Systems Analysis and Design

TENTH EDITION

Kenneth E. Kendall • Julie E. Kendall

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SYSTEMS ANALYSIS AND DESIGN

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SYSTEMS ANALYSIS AND DESIGN

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To the memory of Julia A. Kendall and Edward J. Kendall,
whose lifelong example of working
together will inspire us forever.

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PREFACE

NEW TO THIS EDITION

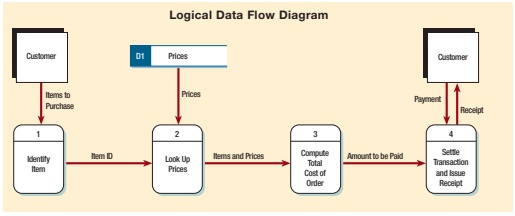
The tenth edition of *Systems Analysis and Design* includes extensive changes inspired by the rapid changes in the IS field over the past four years, and they are included as a response to the thoughtful input of our audience of adopters, students, and academic reviewers. Many new and advanced features are integrated throughout this new edition. In particular:

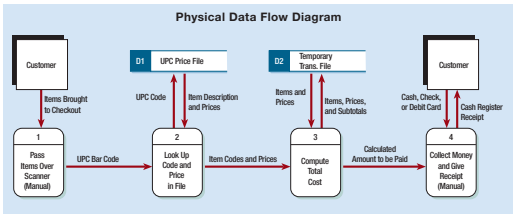
- Innovative material on using responsive design to enable systems analysts and organizations to participate in open source communities (Chapter 1)
- New coverage of the importance of security considerations right from the outset of a systems project (Chapter 1)
- New material on work-sanctioned social media sites to create productive systems development subcultures and collaborative design (Chapter 2)
- Additional material on cloud computing as a platform choice for a systems development project (Chapter 3)
- Innovative material on listening to user stories to complement other interactive information gathering methods (Chapter 4)
- New material on text analytics software to examine unstructured, soft data from customers' blogs, wikis, and social media sites to interpret qualitative material (Chapter 5)
- New and expanded content on agile methods including Scrum, Scrum planning poker, the product backlog, sprint cycle, and burndown charts (Chapter 6)
- New coverage on Kanban systems as they apply to software development (Chapter 6)
- Innovative coverage of DevOps as a cultural shift in the way to organize rapid systems development and operations (Chapter 6)
- Additional material on designing dashboards for decision makers using infographics (Chapter 11)
- New material on responsive Web design for websites that can be viewed on any device (Chapter 11)
- New material comparing and contrasting skeuomorphic design with flat design for websites (Chapter 11)
- Additional material on innovative guidelines for designing for social media (Chapter 11)
- New content on website design including use of navigational elements such as a hamburger icon and breadcrumb trail (Chapter 12)
- New material on the relationship of business intelligence to data warehouses, big data, and data analytics (Chapter 13)
- Additional coverage on database security and risk tradeoffs in securing databases (Chapter 13)
- Innovative material on developing and using blockchains to provide a verifiable electronic record for tracking any kind of business asset (Chapter 13)
- New content on UX design (user experience design) for developing customer-centered ecommerce website experiences (Chapter 14)
- Innovative coverage of designing virtual reality, augmented reality, and intelligent personal assistants (Chapter 14)
- Additional content on using QR codes for improved data entry (Chapter 15)
- Additional material on designing improved cloud security, privacy, and stability, especially for business continuity and disaster recovery (Chapter 16)

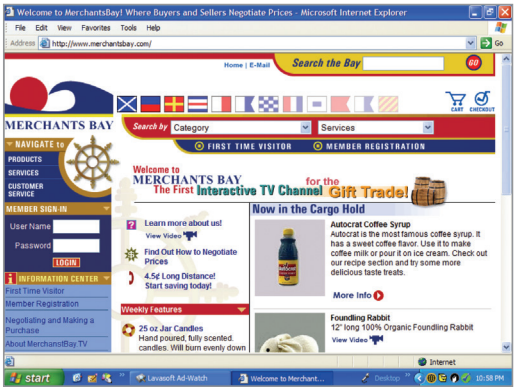
DESIGN FEATURES

Figures have a stylized look to help students more easily grasp the subject matter.

