教育部高等教育司推荐
国外优秀信息科学与技术系列教学用书

系统分析与设计方法

（第五版　影印版）

SYSTEM ANALYSIS AND DESIGN METHODS

(Fifth Edition)

Jeffrey L. Whitten
Lonnie D. Bentley
Kevin C. Dittman

高等教育出版社
Higher Education Press
McGraw-Hill Companies

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图字：01-2001-1037 号

Systems Analysis and Design Methods, 5th ed.
Jeffrey L. Whitten, Lonnie D. Bentley & Kevin C. Dittman

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图书在版编目(CIP)数据

系统分析与设计方法：英文／（美）惠滕（Whitten,J.L.）—5 版．
—北京：高等教育出版社，2001
ISBN 7-04-010045-2

Ⅰ．系… Ⅱ．惠… Ⅲ．①系统分析－英文②系统设计－英文
Ⅳ．N945

中国版本图书馆 CIP 数据核字（2001）第 19857 号

系统分析与设计方法（第五版）
Jeffrey L. Whitten 等

出版发行	高等教育出版社		
社　　址	北京市东城区沙滩后街 55 号		
电　　话	010—64054588	**邮政编码**	100009
网　　址	http: //www.hep.edu.cn http: //www.hep.com.cn	**传　　真**	010—64014048
经　　销	新华书店北京发行所		
印　　刷	北京民族印刷厂		
开　　本	850 × 1168　1/16	**版　　次**	2001 年 5 月第 5 版
印　　张	46.75	**印　　次**	2001 年 5 月第 1 次印刷
字　　数	1 052 000	**定　　价**	43.00 元

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前　言

20 世纪末，以计算机和通信技术为代表的信息科学和技术，对世界的经济、军事、科技、教育、文化、卫生等方面的发展产生了深刻的影响，由此而兴起的信息产业已经成为世界经济发展的支柱。进入 21 世纪，各国为了加快本国的信息产业，加大了资金投入和政策扶持。

为了加快我国信息产业的进程，在我国《国民经济和社会发展第十个五年计划纲要》中，明确提出“以信息化带动工业化，发挥后发优势，实现社会生产力的跨越式发展。”信息产业的国际竞争将日趋激烈。在我国加入 WTO 后，我国信息产业将面临国外竞争对手的严峻挑战。竞争成败最终将取决于信息科学和技术人才的多少与优劣。

在 20 世纪末，我国信息产业虽然得到迅猛发展，但与国际先进国家相比，差距还很大。为了赶上并超过国际先进水平，我国必须加快信息技术人才的培养，特别要培养一大批具有国际竞争能力的高水平的信息技术人才，促进我国信息产业和国家信息化水平的全面提高。为此，教育部高等教育司根据教育部吕福源副部长的意见，在长期重视推动高等学校信息科学和技术的教学的基础上，将实施超前发展战略，采取一些重要举措，加快推动高等学校的信息科学和技术等相关专业的教学工作。在大力宣传、推荐我国专家编著的面向 21 世纪和“九五”重点的信息科学和技术课程教材的基础上，在有条件的高等学校的某些信息科学和技术课程中推动使用国外优秀教材的影印版进行英语或双语教学，以缩短我国在计算机教学上与国际先进水平的差距，同时也有助于强化我国大学生的英语水平。

为了达到上述目的，在分析一些出版社已影印相关教材，一些学校已试用影印教材进行教学的基础上，教育部高等教育司组织并委托高等教育出版社开展国外优秀信息科学和技术优秀教材及其教学辅助材料的引进研究与影印出版的试点工作。为推动用影印版教材进行教学创造条件。

本次引进的系列教材的影印出版工作，是在对我国高校的信息科学和技术专业的课程与美国高校的进行对比分析的基础上展开的；所影印出版的教材均由我国主要高校的信息科学和技术专家组成的专家组，从国外近两年出版的大量最新教材中精心筛选评审

通过的内容新、有影响的优秀教材；影印教材的定价原则上应与我国大学教材价格相当。

教育部高等教育司将此影印系列教材推荐给高等学校，希望有关教师选用，使用后有什么意见和建议请及时反馈。也希望有条件的出版社，根据影印教材的要求，积极参加此项工作，以便引进更多、更新、更好的外国教材和教学辅助材料。

同时，感谢国外有关出版公司对此项引进工作的配合，欢迎更多的国外公司关心并参与此项工作。

教育部高等教育司

二〇〇一年四月

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To my lovely wife Cheryl and my children Robert, Heath, and Coty. Also to Dorothy Miller, the best secretary in the world.
—*Lonnie*

