

SHELLY CASHMAN SERIES®



Systems Analysis and Design

TENTH EDITION

ROSENBLATT

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PREFACE

The Shelly Cashman Series® offers the finest textbooks in computer education. We are proud that our previous editions of *Systems Analysis and Design* have been so well received by instructors and students. *Systems Analysis and Design, Tenth Edition* continues with the innovation, quality, and reliability you have come to expect from the Shelly Cashman Series.

Overview

Systems Analysis and Design, Tenth Edition includes exciting Video Learning Sessions, developed to maximize the learning experience. The Video Learning Sessions combined with the text offer an interactive, multimedia approach to information systems development. Many two- and four-year colleges and schools use this book in information systems, computer science, and e-commerce curriculums. The textbook emphasizes the role of the systems analyst in a dynamic, business-related environment.

Facing a challenging global marketplace, companies need strong IT resources to survive and compete effectively. Many of today's students will become the systems analysts, managers, and IT professionals of tomorrow. This textbook will help prepare them for those roles.

Using this book, students learn how to translate business requirements into information systems that support a company's short- and long-term objectives. Case studies and assignments teach analytical and problem-solving skills. Students learn about traditional structured analysis, object-oriented concepts, and agile methods. Extensive end-of-chapter exercises emphasize critical-thinking skills.

The *Tenth Edition* introduces several major new end-of-chapter features, including the Critical Thinking Challenge, a new set of Video Learning Session tasks, a new CASE Tool Workshop, and new Chapter Exercises. This edition also includes significant updates on topics such as cloud computing, Web 2.0, client/server architecture, e-commerce, wireless standards, and much more.

Objectives of This Textbook

Systems Analysis and Design, Tenth Edition is intended for a three credit-hour introductory systems analysis and design course. This textbook is designed to:

- Enhance critical thinking skills with the new Critical Thinking Challenge feature at the end of each chapter. The scenario-based tasks and sample answers help students develop perception, organization, analysis, problem-solving, and decision-making skills they can take to the workplace.
- Explain systems analysis and design using an appealing full-color format, numerous screen shots and illustrations, and an easy-to-read style that invites students to learn.
- Introduce project management concepts early in the systems development process, with a new chapter that explains project management tools and techniques.
- Challenge students with a Question of Ethics mini-case in each chapter that asks them to respond to real-life ethical issues in an IT environment.
- Provide multi-method coverage, including a comparison of structured, object-oriented, and agile systems development methods.
- Explain how IT supports business requirements in today's intensely competitive environment, and describe major IT developments and trends.

Video Learning Sessions

Eighteen multimedia Video Learning Sessions describe key systems analysis skills and concepts and provide students with a self-paced, interactive learning tool that reinforces the text. The sessions provide step-by-step explanations that are easy to follow and understand.

- The new Training Tasks accompanying each Video Learning Session require soft skills and meta cognition where students must use what they have learned to create training materials for others.
- The **Your Turn** feature accompanying every Video Learning Session challenges students to apply their skills and check their work against sample answers. This hands-on practice can help students better handle actual assignments and tasks.
- The Video Learning Sessions offer a self-paced multimedia format that students can review at their convenience. Topics include concepts that students often struggle to understand. Especially in an online environment, a self-paced video can be a welcome learning partner for an individual student.
- Topics include DFDs, object-oriented analysis, functional decomposition diagrams, structure charts, data normalization, entity-relationship diagrams, decision tables, financial tools, and project management.
- Instructors may use the Video Learning Sessions as classroom presentations, distance-education support, student review tools, and exam preparation.



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Other New and Updated Features in This Text

Systems Analysis and Design, Tenth Edition offers these exciting new and expanded features:

- New Critical Thinking Challenge feature helps students practice critical thinking skills, first by trying Practice Tasks and viewing sample answers, and then by completing the Challenge Tasks. These tasks can help students develop perception, organization, analysis, problem-solving, and decision-making skills that they will need in the workplace.
- New set of Video Learning Session Training Tasks provides added value for this key feature, and challenges students to develop training materials in a real-life context.
- New CASE Tool Workshop feature focuses on basic CASE skills that students can practice, using Visible Analyst® or another tool.
- New end-of-chapter content includes a major revision of Chapter Exercises, Apply Your Knowledge, and all Case Studies.
- New coverage of cloud computing, Web 2.0, client/server architecture, e-commerce, wireless standards, and much more.
- Updated Management Information Systems CourseMate Web site for *Systems Analysis and Design, Tenth Edition* available for a fully digital course solution. CourseMate provides one location for all interactive activities, Video Learning Sessions, and an interactive e-book. EngagementTracker provides the ability to assess student understanding of concepts through the interactive activities.

Organization of This Textbook

Systems Analysis and Design, Tenth Edition, contains 16 learning units in twelve chapters and a four-part Systems Analyst's Toolkit that teaches valuable cross-functional skills.

Chapter 1 – Introduction to Systems Analysis and Design Chapter 1 provides an up-to-date overview of IT issues, major trends, and various systems development approaches, including structured, object-oriented, and agile methods. The chapter emphasizes the important role of systems analysis and design in supporting business objectives.

Chapter 2 – Analyzing the Business Case Chapter 2 offers a business-related starting point for successful systems analysis. Topics include strategic planning, review of systems requests, how to conduct a feasibility study, and the steps in a preliminary investigation.

Chapter 3 – Managing Systems Projects Chapter 3 explains project management, cost estimating, and change control for information systems. This chapter includes hands-on skills that systems analysts can use to create Gantt charts and PERT charts.

Chapter 4 – Requirements Modeling Chapter 4 describes fact-finding techniques and team-based modeling methods, including JAD and RAD, that systems analysts use to model and document a new system.

Chapter 5 – Data and Process Modeling Chapter 5 explains how systems analysts create a logical model for the new system by using data flow diagrams and process description tools, including structured English, decision tables, and decision trees.

Chapter 6 – Object Modeling Chapter 6 explains object-oriented tools and techniques, including use case diagrams, class diagrams, sequence diagrams, state-transition diagrams, activity diagrams, and the Unified Modeling Language.

Chapter 7 – Development Strategies Chapter 7 focuses on software acquisition options, including outsourcing and offshore outsourcing options, application service providers, and other trends that view software as a service rather than a product.

Chapter 8 – User Interface Design Chapter 8 highlights output and report design, the interaction between humans and computers, including usability issues, graphical screen design, input issues, and data entry guidelines.

Chapter 9 – Data Design Chapter 9 describes data design terms, concepts, and skills including entity-relationship diagrams, cardinality, data normalization rules, data warehousing, data mining, a comparison of logical and physical records, and data control measures.

Chapter 10 – System Architecture Chapter 10 explains the elements of system architecture, with emphasis on RFID, ERP, supply chain management, client/server architecture, and network topology, including wireless networking standards and trends.

Chapter 11 – Managing Systems Implementation Chapter 11 includes coverage of application development and implementation topics, including structure charts, documentation techniques, system testing, user training, data conversion, changeover methods, and post-implementation evaluation.

Chapter 12 – Managing Systems Support and Security Chapter 12 describes user support, maintenance techniques, and factors that indicate the end of a system's useful life. This chapter explains IT security concepts, techniques, and tools, and specifically addresses six security levels: physical, network, application, file, user, and procedural security. Chapter 12 also describes risk management, data backup and disaster recovery, and explains future challenges and opportunities that IT professionals will face in a dynamic workplace.

Toolkit Part A – Communication Tools Part A of the Toolkit describes oral and written communication tools that can make a systems analyst more effective. Topics include guidelines for successful communications, tips for better readability, how to organize and plan a presentation, effective speaking techniques, and managing communication skills.

Toolkit Part B – CASE Tools Part B of the Toolkit focuses on computer-aided software engineering (CASE) tools that systems analysts use to document, model, and develop information systems. Examples of several popular CASE tools are provided, along with sample screens that show CASE tool features.