Conceptual diagrams are used to introduce the many tools that systems analysts have at their disposal. This example shows the differences between logical data flow diagrams and physical data flow diagrams. Conceptual diagrams are color coded so students can easily distinguish among them, and their functions are clearly indicated. Many other important tools are illustrated, including use case diagrams, sequence diagrams, and class diagrams.







Computer displays demonstrate important software features that are useful to the analyst. In this edition we introduce UX (user experience) design. Screens are of the utmost importance when we put the user experience first. Actual screen shots show important aspects of design. Analysts are continuously seeking to improve the appearance of the screens and web pages they design. Colorful examples help to illustrate why some screen designs are particularly effective.

Paper forms are used throughout to show how to capture user stories, as well as for input and output design and the design of questionnaires. Blue ink is always used to show writing or data input, thereby making it easier to identify what was filled in by hand. Although most organizations have computerization of manual processes as their goal, much data capture is still done using hand-written paper forms. Improved form design enables analysts to ensure accurate and complete input and output. Better forms also streamline new internal workflows that result from newly automated business-to-consumer (B2C) applications for ecommerce on the Web.

Need or Opportunity:	Apply shortcut methods for faster checkout.					
Story:	If the identity of the customer is known and the delivery address matches, speed up the transaction by accepting the credit card on file and the rest of the customer's preferences such as shipping method.					
		Well Below	**Below Average**	**Average**	**Above Average**	**Well Above**
Activities:	**Coding**			✓		
	Testing			✓		
	Listening			✓		
	Designing				✓	
Resources:	**Time**				✓	
	Cost		✓			
	Quality				✓	
	Scope			✓		

Tables are used when an important list needs special attention or when information needs to be organized or classified. In addition, tables supplement the understanding of the reader in a way that departs from how material is organized in the narrative portion of the book. Most analysts find tables a useful way to organize numbers and text into a meaningful "snapshot."

Activity	Detailed Activity	Weeks Required
Data gathering	Conduct interviews	3
	Administer questionnaires	4
	Read company reports	4
	Introduce prototype	5
	Observe reactions to prototype	3
Data flow and decision analysis	Analyze data flow	8
Proposal preparation	Perform cost-benefit analysis	3
	Prepare proposal	2
	Present proposal	2

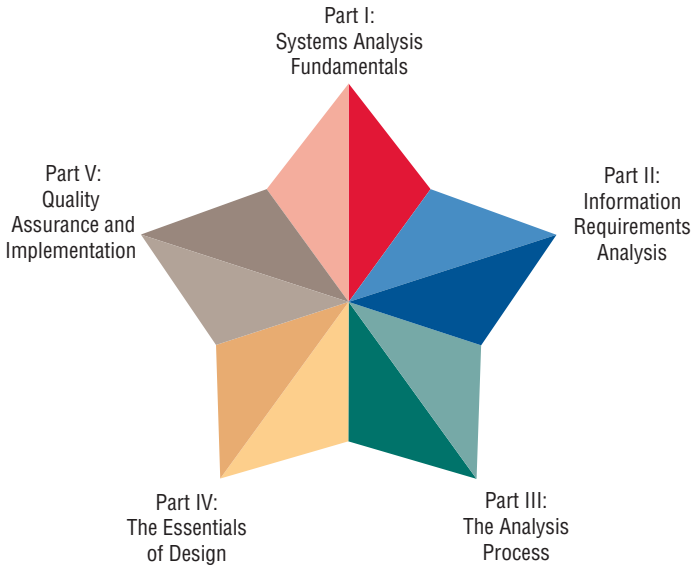
Break these down further,

then estimate time required.

This example of a table from Chapter 3 shows how analysts can refine their activity plans for analysis by breaking them down into smaller tasks and then estimating how much time it will take to complete them. This book is built on the idea that systems analysis and design is a

process that integrates the use of many tools with the unique talents of the systems analyst to systematically improve business through the implementation or modification of computerized information systems. Systems analysts can grow in their work by taking on new IT challenges, whether they are posed by designing for multiple platforms, new types of users, or implementing cloud-based systems; and by keeping up to date in their profession through the application of new methods, software, and alternative tools.