To Dr. Don K. Gentry, Dean of the School of Technology at Purdue University. Thank you for your vision and leadership in sustaining our academic environment; one that values, respects, and rewards this type of scholarship.—*Jeff*

To my loving and caring wife Diana and my children Brandon, Bryan, Andrew, and Ashley. To my father Robert who taught me my set of values—to work hard and look for the best in people. And to Jeff and Lonnie—thanks for the opportunity.—*Kevin*

PREFACE

WHY WE WROTE THIS BOOK

More than ever, today's students are "consumer-oriented," due in part to the changing world economy that promotes quality, competition, and professional currency. They expect to walk away from a course with more than a grade and a promise that they'll someday appreciate what they've learned. They want to "practice" the application of concepts, not just study applications of concepts. As with the previous editions of this book, we wrote it to: (1) balance the coverage of concepts, tools, techniques, and their application, (2) provide the most examples of system analysis and design deliverables available in any book, and (3) balance the coverage of classical methods (such as *structured analysis* and *information engineering*) and emerging methods (e.g., *object-oriented analysis* and *rapid application development*). Additionally, we wrote the textbook to serve the reader as a post-course, professional reference for best current practices.

Consistent with the first four editions, we have written the book using a lively, conversational tone. Our experience suggests that the more traditional, academic tone detracts from student interest. The "talk with you—not at you" style seems to work well with a wider variety of students. We hope that our style does not offend or patronize any specific audience. We apologize if it does.

INTENDED AUDIENCE

Systems Analysis and Design Methods, fifth edition, is intended to support one or more practical courses in information systems development. These courses are normally taught at the sophomore, junior, senior, or graduate level. They are taught in vocational trade schools, junior colleges, colleges, and universities. The courses are taught to both information systems and business majors.

We recommend that students should have taken a computer- and information systems-literacy course. While **not** required or assumed, a programming course can significantly enhance the learning experience provided by this textbook.

ORGANIZATION

Systems Analysis and Design Methods, fifth edition, is divided into five parts. Past experience indicates that instructors can omit and resequence chapters as they feel is important to their audience. Every effort has been made to decouple chapters from one another as much as possible to assist in resequencing the material—even to the extent of reintroducing selected concepts and terminology.

Part One, The Context of Systems Analysis and Design, presents the information systems development scenario and process. The chapters introduce the student to systems analysts, other project team members (including users and management), information systems building blocks (based on the Zachman framework), a contemporary systems development life cycle, and project management. Part One can be covered relatively quickly. Some adopters may prefer to omit project management, or delay it until the end of the book.

Part Two, Systems Analysis Methods, covers the front-end life cycle activities, tools, and techniques for analyzing business problems, specifying business requirements for an information system, and proposing a business and system solution. Coverage includes requirements gathering, data modeling with entity-relationship diagrams, process modeling with data flow diagrams, requirements specification in a data dictionary, and solution identification and the system proposal.

Part Three, Systems Design Methods, covers the middle life cycle activities, tools, and techniques. It includes coverage of both general and detailed design with a particular emphasis on application architecture, rapid development and prototyping, external design (outputs, inputs, and interfaces), and internal design.

Part Four, Beyond Systems Analysis and Design, is a capstone unit that places systems analysis and design into perspective by surveying the

back-end life cycle activities. Specifically, chapters examine system implementation, support, maintenance, and reengineering.

Part Five, Advanced Analysis and Design Methods, teaches object-oriented analysis and design methods using the Unified Modeling Language. The two modules could be integrated into the analysis and design units respectively, omitted altogether, or introduced at the end of the course (or at the beginning of an advanced course).

CHANGES FOR THE FIFTH EDITION

In this edition, we continue to react to changes and expected changes in the information technology domain. Our industry faced many exciting problems including Year 2000 (Y2K) compatibility and the single European currency (called the *euro*). And there are even more opportunities as client/server computing meets the Internet, intranets, and extranets for electronic business and commerce applications. Finally, we see exciting systems analysis and design challenges with *Enterprise Resource Planning* (ERP) applications (such as *SAP*), systems integration, and business process redesign (BPR).

