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Theory and Practice

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Doug Rosenberg and Matt Stephens

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Use Case Driven Object Modeling with UML

Theory and Practice



Doug Rosenberg and
Matt Stephens

Use Case Driven Object Modeling with UML: Theory and Practice

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ISBN-13 (pbk): 978-1-59059-774-3

ISBN-10 (pbk): 1-59059-774-5

Printed and bound in the United States of America 9 8 7 6 5 4 3 2 1

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Distributed to the book trade worldwide by Springer-Verlag New York, Inc., 233 Spring Street, 6th Floor, New York, NY 10013. Phone 1-800-SPRINGER, fax 201-348-4505, e-mail orders-ny@springer-sbm.com, or visit <http://www.springeronline.com>.

For information on translations, please contact Apress directly at 2560 Ninth Street, Suite 219, Berkeley, CA 94710. Phone 510-549-5930, fax 510-549-5939, e-mail info@apress.com, or visit <http://www.apress.com>.

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The UML model and source code for the example use cases in this book are available to readers at <http://www.apress.com> and <http://www.iconixprocess.com/InternetBookstore>.

*For Rob, who has the brightest future of anyone I know.
Keep locating your fastball in unhittable spots,
and good things will continue to happen.*

—Doug Rosenberg

To Michelle, for her never-ending patience and support.

—Matt

Contents at a Glance

| | |
|------------------------------------|-------|
| About the Authors | xv |
| About the Technical Reviewer | xvii |
| Acknowledgments | xix |
| Preface | xxi |
| Introduction | xxvii |

| | | |
|------------------|--------------------------------------|---|
| CHAPTER 1 | Introduction to ICONIX Process | 1 |
|------------------|--------------------------------------|---|

PART 1 ■ ■ ■ Requirements Definition

| | | |
|------------------|---------------------------|----|
| CHAPTER 2 | Domain Modeling | 23 |
| CHAPTER 3 | Use Case Modeling | 49 |
| CHAPTER 4 | Requirements Review | 83 |

PART 2 ■ ■ ■ Analysis, Conceptual Design, and Technical Architecture

| | | |
|------------------|---------------------------------|-----|
| CHAPTER 5 | Robustness Analysis | 101 |
| CHAPTER 6 | Preliminary Design Review | 143 |
| CHAPTER 7 | Technical Architecture | 159 |

PART 3 ■ ■ ■ Design and Coding

| | | |
|-------------------|--|-----|
| CHAPTER 8 | Sequence Diagrams | 185 |
| CHAPTER 9 | Critical Design Review | 233 |
| CHAPTER 10 | Implementation: Getting from Detailed Design to Code | 257 |
| CHAPTER 11 | Code Review and Model Update | 297 |

PART 4 ■ ■ ■ Testing and Requirements Traceability

| | | |
|--------------|------------------------------|-----|
| ■ CHAPTER 12 | Design-Driven Testing | 329 |
| ■ CHAPTER 13 | Addressing Requirements..... | 373 |

PART 5 ■ ■ ■ Appendixes

| | | |
|--------------|-----------------------------|-----|
| ■ APPENDIX A | What's New in UML 2.0 | 395 |
| ■ APPENDIX B | Spring Bin..... | 409 |
| ■ INDEX | | 425 |

Contents

| | |
|------------------------------------|-------|
| About the Authors | xv |
| About the Technical Reviewer | xvii |
| Acknowledgments | xix |
| Preface | xxi |
| Introduction | xxvii |

| | | |
|------------------|--|----------|
| CHAPTER 1 | Introduction to ICONIX Process | 1 |
| | ICONIX Process in Theory | 2 |
| | Overview: Getting from Use Cases to Source Code | 2 |
| | Requirements | 4 |
| | Analysis/Preliminary Design | 9 |
| | Detailed Design | 12 |
| | Implementation | 15 |
| | Extensions to ICONIX Process | 19 |
| | Persona Analysis | 19 |
| | Test-Driven Development (TDD) | 19 |
| | Driving Test Cases from the Analysis Model | 20 |
| | ICONIX Process in Practice: The Internet Bookstore Example | 20 |
| | Summary | 20 |

PART 1 ■ ■ ■ Requirements Definition

| | | |
|------------------|--|-----------|
| CHAPTER 2 | Domain Modeling | 23 |
| | The 10,000-Foot View | 24 |
| | What's a Domain Model? | 24 |
| | Why Start with the Domain Model Instead of Use Cases? | 25 |
| | Domain Modeling in Theory | 26 |
| | Top 10 Domain Modeling Guidelines | 26 |
| | Internet Bookstore: Extracting the First-Pass Domain Model from High-Level Requirements | 30 |
| | Internet Bookstore: Second Attempt at the Domain Model | 35 |
| | Internet Bookstore: Building Generalization Relationships | 37 |

| | |
|---------------------------------------|----|
| Domain Modeling in Practice | 39 |
| Exercises | 39 |
| More Practice | 45 |
| Summary | 47 |