Toolkit Part C – Financial Analysis Tools Part C of the Toolkit explains various tools that systems analysts use to determine feasibility and evaluate the costs and benefits of an information system. Specific tools include payback analysis, return on investment (ROI), and net present value (NPV).

Toolkit Part D – Internet Resource Tools Part D of the Toolkit explains Internet-based information gathering strategies. Topics include search engines, subject directories, the invisible Web, advanced search techniques, Boolean logic and Venn diagrams. This Toolkit Part also discusses social networking, newsgroups, newsletters, blogs, podcasts, RSS feeds, Webinars, mailing lists, Web-based discussion groups, chat rooms, instant messaging, and online learning opportunities.

FOR THE STUDENT

The Shelly Cashman Series wants you to have a valuable learning experience that will provide the knowledge and skills you need to be successful. With that goal in mind, we have included many activities, games, and learning tools, that we hope you will find interesting, challenging, and enjoyable. For example, because a picture is worth a thousand words, each systems development phase begins with an eye-catching Dilbert© cartoon and a multi-color Gantt chart that provides a “*You are Here*” roadmap.

Chapter Learning Tools and How They Will Help You

Dilbert A Dilbert© cartoon introduces each systems development phase. If you’ve been in situations like these, the cartoon may be familiar. If not, you’ll be prepared when they do happen.



Preview Case Each chapter begins with a Preview Case. Within each case, Tina and David show you how they develop a new system for a college bookstore. They discuss key points, and offer a realistic preview.



Toolkit Time These notes, appearing in the margins throughout the book, direct you to the Toolkit following Chapter 12, where you can find further information on certain topics. The Toolkit covers communications, CASE tools, financial analysis, and internet resources.



Case In Point Each chapter includes four brief cases that focus on key issues.



A Question of Ethics A realistic ethical issue is presented at the end of each chapter. These examples force you to examine your reactions and how you would respond to common workplace situations.



Chapter Exercises

End-of-Chapter Exercises

Chapter Exercises Your answers to the ten Questions will show that you understand the key points. Four Discussion Topics and four Projects offer opportunities to dig deeper and learn even more.

Apply Your Knowledge

Apply Your Knowledge Includes four mini-cases focusing on key concepts and skills from the chapter. The cases are brief and to the point, with four tasks for you to perform.

Case Studies

Case Studies Includes a Chapter Case, a Continuing Case, and a Capstone Case. You will work on one or more case studies and apply the skills and knowledge you learned in the chapter.

CASE Tool Workshop

CASE Tool Workshop In this hands-on feature, you will use a CASE tool. To perform the tasks, you need access to Visible Analyst[®] or a similar tool.



MIS CourseMate Online Case Simulation Includes realistic emails, voice mails, and tasks. In this simulation, you act as an entry-level IT team member. You will work with your supervisor and help her develop a new information system.

Critical Thinking Challenge

MIS CourseMate Critical Thinking Challenge Allows students to focus on critical thinking skills while considering realistic scenarios and roles a systems analyst may face. You will perform Practice Tasks and check your answers, then work on Challenge Tasks that require critical thinking skills.

Video Learning Session Payback Analysis

If you have an MIS CourseMate access code, you can launch interactive Video Learning Sessions to help you understand systems development concepts and practice your skills. You can watch the sessions on your computer or mobile device, and pause, rewind, or replay a video at any time. To log on to the MIS CourseMate site at www.cengagebrain.com, you must create a student account and then register this book.

This session is about payback analysis. You'll learn how to calculate the payback period for a project and how to use a spreadsheet to determine a project's payback period.



MIS CourseMate Video Learning

Sessions Includes 18 Video Learning Sessions, complete with practice and training tasks. You will learn key skills and concepts by watching these streaming videos on your computer. You can pause, rewind, or replay at any time, and then perform Your Turn tasks to practice your skills.

Learn It Online

MIS CourseMate Learn It Online Includes Chapter Reinforcement Questions, Flash Cards, Practice Tests, and various games, such as Who Wants To Be a Computer Genius?, Wheel of Terms, and the Crossword Puzzle Challenge. You can use this feature to apply your knowledge and practice your skills.

Additional Support Tools

These additional tools can enhance your learning experience:

GLOSSARY/INDEX This edition of the textbook includes a glossary/index feature to assist your understanding of key terms and phrases, or to use as a quick reference tool.

MANAGEMENT INFORMATION SYSTEMS COURSEMATE MIS CourseMate with eBook for Systems Analysis and Design, Tenth Edition keeps today's students engaged and involved in the learning experience. MIS CourseMate includes an integrated, multimedia rich and interactive eBook, along with a variety of interactive learning tools, including quizzes and games, exercises, web links, videos, and other resources that specifically reinforce and build on the concepts presented in the chapter. These interactive activities are tracked within CourseMate's Engagement Tracker, making it easy to assess students' retention of concepts. All of these resources on the MIS CourseMate for Systems Analysis and Design enable students to become more comfortable using technology and help prepare students to use the Internet as a tool to enrich their lives. To sign in to MIS CourseMate www.cengagebrain.com you first must create a student account and then register this book, as described at www.cengage.com/ct/studentdownloads.

FOR THE INSTRUCTOR

The Shelly Cashman Series is dedicated to providing you all of the tools you need to make your class a success. Information on all supplementary materials is available through your Course Technology representative or by calling one of the following telephone numbers: Colleges, Universities, Continuing Education Departments, Post-Secondary Vocational Schools, Career Colleges, Business, Industry, Government, Trade, Retailer, Wholesaler, Library, and Resellers, call Cengage Learning at 800-354-9706; K-12 Schools, Secondary and Vocational Schools, Adult Education, and School Districts, call Cengage Learning at 800-354-9706. In Canada, call Nelson Cengage Learning at 800-268-2222.

Instructor Resources

The Instructor Resources for this textbook include both teaching and testing aids, and are available for download by logging in at login.cengage.com. The Instructor Resources include:

- **Instructor's Manual** Includes lecture notes summarizing the chapter sections, figures and boxed elements found in every chapter, teacher tips, classroom activities, lab activities, and quick quizzes in Microsoft Word files.
- **Syllabus** Easily customizable sample syllabus that covers policies, assignments, exams, and other course information. Also included is a Microsoft Project file used to create the five Phase Opener Gantt charts. An instructor can use this project file to create a visual syllabus that could include additional tasks, quizzes, and projects. The file also can be used to track class progress through the course. Instructors are welcome to distribute this file to students, and show them how to manage tasks, resources, and deadlines for team projects that might be assigned.
- **PowerPoint Presentations** A multimedia lecture presentation system provides slides for each chapter, based on chapter objectives.
- **Figure Files** Illustrations for every figure in the textbook in electronic form.
- **Solutions to Exercises** Includes solutions for end-of-chapter exercises, including Critical Thinking Challenge Practice and Challenge Task solutions, chapter reinforcement exercises, and extra case studies.

- **Test Bank & Test Engine** Test Banks include 112 questions for every chapter, and feature objective-based and critical thinking question types, page number references, and figure references when appropriate.
- **Additional Activities for Students** The forms that students can use to complete the Case Studies are included. Two additional case studies are also provided for every chapter, to be assigned as homework, extra credit, or assessment tools. Chapter Reinforcement Exercises, which are true/false, multiple-choice, and short answer questions that help students gain confidence in the material learned are included, as are the Your Turn Practice Tasks and sample solutions.
- **Additional Faculty Files** A copy of the powerful CASE tool, Visible Analyst — Student Edition, is provided for instructor evaluation. Several sample solutions to case study tasks also are included. To install this program, you follow a simple registration process that entitles you to use the software and obtain support. Detailed instructions are provided on the Instructor Companion Site. Also included are Word document versions of the e-mail and voice mail messages posted for students on the SCR Web site and the Interview Summaries for the New Century Case Study.