We believe that we have preserved the features adopters liked in the previous editions. And in the spirit of continuous improvement we have made the following changes:

- The information system development, systems analysis, systems design, and systems implementation chapters have been structurally simplified.
- At the request of adopters, the cross-life cycle modules (e.g., project management, interpersonal skills, fact finding and JAD, and feasibility analysis) have been updated and integrated into the mainstream chapters of the book.
- The use of automated tools (such as CASE and RAD) for systems analysis, design, and construction is once again reinforced throughout the book. Some of the tools demonstrated in the fifth edition include *Visio Professional, System Architect 2001, Project 2000,* and *Visual Basic.*
- The fifth edition continues the pedagogical use of full-color applied to an adaptation of Zachman's *Framework for Information Systems Architecture*. The Information Systems Architecture matrix uses these colors to introduce recurring concepts. System models then reinforce those concepts with a consistent use of the same colors.
- The *matrix* framework based on Zachman's *Framework for Information Systems Architecture* continues to organize the subject's conceptual foundations. The fifth edition framework has been updated (and simplified!) to reflect contemporary technologies and methods. The framework has been visually integrated into both the textbook's system development methodology and the beginning of every chapter as a chapter map, showing which aspects of the framework are relevant to that chapter.
- The SoundStage Entertainment Club chapter-opening case study has been enhanced and updated to reflect the advent of Web-centric applications of the Internet, intranets, and extranets.

Specific chapter and module enhancements include:

- Chapter 1, the *modern systems analyst*, has been renamed to **players in the systems game** to reflect a new emphasis on systems analysis and design as a "team sport." Consistent with the textbook's title and subject, the **systems analyst** is still emphasized; however, the framework is introduced to help students better appreciate the roles of the management, user, and technical communities.
- The revamped matrix framework that will be used to organize the rest of the text is introduced in Chapter 2.
- The impact of contemporary techniques (such as **model-driven development, rapid application development,** and **commercial off-the-shelf software integration**) and automated tools (such as **CASE** and **ADEs**) is introduced in the **information systems development** chapter (Chapter 3).
- Immediately after the information systems development chapter, **project management** is introduced in Chapter 4. This chapter has been significantly updated to focus on the activities of project management while retaining (and improving) the demonstration of Microsoft *Project*. The Capability Maturity Model (CMM) drives our coverage of project management.
- The **systems analysis** chapter (Chapter 5) includes new material on the subject of **business process analysis and redesign.** All information systems must be integrated into the business processes of an organization. This is especially true when software applications are procured instead of being built in-house.
- The former fact-finding techniques and joint application development modules have been merged into a single **requirements discovery** chapter (Chapter 6) that is now part of the systems analysis unit.
- Based on encouragement from several adopters, we returned

normalization to the **data modeling** chapter (Chapter 7).

- By popular demand, we provide a complete set of leveled data flow diagrams in the **process modeling** chapter (Chapter 8) (perceived as a strength in the first three editions). Coverage of the bottom-up (Yourdon *modern structured analysis*) approach is clarified from the fourth edition.
- The *network modeling* chapter was deleted since its modeling paradigm has not come into mainstream practice; however, **distribution analysis** coverage has been fully integrated into the data and process modeling material, Chapters 7 and 8.
- The analysis-to-design transition coverage is improved by combining **feasibility analysis** (formerly a module) with coverage of preparing a physical/technical **system proposal** in Chapter 9.
- The **systems design** overview chapter (Chapter 10) offers improved coverage of **commercial off-the-shelf software (COTS)** as an alternative to designing and developing an in-house solution. This "route" introduces issues of both procurement and system integration. This changes the rules of engagement for system design.
- The **application architecture** chapter (Chapter 11) has been updated to reflect the latest in client/server, Web, and other information technologies applicable to information systems. Physical data flow diagrams are used throughout the chapter to demonstrate modern architectures.
- The database design chapter (Chapter 12) has been simplified and updated to include coverage of data distribution analysis.
- The **output, input,** and **graphical user interface design** chapters (Chapters 13, 14, and 15) have been further updated to reflect design considerations for both client/server ("fat client") and Web-based ("thin client") applications.
- The **system construction and implementation** chapter (Chapter 16) provides improved emphasis on system testing, conversion, and user training for distributed information systems.
- The **systems operation and support** chapter (Chapter 17) has been updated to reflect contemporary maintenance and reengineering issues.
- Also at the request of adopters and reviewers, the **object-oriented analysis and design** chapters have been relocated to the end of the book as Modules A and B. Many adopters told us that they omit this advanced material or cover it at the end of the course for transition to an advanced course. The modules have been significantly updated to reflect the official emergence of the ***Unified Modeling Language*** **(UML)** which evolved from the collaboration of three OOA experts: Grady Booch, Ivar Jacobson ("use case"), and James Rumbaugh ("object modeling technique" or OMT).