■ CHAPTER 3 **Use Case Modeling** 49

| | |
|--|----|
| The 10,000-Foot View | 49 |
| Why Do I Need Use Cases in Addition to Functional Requirements? | 50 |
| Don't Forget the Rainy-Day Scenarios | 50 |
| Do an Initial Domain Model Before You Write the Use Cases | 50 |
| Driving Your Design (and Your Tests) from the Use Cases | 51 |
| Use Case Modeling in Theory | 51 |
| Top 10 Use Case Modeling Guidelines | 51 |
| Organizing Use Cases into Packages: Internet Bookstore | 61 |
| Use Case Relationship Roundup | 67 |
| Internet Bookstore: Refining Use Cases | 70 |
| Internet Bookstore: Basic and Alternate Courses | 72 |
| A Couple of Thoughts on Use Case Templates | 74 |
| Use Case or Algorithm? | 76 |
| Use Case Modeling in Practice | 77 |
| Exercises | 77 |
| Exercise Solutions | 78 |
| More Practice | 80 |
| Summary | 81 |

■ CHAPTER 4 **Requirements Review** 83

| | |
|---|----|
| Requirements Review in Theory | 84 |
| Why Review Requirements? | 84 |
| Top 10 Requirements Review Guidelines | 85 |
| Allocating Functional Requirements to Use Cases | 89 |
| Requirements Review in Practice: Internet Bookstore | 89 |
| Removing Everything That's Out of Scope | 90 |
| Naming Participating Domain Objects | 92 |
| Making Sure You Have All the Alternate Courses | 93 |
| Checking That the Use Case Text Isn't Too Abstract | 93 |
| Changing Passive Voice to Active Voice | 95 |
| Tracing Each Requirement to Its Use Cases | 96 |
| Summary | 97 |

PART 2 ■ ■ ■ Analysis, Conceptual Design, and Technical Architecture

| | | |
|------------------------|---|---------|
| ■ CHAPTER 5 | Robustness Analysis | 101 |
| | The 10,000-Foot View | 101 |
| | Where Does Robustness Analysis Fit into the Process? | 102 |
| | Like Learning to Ride a Bicycle | 102 |
| | Anatomy of a Robustness Diagram | 103 |
| | Robustness Analysis in Theory | 104 |
| | Top 10 Robustness Analysis Guidelines | 104 |
| | More About Robustness Diagram Rules | 112 |
| | How Do You Perform Robustness Analysis? | 114 |
| | Updating Your Domain (Static) Model | 125 |
| | Robustness Analysis in Practice | 128 |
| | Exercises | 128 |
| | Exercise Solutions | 132 |
| | More Practice | 140 |
| | Summary | 141 |
| ■ CHAPTER 6 | Preliminary Design Review | 143 |
| | Preliminary Design Review in Theory | 144 |
| | Why Do a PDR At All? | 144 |
| | Top 10 PDR Guidelines | 145 |
| | Preliminary Design Review in Practice: Internet Bookstore | 149 |
| | PDR for the “Write Customer Review” Robustness Diagram | 149 |
| | The Finished “Write Customer Review” Robustness Diagram | 155 |
| | Summary | 157 |
| ■ CHAPTER 7 | Technical Architecture | 159 |
| | The 10,000-Foot View | 160 |
| | What Is Technical Architecture? | 160 |
| | What Are the Duties of a Technical Architect? | 160 |
| | Technical Architecture in Theory | 161 |
| | Top 10 Technical Architecture Guidelines | 161 |
| | Architectural Layering | 162 |
| | Technical Architecture in Practice: Internet Bookstore | 164 |
| | About Spring Framework | 164 |
| | Anatomy of Spring Framework | 165 |

| | |
|---|-----|
| The Internet Bookstore Architecture | 172 |
| Layered Architecture | 172 |
| Flow of Events | 178 |
| Testability | 179 |
| Web Security | 179 |
| Top 10 Technical Architecture Errors (the “Don’ts”) | 180 |
| Summary | 181 |

PART 3 ■ ■ ■ Design and Coding

| | | |
|-------------|---|-----|
| ■ CHAPTER 8 | Sequence Diagrams | 185 |
| | The 10,000-Foot View | 185 |
| | Sequence Diagrams and Detailed OOD | 186 |
| | Sequence Diagram Notation | 186 |
| | Sequence Diagramming in Theory | 187 |
| | Top 10 Sequence Diagramming Guidelines | 187 |
| | How to Draw a Sequence Diagram: Four Essential Steps | 195 |
| | Continuing the Internet Bookstore Example | 206 |
| | Updating Your Class Diagrams As You Go Along | 210 |
| | Synchronizing the Static and Dynamic Parts of the Model | 211 |
| | Internet Bookstore: Updating the Static Model | 211 |
| | Sequence Diagramming in Practice | 217 |
| | Exercises | 217 |
| | Exercise Solutions | 221 |
| | More Practice | 228 |
| | Summary | 230 |
| ■ CHAPTER 9 | Critical Design Review | 233 |
| | The 10,000-Foot View | 234 |
| | Critical Design Review in Theory | 235 |
| | Top 10 Critical Design Review Guidelines | 235 |
| | Using the Class Diagrams to Find Errors on the Sequence Diagrams | 238 |