SOFTWARE BUNDLING OPPORTUNITIES *Systems Analysis and Design, Tenth Edition* can be bundled with several popular software programs:

- **Visible Analyst Student Edition** Whether you are designing e-business applications, developing a data warehouse, or integrating legacy systems with new enterprise applications, Visible Analyst is a valuable software based learning tool that helps students become more marketable with its advanced, affordable, and easy to use modeling capabilities. Visible Analyst was recently awarded the “Best Systems Analysis & Design Modeling Tool” by the Indian Education Ministry. Key users include: Business Analysts who analyze the organization and design of businesses or government departments and assess business models and their integration with technology; other professions that use systems analysis and design methods and techniques include Systems Analysts, Database Engineers, Computer Scientists, and Software Engineers. Visible Analyst is a separate software tool available individually as a Student Edition or as a University Edition with concurrent floating licenses for college or university computer labs. For more information about Visible Analyst, please visit: www.visible.com/Modeler/index.htm or contact sales@visible.com.
- **Microsoft Visio** The advanced diagramming tools of Visio 2010 help you simplify complexity with dynamic, data-driven visuals and new ways to share on the Web in real time. Start by building your diagram with professional-looking templates and modern, pre-drawn shapes. Then, easily link your diagram to popular data sources (such as Excel). You’ll see data automatically refresh right within your diagram, reflected in vibrant visuals such as icons, symbols, colors, and bar graphs. Finally, with just a few clicks, publish your data-linked diagram to SharePoint, and provide access to others on the Web, even if they don’t have Visio. Together, simplicity, data-driven shapes, and Web sharing make Visio 2010 one of the most powerful ways to see and understand important information.

- **Microsoft Project** Microsoft® Project 2010 delivers powerful, visually enhanced ways to effectively manage a wide range of projects and programs. From meeting crucial deadlines to selecting the right resources and empowering your teams, Project 2010 offers easier and more intuitive experiences to help you simply be more productive and realize amazing results.

AUTHOR'S NOTE

As an instructor and a longtime member of the Shelly Cashman Series team, I want this book to be student-friendly, easy to use, and focused on basic skills rather than the latest trend or silver bullet.

Our main goal is to help students learn how to perform systems analysis and design tasks. However, most entry-level IT positions are not filled on the basis of technical knowledge alone, because employers can teach new employees much of what they need to know. Instead, companies tend to seek highly motivated candidates with strong communication, interpersonal, and critical thinking skills. For that reason, the book offers many features and practice tasks that can help students develop “soft skills” that they can bring to the workplace.

To instructors who adopted this book, I know you had many other choices, and I sincerely appreciate your confidence. Together we can make a difference, and provide an outstanding learning experience for our students. Thank you.

ACKNOWLEDGMENTS

First and foremost, special thanks to Deb Kaufmann, our development editor. Deb’s insight and suggestions were extremely valuable. Thanks also to Professor Tim Burns, who teaches at Ramapo College of New Jersey, and to Ron Savilla, my former student at Central Piedmont Community College and a senior network technician. Tim and Ron reviewed the prior edition, and their unique perspectives helped shape the new book.

Finally, sincere thanks to the instructors and students who offered feedback and comments. You said you wanted more interactive content and learning tools, updated end-of-chapter material, and several new features. We hope you will continue to offer suggestions, and we certainly will continue to listen carefully.

ABOUT OUR COVERS

The Shelly Cashman Series is continually updating our approach and content to reflect the way today’s students learn and experience new technology. This focus on student success is reflected on our covers, which feature real students from the University of Rhode Island using the Shelly Cashman Series in their courses, and reflect the varied ages and backgrounds of the students learning with our books. When you use the Shelly Cashman Series, you can be assured that you are learning computer skills using the most effective courseware available.

PHASE

SYSTEMS PLANNING

DELIVERABLE

Preliminary investigation report

TOOLKIT SUPPORT

Communications and financial analysis tools

GOT MIS COURSEMATE?

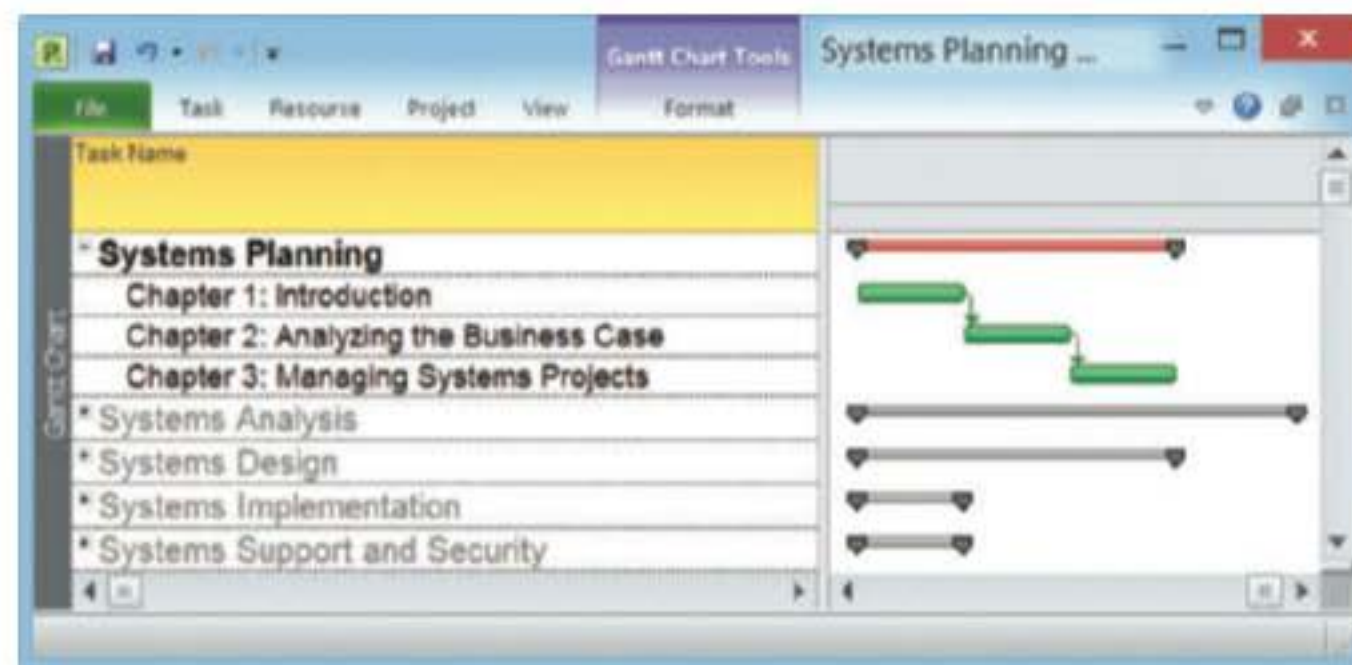
Four Video Learning Sessions explain payback analysis and project management



DILBERT © 2005 Scott Adams. Used By permission of UNIVERSAL UCLUCK. All rights reserved.

As the Dilbert cartoon suggests, it is always a good idea to know whether a project fits the company's overall strategy. You will learn more about the relationship between systems projects and corporate strategies in the systems planning phase.

Systems planning is the first of five phases in the systems development life cycle. After an introduction to systems analysis and design, you will learn how systems projects get started, how to evaluate a project proposal to determine its feasibility, and how to use project management tools and techniques. The deliverable for this phase is the preliminary investigation report.



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CHAPTER

Introduction to Systems Analysis and Design

Chapter 1 is the first of three chapters in the systems planning phase. This chapter describes the role of information technology in today's dynamic business environment. In this chapter, you will learn about the development of information systems, systems analysis and design concepts, and various systems development methods. This chapter also describes the role of the information technology department and its people.