INSTRUCTIONAL RESOURCES AND SUPPLEMENTS

It has always been our intent to provide our adopters with a complete course, not just a textbook. We are especially excited about this edition's comprehensive support package. It includes Web-hosted support, software bundles, and other resources for both the student and instructor. Most have been developed in parallel with this edition. The supplements for the fifth edition of *Systems Analysis and Design Methods* include the following components.

For the Instructor

Instructor's Resource CD-ROM. A presentation manager shell allows you to organize and customize the following components to the needs of your course:

- **Instructor's Guide with Electronic Transparencies and PowerPoint.** This instructor's guide includes course planning materials, teaching guidelines and transparencies, templates, and answers to end-of-chapter problems, exercises, and minicases.

  The transparency repository on the CD-ROM includes many more slides than could be offered in a traditional printed book. All slides are in Microsoft's *PowerPoint* format (complete with instructor notes that provide teaching guidelines and tips). Instructors can (1) pick-and-choose those slides they wish to use, (2) customize slides to their own preferences, and (3) add new slides. Slides can (a) be organized into electronic presentations, or (b) printed as transparencies or transparency masters.

  The slides are also provided in *Adobe Acrobat* format for non-PowerPoint users.
- **Test Bank/Computerized Test Bank.** A test bank and Brownstone Diploma test generation software for online or traditional testing contain questions in the following formats: true/false, multiple choice, sentence completion, and matching. The answers are cross-referenced to the page numbers in the text.
- **Projects and Cases Solutions.** Suggested solutions and supporting material for the optional projects and cases are provided.

Website and Online Learning Center. With the previous edition, we provided the first comprehensive website for adopters of a systems analysis and design textbook. The new website at www.mhhe.com/whitten (URL is also

on front cover of the text) provides a password-protected instructor section for downloading the latest supplemental resources and updates, as well as an Online Learning Center with additional lecture notes, material on chapters not found in the text, and solutions to extra projects and cases. Instructors can also contact the authors from this location.

For the Student

Website and Online Learning Center. The student side of the website contains downloadable templates in *Visio, System Architect,* and Microsoft *Word, Excel,* and *Project,* as well as links to interesting and relevant information regarding systems work. The student Online Learning Center includes additional material such as supplemental chapters and modules, projects and cases, and self-assessment quizzes for each chapter.

Projects and Cases to Accompany Systems Analysis and Design Methods. This casebook, available with this edition as an optional CD-ROM or on the student Online Learning Center, has been updated to include new semester project case studies that can be completed in conjunction with the textbook. A *build your own project* model is retained for those instructors and students who want to maximize value by leveraging students' past and current work experience, or for use with a live-client project.

***System Architect 2001* Student Edition.** In an exclusive agreement between Irwin/McGraw-Hill and Popkin Software & Systems, a student edition of *System Architect 2001* is also available on CD-ROM as a packaging option with the text. *SA 2001* supports all of the diagrams covered in the textbook and includes instructions and tutorials on the CD.

Visible Analyst Workbench Student Edition. In cooperation with Visible Systems, Irwin/McGraw-Hill offers Visible Analyst Workbench as a second CASE tool packaging option with the text. Visible Analyst has recently been updated to support 32-bit technology and incorporates the UML methodology.

Jeffrey L. Whitten
Lonnie D. Bentley
Kevin C. Dittman

ACKNOWLEDGMENTS

We are indebted to many individuals who contributed to the development of five editions of this textbook.

We wish to thank the reviewers and critics of this and prior editions:

Jeanne M. Alm, *Moorhead State University*

Charles P. Bilbrey, *James Madison University*

Ned Chapin, *California State University–Hayward*

Carol Clark, *Middle Tennessee State University*

Gail Corbitt, *California State University–Chico*

Larry W. Cornwell, *Bradley University*

Barbara B. Denison, *Wright State University*

Linda Duxbury, *Carleton University*

Dana Edberg, *University of Nevada–Reno*

Craig W. Fisher, *Marist College*

Raoul J. Freeman, *California State University–Dominguez Hills*

Dennis D. Gagnon, *Santa Barbara City College*

Abhijit Gopal, *University of Calgary*

Patricia J. Guinan, *Boston University*

Bill C. Hardgrave, *University of Arkansas–Fayetteville*

Alexander Hars, *University of Southern California*

Richard C. Housley, *Golden Gate University*

Constance Knapp, *Pace University*

Riki S. Kuchek, *Orange Coast College*

Thom Luce, *Ohio University*

Charles M. Lutz, *Utah State University*

Ross Malaga, *University of Maryland–Baltimore County*

Chip McGinnis, *Park College*

William H. Moates, *Indiana State University*

Ronald J. Norman, *San Diego State University*

Charles E. Paddock, *University of Nevada–Las Vegas*

June A. Parsons, *Northern Michigan University*

Harry Reif, *James Madison University*

Gail L. Rein, *SUNY–Buffalo*

Rebecca H. Rutherfoord, *Southern College of Technology*

Jerry Sitek, *Southern Illinois University–Edwardsville*

Craig W. Slinkman, *University of Texas–Arlington*

John Smiley, *Holy Family College*

Mary Thurber, *Northern Alberta Institute of Technology*

Jerry Tillman, *Appalachian State University*

Jonathan Trower, *Baylor University*

Margaret S. Wu, *University of Iowa*

Jacqueline E. Wyatt, *Middle Tennessee State University*

Vincent C. Yen, *Wright State University*

Ahmed S. Zaki, *College of William and Mary*

Your patience and constructive criticism were essential to shaping this edition and appreciated.

Special thanks are offered to Dorothy Jane Miller who provided special assistance throughout the project. We also thank our students and alumni. You make teaching worthwhile.

Finally, we acknowledge the contributions, encouragement, and patience of the staff at McGraw-Hill/Irwin. For this edition, special thanks to Rick Williamson for never losing his cool in the wake of deadlines missed; to Christine Wright, developmental editor; to Susan Trentacosti, who as project manager for three editions has established the benchmark of excellence in that role. We also thank Keri Johnson, Kiera Cunningham, Melonie Salvati, Marc Mattson, and Merrily Mazza. We hope we haven't forgotten anyone.

To those who used our previous four editions, thank you for your continued support. And for new adopters, we hope you'll see a difference in this text. We eagerly await your reactions, comments, and suggestions.

Jeffrey L. Whitten
Lonnie D. Bentley
Kevin C. Dittman

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BRIEF CONTENTS

PART ONE

The Context of Systems Analysis and Design

1 Players in the Systems Game 2
2 Information System Building Blocks 36
3 Information Systems Development 72
4 Project Management 120

PART TWO

Systems Analysis Methods

5 Systems Analysis 162
6 Requirements Discovery 212
7 Data Modeling and Analysis 254
8 Process Modeling 304
9 Feasibility Analysis and the System Proposal 362

PART THREE

Systems Design Methods

10 Systems Design 392
11 Application Architecture and Modeling 420
12 Database Design 466
13 Output Design and Prototyping 502
14 Input Design and Prototyping 534
15 User Interface Design 568

PART FOUR

Beyond Systems Analysis and Design

16 Systems Construction and Implementation 604
17 Systems Operations and Support 622

PART FIVE

Advanced Analysis and Design Method

A Object-Oriented Analysis and Modeling 644
B Object-Oriented Design and Modeling 674

Glossary/Index 695

CONTENTS

PART ONE THE CONTEXT OF SYSTEMS ANALYSIS AND DESIGN 1

CHAPTER 1

Players in the Systems Game 2
SoundStage Entertainment Club 4
How to Use the Demonstration Case 8
Why Study Systems Analysis and Design Methods? 8
Information Workers 9
- System Owners 9
- System Users 11
- System Designers 12
- System Builders 13
- Systems Analysts 13
- Information Technology Vendors and Consultants 13

The Modern Systems Analyst 13
- Why Do Businesses Need Systems Analysts? 13
- What Is a Systems Analyst? 14
- What Does a Systems Analyst Do? 15
- Where Do Systems Analysts Work? 15

Modern Business Trends and Implications 20
- Total Quality Management 20
- Business Process Redesign 20
- Continuous Process Improvement 21
- Globalization of the Economy 21
- Information Technology Trends and Drivers 22

Preparing for a Career as a Systems Analyst 24
- Working Knowledge of Information Technology 24
- Computer Programming Experience and Expertise 24
- General Business Knowledge 25
- Problem-Solving Skills 25
- Interpersonal Communication Skills 25
- Interpersonal Relations Skills 26
- Flexibility and Adaptability 27
- Character and Ethics 27
- Systems Analysis and Design Skills 28

The Next Generation 29
- Career Prospects 29
- Predictions 29

Where Do You Go from Here? 30

CHAPTER 2

Information System Building Blocks 36
SoundStage Entertainment Club 38
The Product—Information Systems 45
- Transaction Processing Systems 46
- Management Information Systems 47
- Decision Support Systems 47
- Expert Systems 48
- Office Automation Systems 48
- Putting It All Together 49