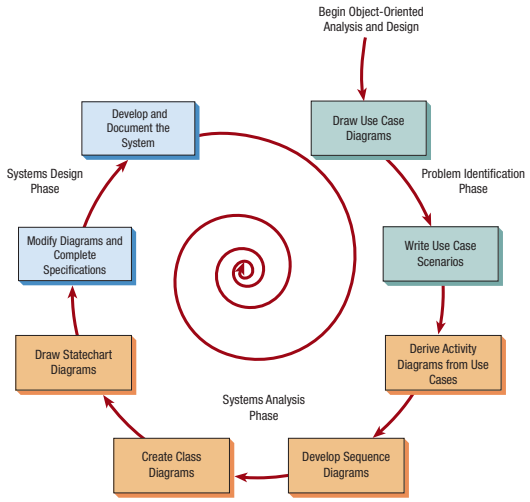
A BRIEF TOUR OF THE TENTH EDITION



Systems analysis and design is typically taught in one or two semesters. This book may be used in either situation. The text is appropriate for undergraduate (junior or senior) curricula at a four-year university, graduate school, or community college. The level and length of the course can be varied and supplemented by using real-world projects, HyperCase, the legacy CPU Case online, or other materials available at the Pearson Instructor Resources website.

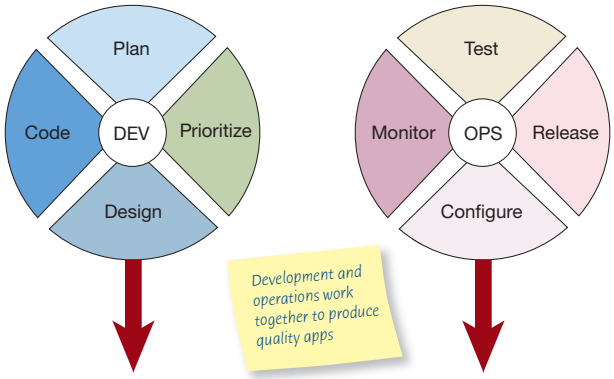
The text is divided into five major parts: Systems Analysis Fundamentals (Part I), Information Requirements Analysis (Part II), The Analysis Process (Part III), The Essentials of Design (Part IV), and Quality Assurance and Implementation (Part V).

Part I (Chapters 1–3) stresses the basics students need to know about what an analyst does and introduces the three main methodologies of the systems development life cycle (SDLC), agile approaches, and object-oriented analysis with universal modeling language (UML), along with reasons and situations for when to use them. Part I introduces the three roles of a systems analyst—consultant, supporting expert, and agent of change—along with ethical issues and professional guidelines for serving as a systems consultant. The importance of designing security into new systems from the beginning is noted. Material on virtual teams and virtual organizations, and the concept of human–computer interaction (HCI) is introduced as well. The use of open source software (OSS) and how analysts and organizations can participate in open source communities by using responsive design is introduced.

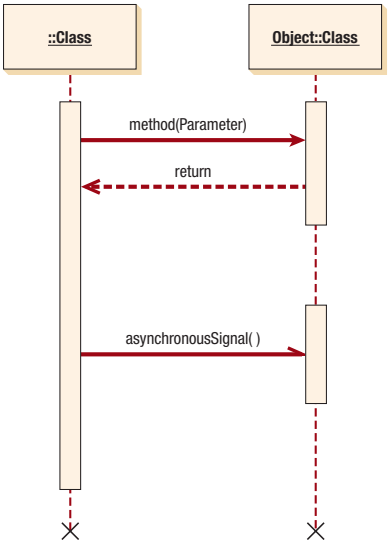


Chapter 2 includes how to initially approach an organization by drawing context-level data flow diagrams, using entity-relationship models, and developing use cases and use case scenarios. It views the organization as a system through the description of enterprise resource planning (ERP) systems. Also included is the importance of using employer-sanctioned social media to create a strong workplace culture. Chapter 3 focuses on project management. It introduces material on when to use cloud services versus purchasing hardware and software. Project management techniques including time estimation techniques for project management are discussed. Material in Chapter 3 will help students approach projects using the work breakdown structure (WBS). Creating a problem definition, developing a project charter, and determining feasibility are also covered. Chapter 3 guides students in writing and presenting a professional and effective systems proposal that incorporates figures and graphs to communicate with users.