INTRODUCTION

OBJECTIVES

When you finish this chapter, you will be able to:

- Describe the impact of information technology
- Define systems analysis and design and the role of a systems analyst
- Define an information system and describe its components
- Explain how to use business profiles and models
- Explain Internet business strategies and relationships, including B2C and B2B
- Identify various types of information systems and explain who uses them
- Distinguish among structured analysis, object-oriented analysis, and agile methods
- Explain the waterfall model, and how it has evolved
- Discuss the role of the information technology department and the systems analysts who work there

The headlines in Figure 1-1 offer dramatic examples of how information technology affects our society. Companies use information as a weapon in the battle to increase productivity, deliver quality products and services, maintain customer loyalty, and make sound decisions. In a global economy with intense competition, information technology can mean the difference between success and failure.



FIGURE 1-1 These headlines show the enormous impact of information technology on our lives.

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PREVIEW CASE: Mountain View College Bookstore

Background: Mountain View College is located in New England. The school has grown rapidly and now has 8,000 students at three campuses, each with a branch bookstore. Wendy Lee, manager of college services, is responsible for all bookstore operations. Wendy wants a new information system that will increase efficiency and improve customer service.



As the case begins, Tina Allen, a systems analyst in the college's Information Technology department, is talking with David Conroe. David is majoring in information systems at Mountain View College and is earning credit toward his degree by working part-time as a student intern.

Participants: Tina and David
Location: Tina's office, 10 a.m., Monday morning, August 19, 2013
Project status: Initial discussion
Discussion topics: Basic systems development concepts

Tina: Welcome aboard, David.

David: I'm glad to be here. What's on the agenda?

Tina: Well, there's been some talk about a new bookstore information system. Wendy says nothing is definite yet, but she suggested that we should get ready.

David: So we start by learning about the bookstore business?

Tina: Yes, the best system in the world isn't worth much unless it supports business and information needs. But let's not get ahead of ourselves. First, we need to talk about business information systems in general. Then we'll build a business model so we can understand the specific operations and processes at the bookstore. We'll also discuss systems analysis and design tools and techniques. Let's start with an overview of information systems and their characteristics.

David: That makes sense. What about the basic systems analysis techniques you mentioned?

Tina: On this project, we'll use what's called a structured method, which is based on the concept of a systems development life cycle, or SDLC for short. I'll also explain object-oriented and agile methods, and you'll learn about modeling tools and techniques. We'll follow a set of basic system development guidelines as we go along.

David: How does the SDLC work?

Tina: The SDLC is like constructing a building. First, you would list specific objectives for the project. Then, you might hire an architect to create drawings that show the finished building. Later, you'd need detailed blueprints for the construction workers. When the building is done, you would check everything, turn it over to the new owners, and make sure they're happy with the results.

David: And that's how we'll develop new information systems?

Tina: It sure is. We'll use a program called Microsoft Project to create a list of tasks we can work on.



FIGURE I-2 Typical introductory tasks for systems projects

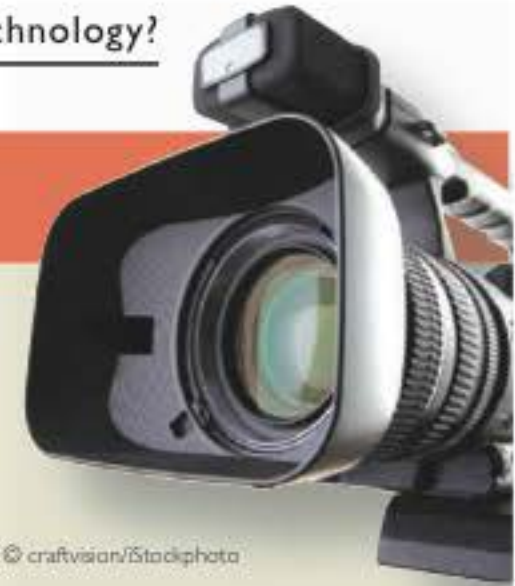
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Video Learning Sessions

Welcome and Introduction

If you have an MIS CourseMate access code, you can launch interactive Video Learning Sessions to help you understand systems development concepts and practice your skills. You can watch a session on your computer or mobile device, and pause, rewind, or replay a video at any time. To log on to the MIS CourseMate site at www.cengagebrain.com, you must create a student account and then register this book.

These two sessions include a personal welcome from the author and an introduction to the video learning concept. You'll view sample screens, get a feel for the topics, and see an example of the Your Turn feature that allows you to practice your skills and check your answers.



WHAT IS INFORMATION TECHNOLOGY?

Information technology (IT) refers to the combination of hardware, software, and services that people use to manage, communicate, and share information. Although fictitious, the bold headlines in Figure 1-1 show the huge impact of IT on our society.

More than ever, business success depends on information technology. IT is driving a new digital economy, where advances in hardware, software, and connectivity can provide enormous benefits to businesses and individuals. Although economic trends affect IT spending levels, most firms give IT budgets a high priority, in good times or bad. The reason is simple — during periods of growth, companies cannot afford to lag behind the IT curve. Conversely, when the economy slows down, firms often use IT to reduce operating costs and improve efficiency.

The following sections will give you a sense of IT history, an overview of systems analysis and design, and a description of the system analyst's role.

Welcome to the 21st Century: The IT Journey Continues

The history of IT is a fascinating study of human progress and achievement. We are dazzled by the latest and greatest technology, just as our parents and grandparents were astonished by the arrival of television, space flight, and personal computing. It is important for IT professionals, who live and work in this exciting world, to realize that each technology advance is part of a long-term process that often brings dramatic change, but never really ends. The story of IBM is a good example.

As its name suggests, International Business Machines was a major supplier of office equipment and typewriters long before the modern computer era. IBM's predecessor company was founded in 1896 by Herman Hollerith, who invented a card that identified characters by the location of punched holes. A deck of hundreds, or even thousands of these cards could store data that was easily sorted, queried, and printed by machines. This system sounds archaic today, but punch card technology was a huge advance that revolutionized the business world, and was in use into the 1960s and beyond. After a century of progress, IBM is now a global giant with a half-million employees, numerous patents, and more Nobel Prize winners than any other IT firm.

Figure 1-3 shows an employee clocking in with a punch card in 1953, and how an employee might clock in today, using a magnetic card linked to a corporate database. Perhaps students 60 years from now will view our current technology the same way we smile at punched cards. Meanwhile, welcome aboard — it will be an interesting ride!