A Framework for Information Systems Architecture 51
DATA Building Blocks 52
PROCESS Building Blocks 56
- INTERFACE Building Blocks 60
- Using the Framework for Information Systems Architecture 63

Where Do You Go from Here? 66

CHAPTER 3

Information Systems Development 72
SoundStage Entertainment Club 74
The Process of Systems Development 75
- The Capability Maturity Model 76
- Systems Life Cycle versus Systems Development Methodologies 77
- Underlying Principles for Systems Development 79

A Systems Development Methodology 84
- Project Identification 84
- Project Phases 86
- Cross Life Cycle Activities 92

Alternative Routes and Methods 94
- Model-Driven Development Route 94
- Rapid Application Development Route 98
- Commercial Off-the-Shelf Package Software Route 100
- Hybrid Approaches 103
- The Maintenance and Reengineering Route 105

Automated Tools and Technology 106
CASE—Computer-Aided Systems Engineering 107
Application Development Environments 109
Process and Project Managers 110
Where Do You Go from Here? 111

CHAPTER 4

Project Management 120
SoundStage Entertainment Club 122
What Is Project Management? 123
The Causes of Failed Projects 125
The Project Management Body of Knowledge 126
The Project Management Life Cycle 132
Activity 1—Negotiate Scope 133
Activity 2—Identify Tasks 134
Activity 3—Estimate Task Durations 136
Activity 4—Specify Intertask Dependencies 137
Activity 5—Assign Resources 139
Activity 6—Direct the Team Effort 143
Activity 7—Monitor and Control Progress 144
Activity 8—Assess Project Results and Experiences 154
Where Do You Go from Here? 154

PART TWO SYSTEMS ANALYSIS METHODS 161

CHAPTER 5

Systems Analysis 162
SoundStage Entertainment Club 164
What Is Systems Analysis? 165
Systems Analysis Approaches 167
Model-Driven Analysis Approaches 167
Accelerated Analysis Approaches 171
Requirements Discovery Methods 172
Business Process Redesign Methods 173
FAST Systems Analysis Strategies 174
The Preliminary Investigation Phase 174
Task 1.1—List Problems, Opportunities, and Directives 176
Task 1.2—Negotiate Preliminary Scope 178
Task 1.3—Assess Project Worth 179
Task 1.4—Plan the Project 179
Task 1.5—Present the Project and Plan 180
The Problem Analysis Phase 181
Task 2.1—Study the Problem Domain 183
Task 2.2—Analyze Problems and Opportunities 185
Task 2.3—Analyze Business Processes 186
Task 2.4—Establish System Improvement Objectives 187
Task 2.5—Update the Project Plan 188
Task 2.6—Present Findings and Recommendations 188
The Requirements Analysis Phase 189
Task 3.1—Define Requirements 192
Task 3.2—Analyze Functional Requirements 193
Task 3.3—Trace and Complete Requirements 195
Task 3.4—Prioritize Requirements 196
Task 3.5—Update the Project Plan 196
Ongoing Requirements Management 197
The Decision Analysis Phase 197
Task 4.1—Identify Candidate Solutions 199
Task 4.2—Analyze Candidate Solutions 200
Task 4.3—Compare Candidate Solutions 202
Task 4.4—Update the Project Plan 202
Task 4.5—Recommend a Solution 202
The Next Generation of Systems Analysis 203
Where Do You Go from Here? 205

CHAPTER 6

Requirements Discovery 212
SoundStage Entertainment Club 214
An Introduction to Requirements Discovery 215
The Process of Requirements Discovery 218
Problem Discovery and Analysis 218
Requirements Discovery 219
Documenting and Analyzing Requirements 221
Requirements Management 223
Requirements Discovery Methods 223
Sampling of Existing Documentation, Forms, and Files 223
Research and Site Visits 225
Observation of the Work Environment 226
Questionnaires 228
Interviews 230
How to Conduct an Interview 232
Discovery Prototyping 237
Joint Requirements Planning (JRP) 238
A Fact-Finding Strategy 243
Documenting Requirements Methods 244
Use Cases 244
How to Document a Use Case 245

Decision Tables 247
Requirements Tables 247
Where Do You Go from Here? 249

CHAPTER 7

Data Modeling and Analysis 254
SoundStage Entertainment Club 256
An Introduction to Systems Modeling 257
System Concepts for Data Modeling 260
Entities 260
Attributes 261
Relationships 264
The Process of Logical Data Modeling 273
Strategic Data Modeling 273
Data Modeling during Systems Analysis 275
Looking Ahead to Systems Design 276
Automated Tools for Data Modeling 277
How to Construct Data Models 277
Entity Discovery 277
The Context Data Model 279
The Key-Based Data Model 281
Generalized Hierarchies 284
The Fully Attributed Data Model 284
Analyzing the Data Model 286
What Is a Good Data Model? 286
Data Analysis 288
Normalization Example 288
Mapping Data Requirements to Locations 297
Where Do You Go from Here? 298