Part II (Chapters 4–6) emphasizes the use of systematic and structured methodologies for performing information requirements analysis. Attention to analysis helps analysts ensure that they are addressing the correct problem before designing a system. Chapter 4 introduces a group of interactive methods, including interviewing, joint application design (JAD), and constructing questionnaires. It expands material on listening to user stories in order to understand organization behaviors and values. Chapter 5 introduces a group of unobtrusive methods for ascertaining information requirements of users. These methods include sampling, investigating hard and archival data, and observation of decision makers' behavior and their physical environment. New material on the use of text analytics software to examine unstructured data from blogs, wikis, interviews, and social media sites is added. Chapter 6 on agile modeling and prototyping is innovative in its treatment of prototyping as another data-gathering technique that enables the analyst to solve the right problem by getting users involved from the start. Agile approaches have their roots in prototyping, and this chapter begins with prototyping to provide a proper context for understanding, and then takes up the agile approach. The values and principles, activities, resources, practices, processes, and tools associated with agile methodologies are presented. New and expanded coverage of agile methods including Scrum, Scum planning poker, the product backlog, sprint cycle, and burndown charts are included. Kanban systems as they apply to software development are introduced, and innovative coverage of DevOps as a cultural shift in the way to organize rapid systems development and operations is covered.

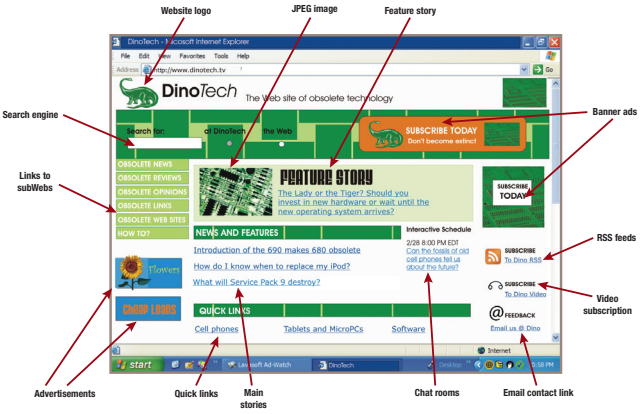


Part III (Chapters 7–10) details the analysis process. It builds on the previous two parts to move students into analysis of data flows as well as structured and semistructured decisions. It provides step-by-step details on how to use structured techniques to draw data flow diagrams (DFDs). Chapter 7 provides coverage of how to create child diagrams; how to develop both logical and physical data flow diagrams; and how to partition data flow diagrams. Chapter 8 features material on the data repository and vertical balancing of data flow diagrams. Chapter 8 also includes extensive coverage of extensible markup language (XML) and demonstrates how to use data dictionaries to create XML. Chapter 9 includes material on developing process specifications. A discussion of both logical and physical process specifications



shows how to use process specifications for horizontal balancing. Chapter 9 also covers how to diagram structured decisions with the use of structured English, decision tables, and decision trees. In addition, the chapter covers how to choose an appropriate decision analysis method for analyzing structured decisions and creating process specifications.

Part III concludes with Chapter 10 on object-oriented systems analysis and design. This chapter includes an in-depth section on using unified modeling language (UML). There is detailed coverage of the use case model, creating the class model diagram with UML, sequence diagrams, creating gen/spec diagrams, use case scenarios, and activity diagrams. Through several examples and Consulting Opportunities, this chapter demonstrates how to use an object-oriented approach. Consulting Opportunities, diagrams, and problems enable students to learn and use UML to model systems from an object-oriented perspective. Students learn the appropriate situations for using an object-oriented approach. This chapter helps students to decide whether to use the SDLC, the agile approach, or object-oriented systems analysis and design to develop a system.



Part IV (Chapters 11–14) covers the essentials of design. It begins with designing output because many practitioners believe systems to be output driven. The design of Web-based forms is covered in detail. Particular attention is paid to relating output method to content, the effect of output on users, and designing good forms and screens. Chapter 11 considers output, including Web displays, audio, and electronic output such as web pages, email, and RSS feeds. Designing a website for ecommerce purposes is emphasized, and the importance of adding Web 2.0 technologies and social media to corporate and ecommerce websites is explored. Additional material on designing dashboards using infographics is provided. New material on responsive Web design is included. Flat versus skeuomorphic design is covered, as are innovative guidelines for designing for social media. Designing apps for smartphones and tablets is integrated, along with storyboarding, wireframing, and mockups. Output production and XML are covered.

