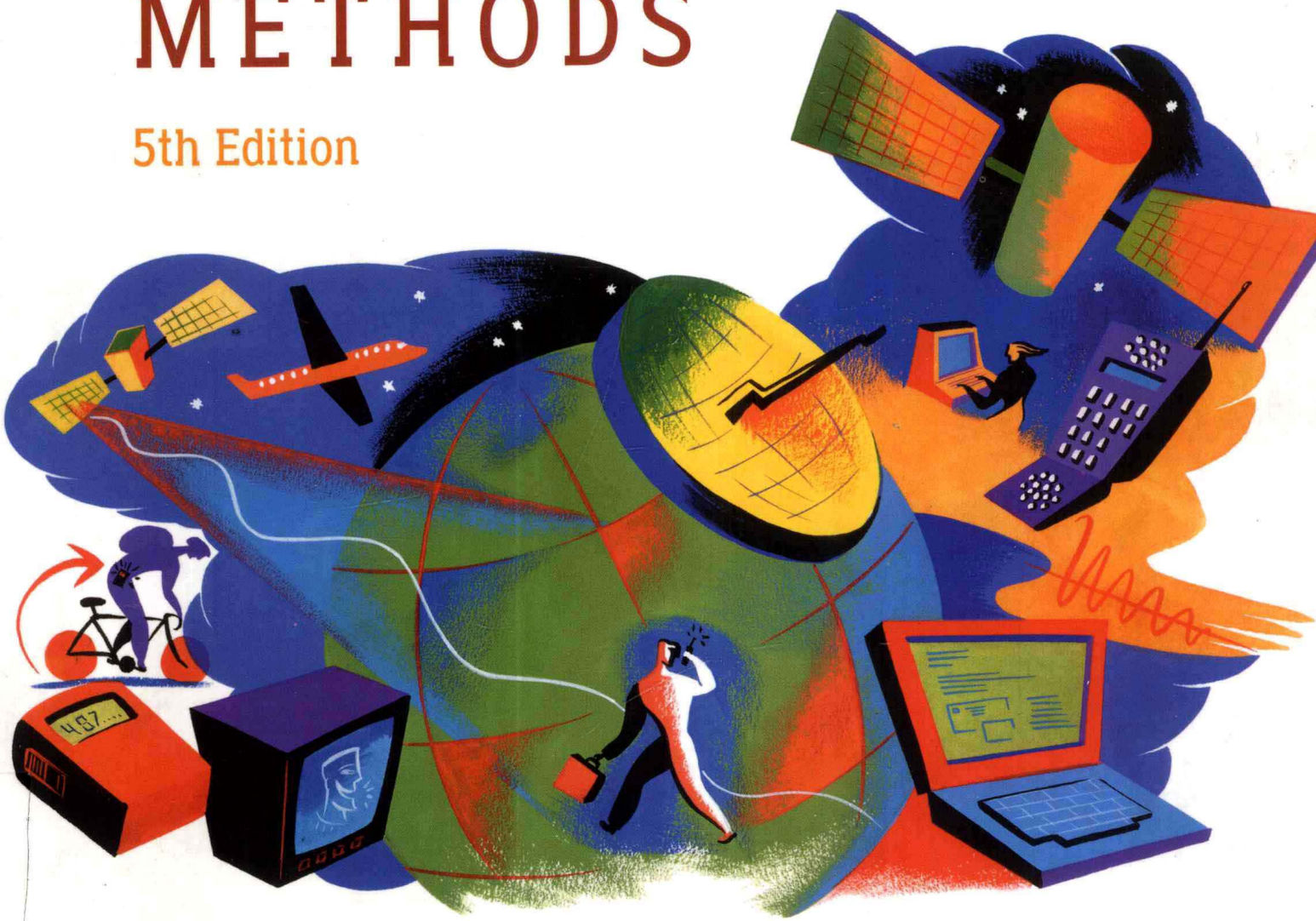
SYSTEMS ANALYSIS AND DESIGN METHODS

5th Edition



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FIFTH EDITION

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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

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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.

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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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PART ONE

THE CONTEXT OF SYSTEMS ANALYSIS AND DESIGN

This is a practical book about information systems development methods. All businesses and organizations develop information systems. You can be assured that you will play some role in the systems analysis and design for those systems—either as a customer or user of those systems or as a developer of those systems. Systems analysis and design is about business problem solving and computer applications. The methods you will learn in this book can be applied to a wide variety of problem domains, not just those involving the computer.

Before we begin, we assume you've completed an introductory course in computer-based information systems. Many of you have also completed one or more programming courses (using technologies such as *Access, COBOL,* C/C++, or *Visual Basic*). That will prove helpful, since systems analysis and design precede and/or integrate with those activities. But don't worry—we'll review all the necessary principles on which systems analysis and design is based.

Part One focuses on the big picture. Before you learn about specific activities, tools, techniques, methods, and technology, you need to understand this big picture. As you explore the context of systems analysis and design, we will introduce many ideas, tools, and techniques that are not explored in great detail until later in the book. Try to keep that in mind as you explore the big picture.

Systems development isn't magic. There are no secrets for success, no perfect tools, techniques, or methods. To be sure, there are skills that can be mastered. But the complete and consistent application of those skills is still an art.

We start in Part One with fundamental concepts, philosophies, and trends that provide the context of systems analysis and design methods—in other words, the basics! If you understand these basics, you will be better able to apply, with confidence, the practical tools and techniques you will learn in Parts Two through Five. You will also be able to adapt to new situations and methods.

Four chapters make up this part. Chapter 1, Players in the Systems Game, introduces you to the *PARTICIPANTS* in systems analysis and design with special emphasis on the modern systems analyst as the facilitator of systems work. You'll also learn about the relationships among systems analysts, end-users, managers, and other information systems professionals. Finally, you'll learn to prepare yourself for a career as an analyst (if that is your goal). Regardless, you will understand how you will interact with this important professional.

Chapter 2, Information System Building Blocks, introduces the *PRODUCT* we will teach you how to build—*information systems.* Specifically, you will learn to examine information systems in terms of common building blocks: DATA, PROCESSES, and INTERFACES—each from the perspective of different participants or stakeholders. A visual matrix framework will help you organize these building blocks so that you can see them applied in the subsequent chapters.

Chapter 3, Information Systems Development, introduces a high-level (meaning general) process for information systems development. This is called a *systems development life cycle.* We will present the life cycle in a form in which most of you will experience it—a *systems development methodology.* This methodology will be the context in which you will learn to use and apply the systems analysis and design methods taught in the remainder of the book.

Chapter 4, Project Management, introduces project management techniques. All systems projects are dependent on the principles that are surveyed. This chapter introduces two modeling techniques for project management: *Gantt* and *PERT.* These tools help you schedule activities, evaluate progress, and adjust schedules.