Coming to work in 1953



© ClassicStock / Alamy

... and in 2013



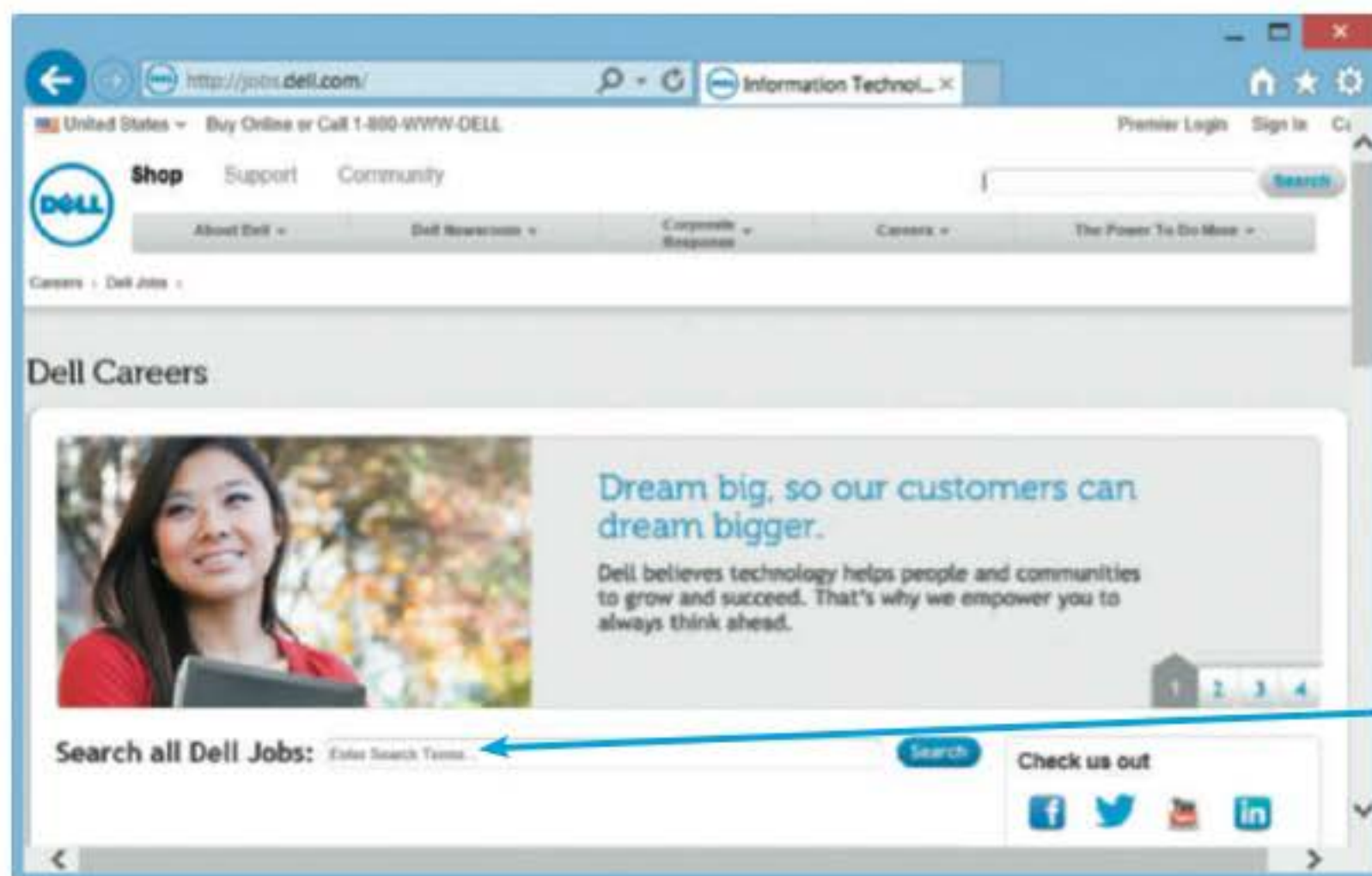
© Cusp / SuperStock

FIGURE I-3 How times have changed!

Systems Analysis and Design

Systems analysis and design is a step-by-step process for developing high-quality information systems. An information system combines technology, people, and data to provide support for business functions such as order processing, inventory control, human resources, accounting, and many more. Some information systems handle routine day-to-day tasks, while others can help managers make better decisions, spot marketplace trends, and reveal patterns that might be hidden in stored data.

Information systems typically are developed by talented people, including a mix of managers, users, network administrators, Web designers, programmers, and systems analysts. Capable IT professionals like these are always in demand, even in a slow economy. For example, notice how Dell reaches out to candidates on its Web site, as shown in Figure 1-4.

**FIGURE I-4** Dell is an example of a firm that invites potential candidates to search for jobs on its Web site.

© 2011 Dell

What Does a Systems Analyst Do?

A **systems analyst** is a valued member of the IT department team who helps plan, develop, and maintain information systems. Analysts must be excellent communicators with strong analytical and critical thinking skills. Because systems analysts transform business requirements into IT projects, they must be business-savvy as well as technically competent, and be equally comfortable with managers and programmers, who sometimes have different points of view, as Dilbert fans already know.

Most companies assign systems analysts to the IT department, but analysts also can report to a specific user area such as marketing, sales, or accounting. As a member of a functional team, an analyst is better able to understand the needs of that group and how IT supports the department's mission. Smaller companies often use consultants to perform systems analysis work on an as-needed basis.

On any given day, an analyst might be asked to document business processes, test hardware and software packages, design input screens, train users, and plan e-commerce Web sites. A systems analyst also manages IT projects, including tasks, resources, schedules, and costs. To keep managers and users informed, the analyst conducts meetings, delivers presentations, and writes memos, reports, and documentation.

To learn more about becoming a systems analyst, you should review the last section in this chapter, which lists typical skills and education requirements, certifications, career opportunities, and the impact of future IT trends on systems analysts.

CASE IN POINT 1.1: CLOUD NINE FINANCIAL ADVISORS

Cloud Nine provides its clients with a monthly newsletter that offers recommendations about stocks to buy or sell. Doug Layton, Cloud Nine's president, has asked your opinion on whether dot-com stocks might be good investments for the future. He specifically mentioned Google, eBay, Amazon.com, and Yahoo!, but he said you could suggest other companies. Doug wants you to do some Internet research to learn more about these Web-based companies and their future prospects. You can use a search engine, or start by visiting the Web sites of publications such as *Forbes*, *Fortune Magazine*, *Business Week*, or *The Wall Street Journal*, among others.



FIGURE 1-5 Consider the amazing technology that enabled the Hubble telescope to capture this image.

Courtesy of The Hubble Heritage Team (AURA / STScI / NASA)

INFORMATION SYSTEM COMPONENTS

A **system** is a set of related components that produces specific results. For example, specialized systems route Internet traffic, manufacture microchips, and control complex entities like the Hubble Telescope, which took the amazing image shown in Figure 1-5. A **mission-critical system** is one that is vital to a company's operations. An order processing system, for example, is mission-critical because the company cannot do business without it.

Every system requires input data. For example, your computer receives data when you press a key or click a menu command. In an information system, **data** consists of basic facts that are the system's raw material. **Information** is data that has been transformed into output that is valuable to users.

An information system has five key components, as shown in Figure 1-6: hardware, software, data, processes, and people.

Hardware

Hardware consists of everything in the physical layer of the information system. For example, hardware can include servers, workstations, networks, telecommunications equipment, fiber-optic cables, mobile devices, scanners, digital capture devices, and other technology-based infrastructure. A large concentration of servers working together is called a **server farm**. As new technologies emerge, manufacturers race to market the innovations and reap the rewards.

Hardware purchasers today face a wide array of technology choices and decisions. In 1965, Gordon Moore, a cofounder of Intel, predicted that the number of transistors on an integrated circuit chip would double about every 24 months. His concept, called **Moore's Law**, has remained valid for almost 50 years. Fortunately, as hardware became more powerful, it also became much less expensive. Large businesses with thousands or millions of sales transactions require company-wide information systems and powerful servers, such as those shown in Figure 1-7.

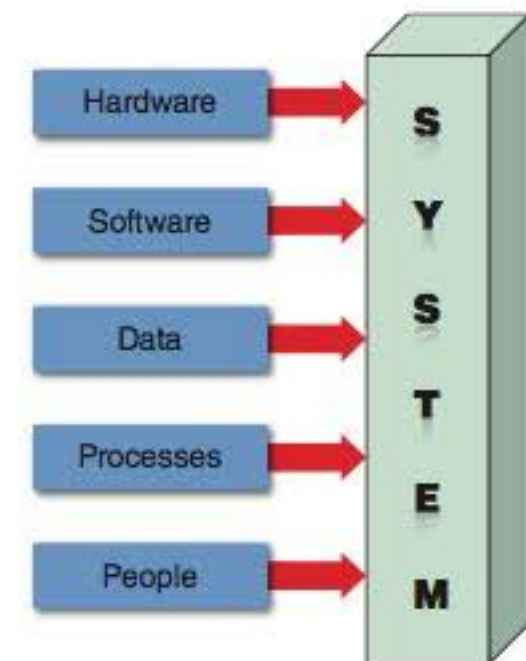


FIGURE 1-6 An information system needs these components.

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Software

Software refers to the programs that control the hardware and produce the desired information or results. Software consists of system software and application software.