CHAPTER 8

Process Modeling 304
SoundStage Entertainment Club 306
An Introduction to Systems Modeling 307
System Concepts for Process Modeling 310
Process Concepts 310
Data Flows 321
External Agents 329
Data Stores 330
The Process of Logical Process Modeling 331
Strategic Systems Planning 331
Process Modeling for Business Process Redesign 332
Process Modeling during Systems Analysis 332
Looking Ahead to Systems Design 332
Fact-Finding and Information Gathering for Process Modeling 334
Computer-Aided Systems Engineering (CASE) for Process Modeling 334
How to Construct Process Models 336
The Context Data Flow Diagram 336
The Functional Decomposition Diagram 337
The Event-Response or Use Case List 339
Event Decomposition Diagrams 340
Event Diagrams 340
The System Diagram(s) 345
Primitive Diagrams 347
Completing the Specification 347
Synchronizing of System Models 351
Data and Process Model Synchronization 351
Process Distribution 352
The Next Generation 353
Where Do You Go from Here? 355

CHAPTER 9

Feasibility Analysis and the System Proposal 362
SoundStage Entertainment Club 364
Feasibility Analysis and the System Proposal 364
Feasibility Analysis—A Creeping Commitment Approach 365
Systems Analysis—Preliminary Investigation Checkpoint 365
Systems Analysis—Problem Analysis Checkpoint 365
Systems Design—Decision Analysis Checkpoint 367
Four Tests for Feasibility 367
Operational Feasibility 367
Technical Feasibility 369
Schedule Feasibility 369
Economic Feasibility 370
The Bottom Line 370
Cost-Benefit Analysis Techniques 370
How Much Will the System Cost? 370
What Benefits Will the System Provide? 371
Is the Proposed System Cost-Effective? 373
Feasibility Analysis of Candidate Systems 377
Candidate Systems Matrix 377
Feasibility Analysis Matrix 378
The System Proposal 380
Written Report 380
Formal Presentation 383

PART THREE SYSTEMS DESIGN METHODS 391

CHAPTER 10

Systems Design 392
SoundStage Entertainment Club 394
What Is Systems Design? 394
Systems Design Approaches 395
Model-Driven Approaches 395
Rapid Application Development (RAD) 401
FAST Systems Design Strategies 401

Systems Design for In-house Development—The "Build" Solution 401
Task 5.1—Design the Application Architecture 403
Task 5.2—Design the System Database(s) 405
Task 5.3—Design the System Interface 405
Task 5.4—Package Design Specifications 407
Task 5.5—Update the Project Plan 408
Systems Design for Integrating Commercial Software—The "Buy" Solution 408
Task 4.1—Research Technical Criteria and Options 408
Task 4.2—Solicit Proposals (or Quotes) from Vendors 411
Task 5A.1—Validate Vendor Claims and Performances 413
Task 5A.2—Evaluate and Rank Vendor Proposals 413
Task 5A.3—Award (or Let) Contract and Debrief Vendors 414
Impact of Buy Decisions on Remaining Life Cycle Phases 414
Where Do You Go from Here? 415

CHAPTER 11

Application Architecture and Modeling 420
SoundStage Entertainment Club 422
Application Architecture 423
Physical Data Flow Diagrams 424
Physical Processes 425
Physical Data Flows 428
Physical External Agents 430
Physical Data Stores 430
Information Technology Architecture 430
Distributed Systems 432
DATA Architectures—Distributed Relational Databases 443
INTERFACE Architectures—Inputs, Outputs, and Middleware 445
PROCESS Architecture—The Software Development Environment 449
Application Architecture Strategies for Systems Design 452
The Enterprise Application Architecture Strategy 452
The Tactical Application Architecture Strategy 452
Modeling the Application Architecture of an Information System 453
Drawing Physical Data Flow Diagrams 453
Prerequisites 454
The Network Architecture 454
DATA Distribution and Technology Assignments 456
PROCESS Distribution and Technology Assignments 456
The Person/Machine Boundaries 458
Where Do You Go from Here? 458

