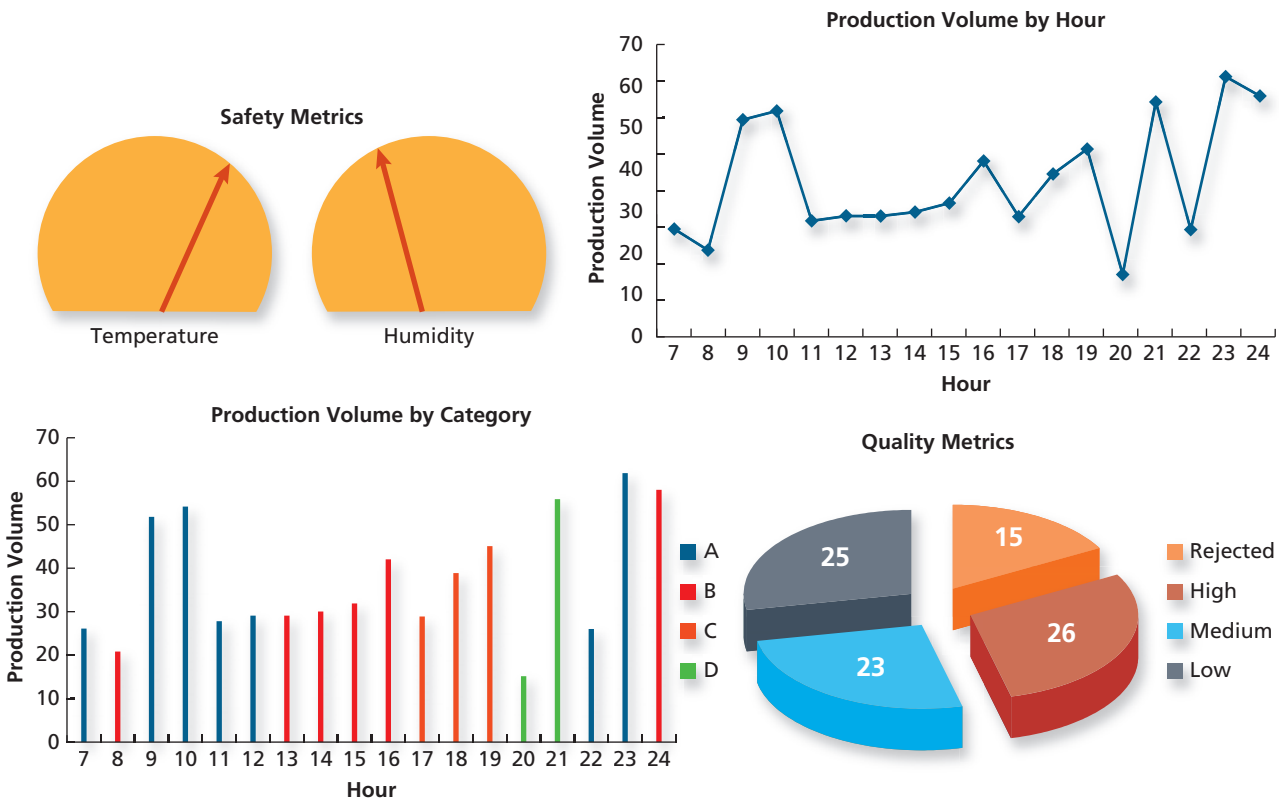
Many organizations choose commercially produced information systems to handle their back-office information needs, relying on software packages such as SAP, Oracle, NetSuite, or QuickBooks. Some organizations are moving these functions to service providers or even outsourcing them entirely. India became 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).
- 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 shave 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.

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



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.

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.

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 *American Idol*'s cell-phone voting 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.

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.

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

Source: Aaron Amat/Shutterstock

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 the links you click reveal your interests and intentions, and marketers try to display ads that match just what you are looking for. Spending for digital ads should top $55 billion by 2016.[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.

The huge success of social networks prompts many corporations to launch experiments to see how their collaborative features could support business. Research analysts predict that 50% of large companies will depend heavily on internal social networks for

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.

	% Internet Users Who Use . . .
Any social networking site	67%
Facebook	67%
LinkedIn	20%
Twitter	16%
Pinterest	15%
Instagram	13%
Tumblr	6%

FIGURE 1-5
Social networking sites and their demographics.

Sources: Duggan, M., & Brenner, J. (February 14, 2013). The demographics of social media users – 2012. http://pewinternet.org/Reports/2013/Social-media-users.aspx, accessed March 25, 2013. Carlson, N. (February 27, 2012). Infographic: Who really uses LinkedIn? Business Insider, http://www.businessinsider.com/infographic-who-really-uses-linkedin-2012-2, accessed March 25, 2013.

their employees by 2016, and that, for many of them, the network will be at least as important as email is now.[5]

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 to 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.

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?" The iPhone's market share rose to over 50%, in part because no other smartphone had anything like Siri. But competitive advantage can be fleeting, and IBM has plans to develop a supercharged personal assistant for mobile phones based on "Watson," the supercomputer that surprised the world by defeating two Jeopardy champions.[6] Time will tell which personal assistant wins the most hearts.

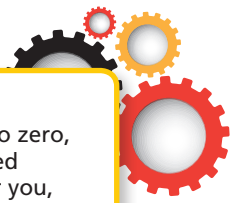
Strategy is equally important to nonprofit organizations and government agencies, and their information systems break new ground by offering new services to the public, streamlining operations, and improving decision making. For instance, U.S. citizens can apply for social security benefits online, rather 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 EndNote or RefNote. Online libraries and reference databases offer links to export the

citation in any format, so typing is unnecessary.

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 ones on this page—that will help you improve your own productivity.



PRODUCTIVITY TIP
Time management experts advise that you process your email inbox to zero, flagging important messages and rerouting others by using automated filtering tools. Stop devoting time to tasks that technology can do for you, and don't be a slave to your email.

PRODUCTIVITY TIP
Many colleges and universities have agreements with software companies to offer discounts to their students. Before you buy software, check with your IT department. Once you leave student status behind, you'll be hard-pressed to find deals like the ones you can get now.

THE NATURE OF INFORMATION

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

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. 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 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 makes 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

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.