System software manages the hardware components, which can include a single workstation or a global network with many thousands of clients. Either the hardware manufacturer supplies the system software or a company purchases it from a vendor. Examples of system software include the operating system, security software that protects the computer from intrusion, device drivers that communicate with hardware such as printers, and utility programs that handle specific tasks such as data backup and disk management. System software also controls the flow of data, provides data security, and manages network operations. In today's interconnected business world, network software is vitally important.

Application software consists of programs that support day-to-day business functions and provide users with the information they need. Examples of company-wide applications, called **enterprise applications**, include order processing systems, payroll systems, and company communications networks. On a smaller scale, individual users can boost productivity with tools such as spreadsheets, presentation software, and database management systems.

Application software includes horizontal and vertical systems. A **horizontal system** is a system, such as an inventory or payroll application, that can be adapted for use in many different types of companies. A **vertical system** is designed to meet the unique requirements of a specific business or industry, such as a Web-based retailer, a medical practice, or an auto dealership.

Most companies use a mix of software that is acquired at various times. When planning an information system, a company must consider how a new system will interface with older systems, which are called **legacy systems**. For example, a new human resources system might need to exchange data with an legacy payroll application.

Data

Data is the raw material that an information system transforms into useful information. An information system can store data in various locations, called tables. By linking the tables, the system can display the specific information that the user needs — no more, and no less.



FIGURE 1-7 Server farms provide the enormous power and speed that modern IT systems need.

© Joyful/Shutterstock

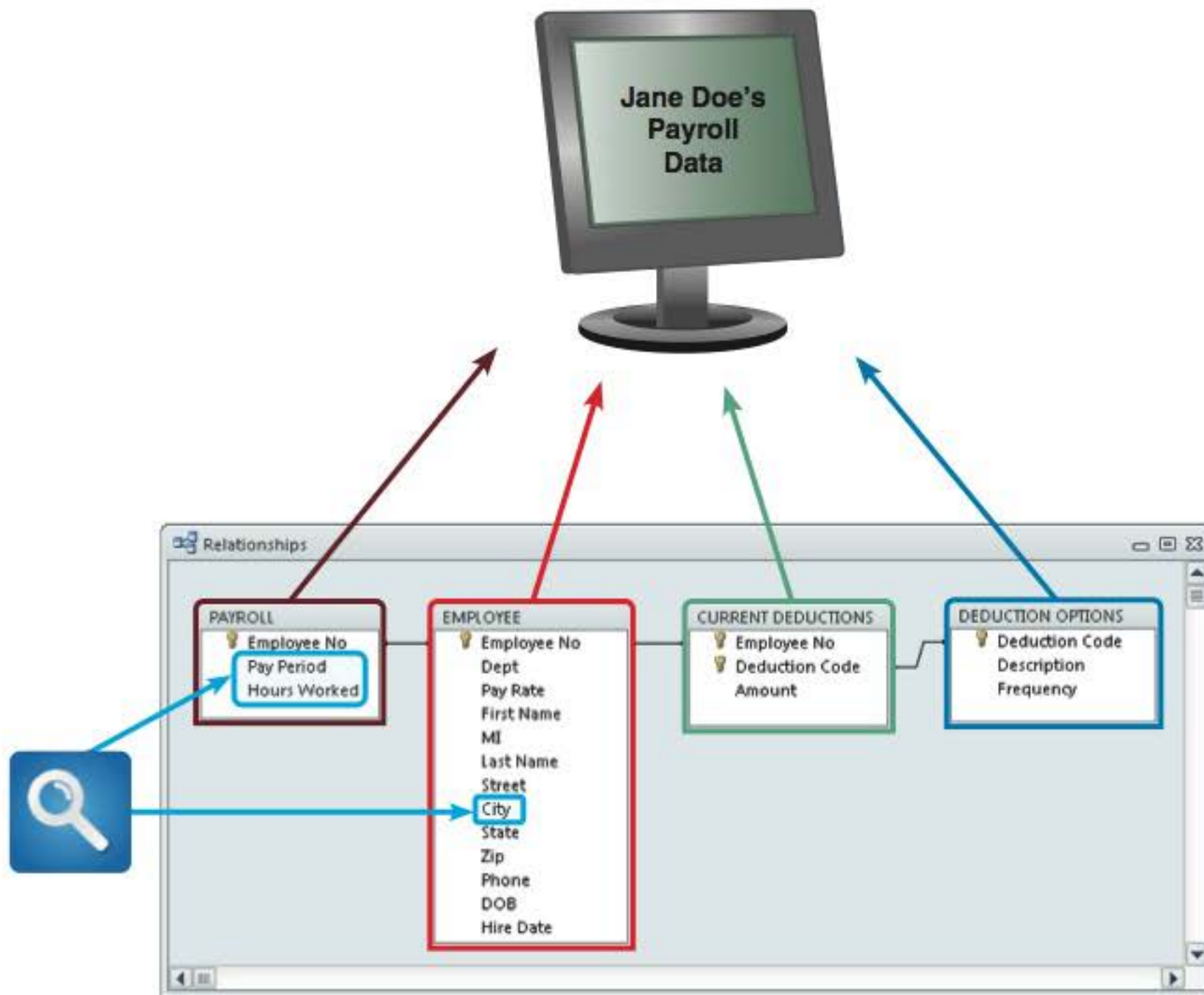


FIGURE 1-8 In a typical payroll system, data is stored in separate tables that are linked to form an overall database.

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Figure 1-8 shows a payroll system that stores data in four separate tables. Notice that the linked tables work together to supply 19 different data items to the screen. A user can display any or all data items, and filter the data to fit defined limits. In this example, the user requested a list of employees who live in a certain city and worked more than 40 hours in the last pay period. Jane Doe's name was the first to display.

Processes

Processes describe the tasks and business functions that users, managers, and IT staff members perform to achieve specific results. Processes are the building blocks of an information system because they represent actual day-to-day business operations. To build a successful information system, analysts must understand business processes and document them carefully.

People

People who have an interest in an information system are called **stakeholders**. Stakeholders include the management group responsible for the system, the **users** (sometimes called end users) inside and outside the company who will interact with the system, and IT staff members, such as systems analysts, programmers, and network administrators who develop and support the system.

Each stakeholder group has a vital interest in the information system, but most experienced IT professionals agree that the success or failure of a system usually depends on whether it meets the needs of its users. For that reason, it is essential to understand user requirements and expectations throughout the development process.

BUSINESS IN THE 21ST CENTURY

To design successful systems, systems analysts must understand a company's business operations. Each situation is different. For example, a retail store, a medical practice, and a hotel chain all have unique information systems requirements. As the business world changes, systems analysts can expect to work in new kinds of companies that will require innovative IT solutions.

Business in the 21st century will be shaped by three major trends: rapidly increasing globalization, technology integration for seamless information access, and the rapid growth of cloud-based computing and services. All these trends will be Internet-centric, and driven by the immense power of the Web.

The Internet Model

Internet-based commerce is called **e-commerce** (**electronic commerce**) or **I-commerce** (**Internet commerce**). Internet-based systems involve various hardware and software designs, but a typical model is a series of Web pages that provides a user interface, which communicates with database management software and a Web-based data server. As Internet-based commerce continues to grow, career opportunities will expand significantly for IT professionals such as Web designers, database developers, and systems analysts.

E-commerce includes two main sectors: **B2C** (**business-to-consumer**) and **B2B** (**business-to-business**). Within these broad categories, competition is dynamic, extreme, and global. Every day brings new ideas, new players, and new ways to involve customers, suppliers, and hordes of social network participants. The following sections discuss this rapidly changing environment.

B2C (Business-to-Consumer)

Using the Internet, consumers can go online to purchase an enormous variety of products and services. This new shopping environment allows customers to do research, compare prices and features, check availability, arrange delivery, and choose payment methods in a single convenient session. Many companies, such as airlines, offer incentives for online transactions because Web-based processing costs are lower than traditional methods. By making flight information available online to last-minute travelers, some airlines also offer special discounts on seats that might otherwise go unfilled.