CHAPTER 12

Database Design 466
SoundStage Entertainment Club 468
Conventional Files versus the Database 470
The Pros and Cons of Conventional Files 470
The Pros and Cons of Database 472
Database Concepts for the Systems Analyst 473
Fields 473
Records 473
Files and Tables 474
Databases 475
Prerequisite for Database Design—Normalization 481
What Is a Good Data Model? 481
Conventional File Design 482
Modern Database Design 482
Goals and Prerequisites to Database Design 483
The Database Schema 483
Data and Referential Integrity 488
Roles 489
Database Distribution and Replication 491
Database Prototypes 492
Database Capacity Planning 492
Database Structure Generation 492
The Next Generation of Database Design 493
Where Do You Go from Here? 495

CHAPTER 13

Output Design and Prototyping 502
SoundStage Entertainment Club 504
Output Design Concepts and Guidelines 505
Distribution and Audience of Outputs 505
Implementation Methods for Outputs 509
How to Design and Prototype Outputs 513
Automated Tools for Output Design and Prototyping 513
Output Design Guidelines 515
The Output Design Process 517
Web-Based Outputs and E-Business 525
Where Do You Go from Here? 528

CHAPTER 14

Input Design and Prototyping 534
SoundStage Entertainment Club 536
Input Design Concepts and Guidelines 537
Data Capture, Data Entry, and Data Processing 537
Input Methods and Implementation 540
System User Issues for Input Design 543
Internal Controls—Data Editing for Inputs 544
GUI Controls for Input Design 546
Common GUI Controls for Inputs 546
Advanced Input Controls 552
How to Design and Prototype Inputs 552
Automated Tools for Input Design and Prototyping 554

The Input Design Process 554
Web-Based Inputs and E-Business 560
Where Do You Go from Here? 560

CHAPTER 15

User Interface Design 568
SoundStage Entertainment Club 570
User Interface Design Concepts and Guidelines 571
Types of Computer Users 571
Human Factors 572
Human Engineering Guidelines 573
Dialogue Tone and Terminology 574
User Interface Technology 575
Operating Systems and Web Browsers 575
Display Monitor 575
Keyboards and Pointers 576
Graphical User Interface Styles and Considerations 577
Windows and Frames 577
Menu-Driven Interfaces 577
Instruction-Driven Interfaces 584
Question-Answer Dialogues 586
Special Considerations for User Interface Design 587
How to Design and Prototype a User Interface 590
Automated Tools for User Interface Design and Prototyping 590
The User Interface Design Process 592
Where Do You Go from Here? 597

PART FOUR BEYOND SYSTEMS ANALYSIS AND DESIGN 603

CHAPTER 16

Systems Construction and Implementation 604
SoundStage Entertainment Club 606
What Is Systems Construction and Implementation? 607
The Construction Phase 607
Task 6.1—Build and Test Networks (If Necessary) 607
Task 6.2—Build and Test Databases 609
Task 6.3—Install and Test New Software Packages (If Necessary) 609
Task 6.4—Write and Test New Programs 609
The Implementation Phase 611
Task 7.1—Conduct System Test 612
Task 7.2—Prepare Conversion Plan 612
Task 7.3—Install Databases 615
Task 7.4—Train Users 615
Task 7.5—Convert to New System 616
Where Do You Go from Here? 617

CHAPTER 17

Systems Operations and Support 622
SoundStage Entertainment Club 624
The Context of Systems Operation and Support 625
System Maintenance 628
Task 8.1.1—Validate the Problem 629
Task 8.1.2—Benchmark Program 630
Task 8.1.3—Study and Debug the Program 631
Task 8.1.4—Test the Program 631
System Recovery 632
Technical Support 633
System Obsolescence 633
Task 8.4.1—Analyze Enhancement Request 635
Task 8.4.2—Make the Quick Fix 635
Task 8.4.3—Recover Existing Physical System 636
System Enhancement 638
Where Do You Go from Here? 638

PART FIVE ADVANCED ANALYSIS AND DESIGN METHODS 643

MODULE A

Object-Oriented Analysis and Modeling 644
An Introduction to Object Modeling 646
System Concepts for Object Modeling 647
Objects, Attributes, Methods, and Encapsulation 647
Classes, Generalization, and Specialization 649
Object/Class Relationships 651
Messages 654
Polymorphism 654
The UML Diagrams 655
The Process of Object Modeling 656
Modeling the Functional Description of the System 656
Finding and Identifying the Business Objects 659
Organizing the Objects and Identifying Their Associations 661
Modeling the Behavior of the Objects 668
Where Do You Go from Here? 668

MODULE B

Object-Oriented Design and Modeling 674
An Introduction to Object-Oriented Design 676

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