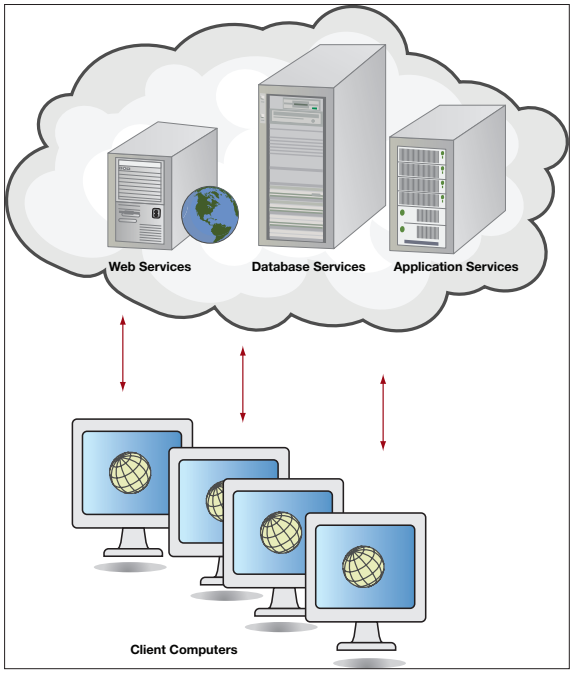
Chapter 12 includes innovative material on designing for smartphones and tablets as well as designing Web-based input forms and other electronic forms design. Also included is computer-assisted forms design. Chapter 12 also features in-depth coverage of website design, new content on how to add navigational elements to websites such as a hamburger menus and breadcrumb trails, and includes guidelines on when designers should add video, audio, and animation to website designs. There is detailed consideration of how to create effective graphics for corporate websites and ways to design effective onscreen navigation for website users.

Coverage of intranet and extranet page design is included. Consideration of database integrity constraints and how the user interacts with the computer and how to design an appropriate interface are discussed. The importance of user feedback is also found in Part IV. How to design accurate data entry procedures that take full advantage of computer and human capabilities to assure entry of quality data is emphasized here.

Chapter 13 demonstrates how to use an entity-relationship diagram to determine record keys and provides guidelines for file/database relation design. Students are shown the relevance of database design for the overall usefulness of the system, and how users actually use databases. New material on the relationship between business intelligence (BI) and data warehouses, big data, and data analytics software is added in the context of data warehouses. Additional material on database security and risk tradeoffs in securing databases is added. Innovative material on developing and using blockchains to provide a verifiable electronic record for tracking any kind of business asset is included.

Chapter 14 emphasizes human–computer interaction (HCI), especially as it relates to interface design, as well as UX design. It discusses the importance of HCI in designing systems that suit individuals and assisting them in achieving personal and organization goals through their use of information technology. The concept of usability is introduced, so that systems analysis students can knowledgeably incorporate HCI practices in their designs. Chapter 14 introduces material on how to design gesture-based (multitouch) interfaces for smartphones and tablets, as well as designing alerts, notices, and queries. Material on designing easy onscreen navigation for website visitors is included. The chapter presents innovative approaches to searching on the Web, highlights material on graphic user interface (GUI) design, and provides innovative approaches to designing dialogues. Chapter 14 articulates specialized design considerations for ecommerce websites. New material on UX design (user experience design) for developing customer-centered ecommerce websites is included. Mashups, new applications created by combining two or more Web-based application programming interfaces, are also covered. Innovative material on designing virtual reality (VR), augmented reality (AR), and intelligent personal assistants is included. Chapter 14 includes extensive coverage on how to formulate queries, all within the framework of HCI.

Part V (Chapters 15 and 16) concludes the book. Chapter 15 focuses on designing accurate data entry procedures and includes material on managing the supply chain through the effective design of business-to-business (B2B) ecommerce. It includes suggestions for incorporating two-dimensional codes QR codes and bar codes into data entry designs. It also considers the usefulness of RFID for automatic data collection. Chapter 16 emphasizes taking a total quality approach to improving software design and maintenance. In addition, material on system security and firewalls is included. Testing, auditing, and maintenance of systems are discussed in the context of total quality management. This chapter helps students understand how service-oriented architecture (SOA) and cloud computing combined with ERP are significantly altering the landscape of information systems design. In addition, students learn how to design appropriate training programs for users of the new system, how to recognize the differences among physical conversion strategies, and how to be able to recommend an appropriate one to a client. Chapter 16 also presents techniques for modeling networks, which can be done with popular tools such as Microsoft Visio.