B2C commerce is changing traditional business models and creating new ones. For example, a common business model is a retail store that sells a product to a customer. To carry out that same transaction on the Internet, the company must develop an online store and deal with a totally different set of marketing, advertising, and profitability issues.

Some companies have found new ways to use established business models. For example, eBay.com has transformed a traditional auction concept into a popular and successful method of selling goods and services. Other retailers seek to enhance the online shopping experience by offering gift advisors, buying guides, how-to clinics, and similar features. In the e-commerce battles, the real winners are online consumers, who have more information, better choices, and the convenience of shopping at home.

B2B (Business-to-Business)

Although the business-to-consumer (B2C) sector is more familiar to retail customers, the volume of business-to-business (B2B) transactions is many times greater. Industry observers predict that B2B sales will increase sharply as more firms seek to improve efficiency and reduce costs.

Initially, electronic commerce between two companies used a data sharing arrangement called **electronic data interchange (EDI)**. EDI enabled computer-to-computer data transfer, usually over private telecommunications lines. Firms used EDI to plan production, adjust inventory levels, or stock up on raw materials using data from another company's information system. As B2B volume soared, company-to-company transactions migrated to the Internet, which offered standard protocols, universal availability, and low communication costs. The main advantage of the Web is that it offers seamless communication between different hardware and software environments, anywhere and anytime.

Because it allows companies to reach the global marketplace, B2B is especially important to smaller suppliers and customers who need instant information about prices and availability. In an approach that resembles an open marketplace, some B2B sites invite buyers, sellers, distributors, and manufacturers to offer products, submit specifications, and transact business.

Most large firms and government agencies use **supply chain management (SCM)** software. A **supply chain** refers to all the companies who provide materials, services, and functions needed to provide a product to a customer. For example, a Sherwin-Williams customer who buys a gallon of paint is at the end of a chain that includes the raw material sources, packaging suppliers, manufacturers, transporters, ware-

houses, and retail stores. Because SCM is complex and dynamic, specialized software helps businesses manage inventory levels, costs, alternate suppliers, and much more. Figure 1-9 shows a valuable overview of SCM issues that can be downloaded free from SAP, a world leader in corporate software solutions.

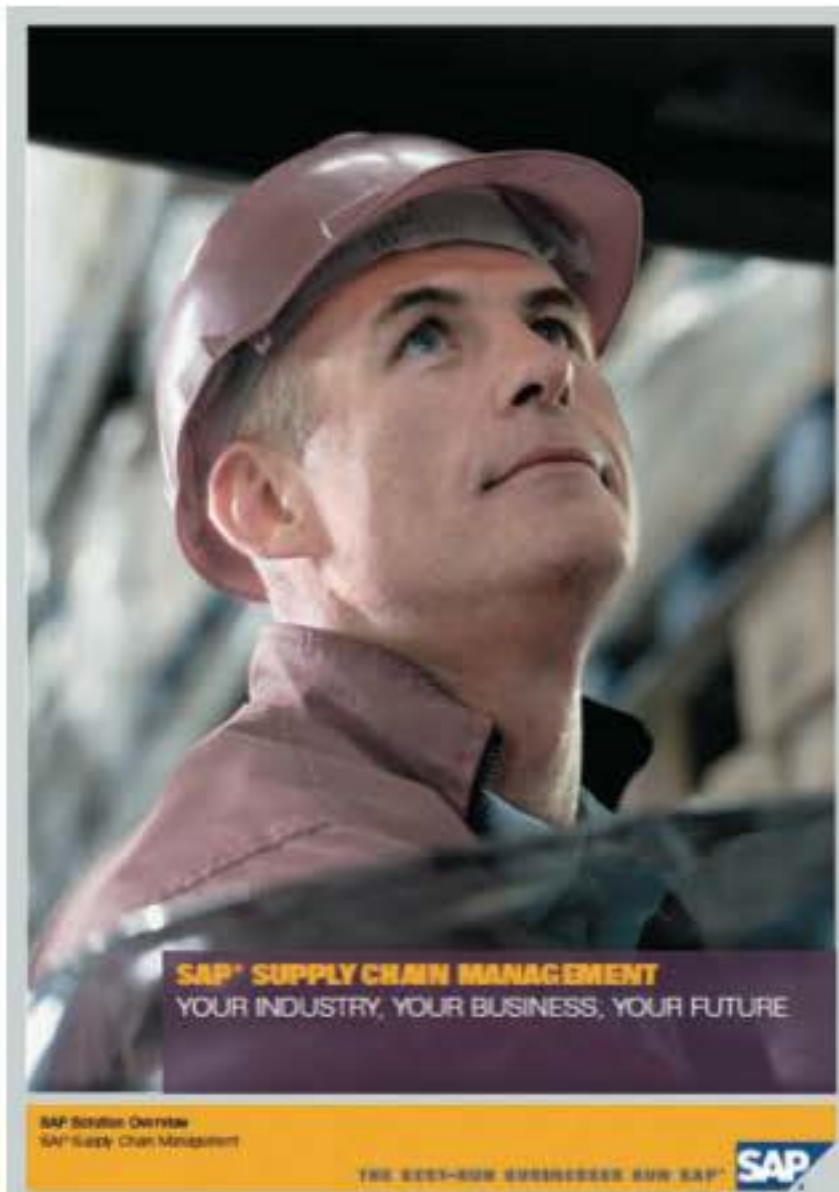


FIGURE 1-9 This free publication offers a valuable overview of SCM issues. You can download it at SAP's Web site.

© 2008 by SAP AG

What's Next?

Traditionally, IT companies were identified as product-oriented or service-oriented. **Product-oriented** firms manufactured computers, routers, or microchips, while **service-oriented** companies included consultants, vendors, software developers, and service providers.

Today, those distinctions are gone. Most successful IT companies offer a mix of products, services, and support. Value-added services such as consulting, software, and technical support often are more profitable than hardware sales. In a striking example of this trend, IBM's 2011 annual report notes that software and services produced more than 80 percent of pre-tax income. Figure 1-10 shows the contrast: Over an 11-year period, hardware and financing profit remained flat, while software and services income more than tripled!

These days, with rising fuel prices and an eye on expenses, shopping at home is more popular than ever. The strongest players in this market are called Internet-dependent firms, because their primary business depends