Material on security and privacy in relation to designing ecommerce applications is included. Coverage includes security for firewalls, gateways, public key infrastructure (PKI), secure electronic transaction (SET), secure sockets layer (SSL), virus protection software, URL filtering products, email filtering products, and virtual private networks (VPN) is included. Additional coverage on designing improved cloud security, privacy, and stability, especially for business continuity and disaster recovery, is included.

Important coverage of how the analyst can promote and monitor a corporate website is included in this section, which features Web activity monitoring, website promotion, Web traffic analysis, and audience profiling to ensure the effectiveness of new ecommerce systems. Techniques for evaluating the completed information systems project are covered systematically as well.

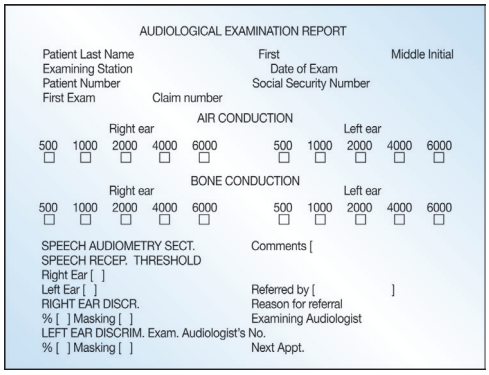
This tenth edition contains an updated **Glossary** of terms and a separate list of updated **Acronyms** used in the book and in the systems analysis and design field.

PEDAGOGICAL FEATURES

Chapters in this tenth edition contain:

- **Learning Objectives** at the beginning of each chapter
- **Summaries** at the end of each chapter that tie together the salient points of the chapter and provide an excellent source of review for exams
- **Keywords and Phrases** for each chapter
- **Review Questions** to help with learning key definitions and terms
- **Problems** that help students apply and extend the concepts and tools they are learning to practical situations
- **Group Projects** that help students work together in a systems team to solve important problems that are best solved through group interaction
- **Consulting Opportunities** now with more than 50 minicases throughout the book
- **Mac Appeal** columns that inform students about design software available on the Mac and iPhone
- **HyperCase Experiences** in each chapter simulate organizational experience and focus learning from HyperCase online

CONSULTING OPPORTUNITIES


AUDIOLOGICAL EXAMINATION REPORT

Patient Last Name First Middle Initial
Examining Station Date of Exam
Patient Number Social Security Number
First Exam Claim number

AIR CONDUCTION

	Right ear					Left ear				
500	1000	2000	4000	6000	500	1000	2000	4000	6000
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

BONE CONDUCTION

	Right ear					Left ear				
500	1000	2000	4000	6000	500	1000	2000	4000	6000
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

SPEECH AUDIOMETRY SECT. Comments [
SPEECH RECEP. THRESHOLD
Right Ear [ ]
Left Ear [ ] Referred by [ ]
RIGHT EAR DISCR. Reason for referral
% [ ] Masking [ ] Examining Audiologist
LEFT EAR DISCRIM. Exam. Audiologist's No.
% [ ] Masking [ ] Next Appt.

This tenth edition presents more than 50 Consulting Opportunities, addressing significant and emerging topics arising in information systems, including designing systems from an HCI perspective, ecommerce applications for the Web, cloud computing decisions, and using UML to model information systems from an object-oriented perspective. Consulting Opportunities can be used for motivating thoughtful in-class discussions or assigned as homework or take-home exam questions.

Not all systems work demands extended two- or three-year projects, so many Consulting Opportunities included can be solved in 20 to 30 minutes of group discussion, group writing, or individual writing. These minicases, written in a humorous manner to enliven the material, require students to synthesize what they have learned up to that point in the course, ask students to mature in their professional and ethical judgment, and expect students to articulate the reasoning that led to their systems decisions.

HYPERCASE EXPERIENCES

HYPERCASE® EXPERIENCE 3.2

"Sometimes the people who have been here for some time are surprised at how much we have actually grown. Yes, I do admit that it isn't easy to keep track of what each person is up to or even what purchases each department has made in the way of hardware and software. We're working on it, though. Mr. Evans would like to see more accountability for computer purchases. He wants to make sure we know what we have, where it is, why we have it, who's using it, and if it's boosting MRE productivity, or, as he so delicately puts it, 'to see whether it's just an expensive toy' that we can live without."

HYPERCASE Questions

1. Complete a computer equipment inventory for the Training and Management Systems Department, describing all the systems you find. *Hint:* Create an inventory form to simplify your task.
2. Using the software evaluation guidelines given in the chapter, do a brief evaluation of GEMS, a software package used by the Training and Management Systems Department employees. In a paragraph, briefly critique this custom software by comparing it with COTS software such as Microsoft Project.
3. List the intangible costs and benefits of GEMS, as reported by employees of MRE.
4. Briefly describe the two alternatives Mr. Evans is considering for the proposed project tracking and reporting system.
5. What organizational and political factors should Mr. Evans consider in proposing his new system at MRE? (In a brief paragraph, discuss three central conflicts.)

Reception Area - Mozilla Firefox

MRE

EXIT

FIGURE 3.HC1

The reception room resembles a typical corporation. While you are in this HyperCase screen, click on the small red directory if you want to visit an MRE employee.

HyperCase Experiences that pose challenging student exercises are present in each chapter. HyperCase 2.10 has organization problems featuring information systems technology. HyperCase represents an original virtual organization that allows students who access it to become immediately immersed in organization life. Students will interview people, observe office environments, analyze their prototypes, and review the documentation of their existing systems.

HyperCase 2.10 is Web-based, interactive software that presents an organization called Maple Ridge Engineering (MRE) in a colorful, three-dimensional graphics environment. HyperCase permits professors to begin approaching a systems analysis and design class with exciting multimedia

material. Carefully watching their use of time and managing multiple methods, students use the hypertext characteristics of HyperCase on the Web to create their own individual paths through the organization.

Maple Ridge Engineering is drawn from the actual consulting experiences of the authors of the original version (Raymond Barnes, Richard Baskerville, Julie E. Kendall, and Kenneth E. Kendall). Allen Schmidt joined the project for version 2.0 and has remained with it. Peter Schmidt was the HTML programmer, and Jason Reed created the images for the initial Web version.

Each chapter contains HyperCase Experiences that include assignments (and even some clues) to help students solve difficult organization problems including developing new systems, merging departments, hiring employees, security, ecommerce, and disaster recovery planning they encounter at MRE. HyperCase has been fully tested in classrooms and was an award winner in the Decision Sciences Institute Innovative Instruction competition.

EXPANDED WEB SUPPORT

Systems Analysis and Design, tenth edition, features Web-based support for solid but lively pedagogical techniques in the information systems field:

- The website, located at **www.pearsonglobaleditions.com**, contains a wealth of critical learning and support tools, which keep class discussions exciting.
- **HyperCase 2.10** is an award-winning, interactive organization game. Students are encouraged to interview people in the organization, analyze problems, drill down into and modify data flow diagrams and data dictionaries, react to prototypes, and design new input and output.
- **A legacy case, the Central Pacific University (CPU) case is online**. In keeping with our belief that a variety of approaches is important, the entire legacy Central Pacific University (CPU) case, accompanied by partially solved Student Exercises, is fully available online. The legacy CPU case makes use of Microsoft Access, Microsoft Visio, and the popular CASE tool Visible Analyst by Visible Systems, Inc., for the sample screen shots and the student exercises. The legacy CPU case takes students through all phases of the systems development life cycle.

EXPANDED INSTRUCTOR SUPPLEMENTAL WEB SUPPORT

Extended support for instructors using this edition can be found at the official website located at **www.pearsonglobaleditions.com**. Resources include:

- **Instructor's Manual**—The Instructor's Manual contains answers to problems, solutions to cases, and suggestions for approaching the subject matter.
- **PowerPoint Presentations—**The PowerPoints feature lecture notes that highlight key text terms and concepts. Professors can customize the presentation by adding their own slides or by editing the existing ones.
- **TestGen Testbank File**—The TestGen Testbank file is an extensive set of multiple-choice, true/false, and essay-type questions for each chapter of the text. Questions are ranked according to difficulty level and referenced with page numbers from the text. The TestGen Testbank file is available in Microsoft Word format and as the computerized Prentice Hall TestGen software, with course management system conversions.