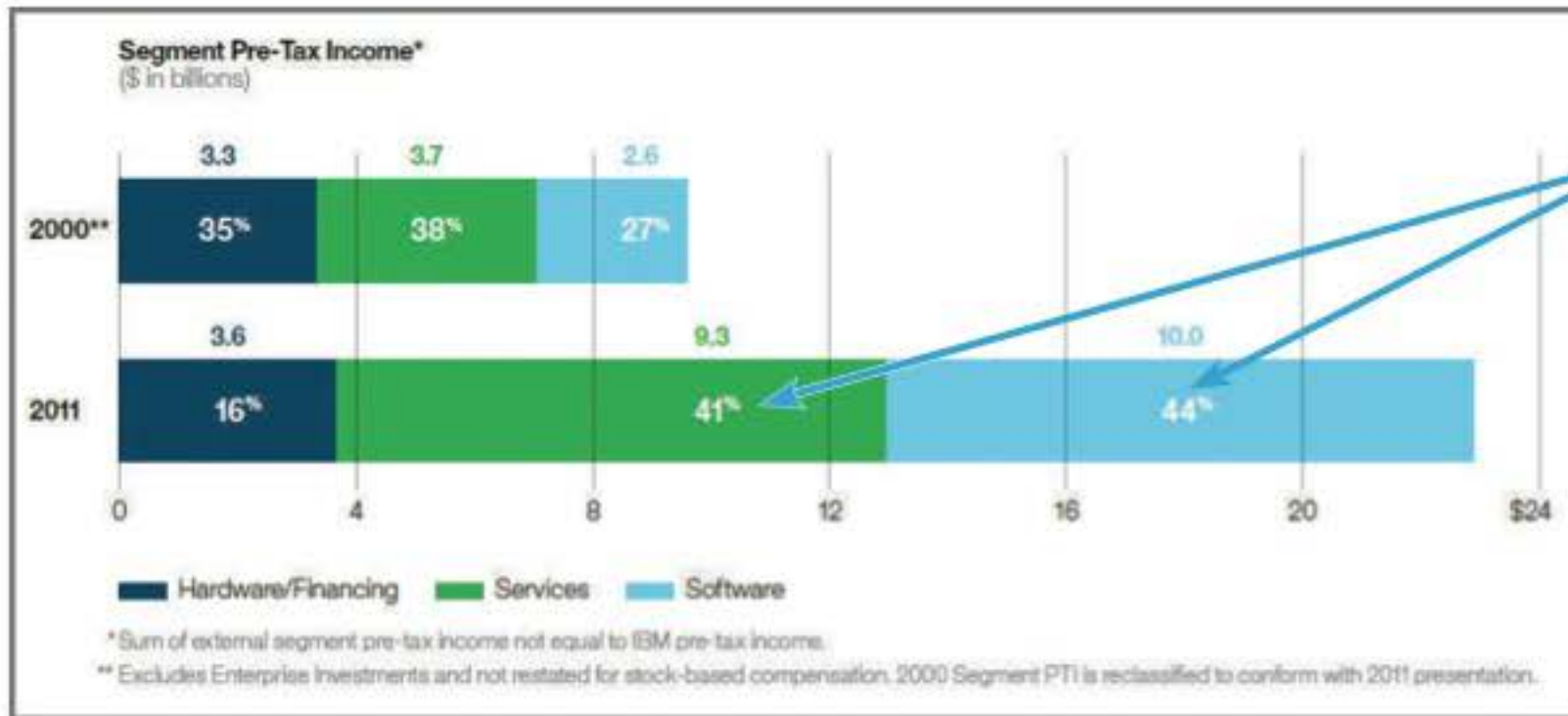


FIGURE I-10 IBM's 2011 report shows a dramatic increase in key business segments such as software and services, compared to slow-growth profits from hardware sales and financing.

© IBM Corporation 1994, 2012.

on the Internet rather than a traditional business channel. At the other end of the scale are traditional businesses, sometimes called brick-and-mortar companies because they conduct business primarily from physical locations. Although they have stores where customers can see and touch the products, most successful brick-and-mortar firms — such as Lowe's, Costco, Target, and Wal-Mart — have expanded their Web-based marketing channels to increase sales and serve customers better. This strategy combines the convenience of online shopping *and* the alternative of hands-on purchasing for those who prefer that option. Figure 1-11 shows several shopping and pickup options that Wal-Mart offers, so customers can choose the method they prefer.



FIGURE I-11 Wal-Mart enhances a customer's online experience by offering several shopping and pickup options, so customers can choose the method they prefer.

© 2012 Wal-Mart Stores, Inc.

In addition to physical products, consumers also buy a huge amount of digital content. Firms such as Apple, Amazon, Kindle, Netflix, and many others are fighting for a share of this rapidly growing market. Digital delivery is fast, convenient, and can be consumed on everything from mobile phones to large wall-mounted TVs.

The Web makes it possible for businesses to operate 100% online, as virtual companies. Although we take this for granted today, giant companies such as Amazon and eBay could not have existed without the Internet. The Web-based business model also leveled the playing field for small firms, so that micro-businesses can reach out to a global marketplace.

Just as eBay revived the auction model, the discount coupon business is another example of a traditional marketing method that has taken on new life. One of the best examples is a firm called Groupon, which claims to find daily deals in more than 48 countries. If it knows where you are, Groupon will display local offers and bargains, such as the Boston-based ads shown in Figure 1-12.

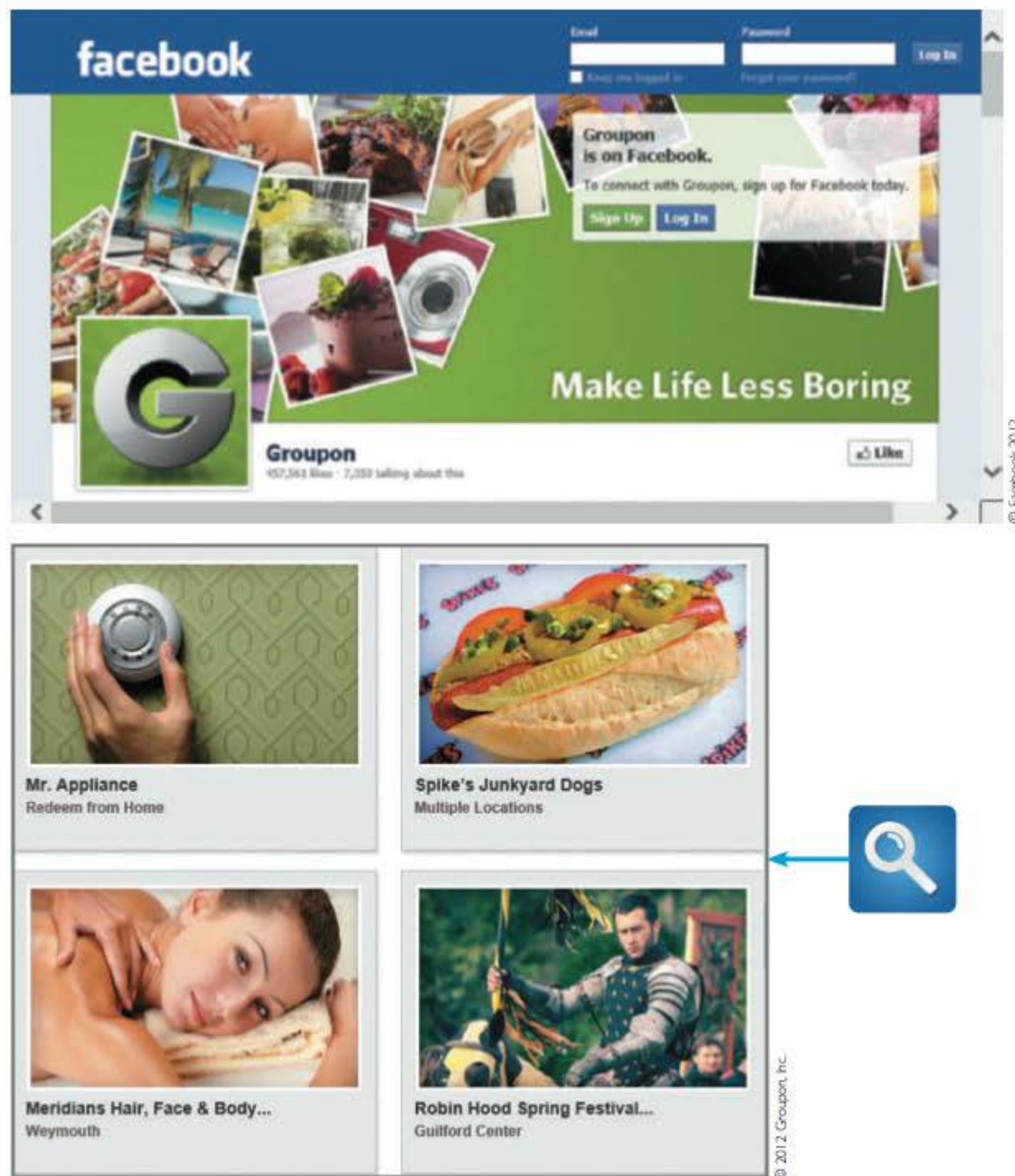


FIGURE I-12 This Groupon ad showcases local offers and bargains in the Boston area.

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