| | |
|--|-----|
| Critical Design Review in Practice: Internet Bookstore | 238 |
| CDR for the “Show Book Details” Use Case | 238 |
| CDR for the “Write Customer Review” Use Case | 245 |
| The Updated Bookstore Diagrams | 252 |
| Summary | 255 |

■ CHAPTER 10 Implementation: Getting from Detailed Design to Code

| | |
|---|-----|
| The 10,000-Foot View | 258 |
| Programmer-Driven Design | 258 |
| Spring Framework | 258 |
| Implementation in Theory: Getting from Design to Code | 258 |
| Top 10 Implementation Guidelines | 259 |
| Implementation in Practice: Internet Bookstore | 263 |
| Creating the Database | 263 |
| Preparing the Style Sheet | 265 |
| Mapping Domain (Entity) Classes to Real Classes | 266 |
| Implementing the “Show Book Details” Use Case | 268 |
| Implementing the “Write Customer Review” Use Case | 278 |
| More Practice | 294 |
| Summary | 295 |

■ CHAPTER 11 Code Review and Model Update

| | |
|--|-----|
| The 10,000-Foot View | 298 |
| Code Review and Model Update in Theory | 298 |
| Top 10 Code Review and Model Update Guidelines | 299 |
| Why Are Code Reviews Necessary After All That Design Work? | 302 |
| Code Review and Model Update in Practice | 303 |
| Code Review and Model Update Checklist | 304 |
| “Show Book Details” Use Case | 304 |
| “Write Customer Review” Use Case | 309 |
| Future Iterations | 324 |
| Summary | 325 |

PART 4 ■ ■ ■ Testing and Requirements Traceability

| | | |
|---------------------|--|-----|
| ■ CHAPTER 12 | Design-Driven Testing | 329 |
| | Design-Driven Testing in Theory | 330 |
| | Top 10 Design-Driven Testing Guidelines | 330 |
| | Different Kinds of Testing | 331 |
| | Driving Test Cases from Robustness Diagrams | 334 |
| | Using the Agile ICONIX/EA Add-in | 336 |
| | Driving Unit Tests from the Test Cases | 338 |
| | A Quick Introduction to JUnit | 339 |
| | Writing Effective Unit Tests | 342 |
| | Design-Driven Testing in Practice | 343 |
| | Unit Tests for the Internet Bookstore | 344 |
| | Top 10 Design-Driven Testing Errors (the “Don’ts”) | 369 |
| | More Practice | 370 |
| | Summary | 371 |
| ■ CHAPTER 13 | Addressing Requirements | 373 |
| | Requirements Gathering in Theory | 374 |
| | Top 10 Requirements Gathering Guidelines | 374 |
| | Why Bother Tracking Requirements? | 377 |
| | Requirements Allocation and Traceability in Theory | 378 |
| | Requirements Gathering in Practice | 379 |
| | Organizing Requirements in EA: BillyBob 2.0 | 379 |
| | Using a Visual Modeling Tool to Support Requirements | 382 |
| | More Practice | 389 |
| | Summary | 390 |

PART 5 ■ ■ ■ Appendixes

| | | |
|---------------------|---|-----|
| ■ APPENDIX A | What's New in UML 2.0 | 395 |
| | Overview of Changes in UML 2.0 | 395 |
| | Composite Structure Diagrams | 396 |
| | Activity and State Diagrams | 399 |
| | Sequence and Interaction Overview Diagrams | 401 |
| | Timing Diagrams | 404 |
| | Component and Deployment Diagrams | 406 |
| | What's Still Missing in UML | 407 |
| ■ APPENDIX B | Spring Bin | 409 |
| | Spring in More Detail | 409 |
| | A (Very) Brief Example of IoC | 409 |
| | Models, Views, and Controllers | 412 |
| | Internet Bookstore Design: Spring Details | 414 |
| | "Show Book Details" Use Case | 414 |
| | "Write Customer Review" Use Case | 416 |
| | Internet Bookstore Implementation: Spring Details | 417 |
| | Folder Structure | 418 |
| | Contents of the war\WEB-INF Folder | 418 |
| | Contents of the war\WEB-INF\jsp and | |
| | war\WEB-INF\jsp\include Folders | 421 |
| | Java Package Hierarchy | 422 |
| ■ INDEX | | 425 |

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Doug has been providing system development tools and training for nearly two decades, with particular emphasis on object-oriented methods. He developed a unified Booch/Rumbaugh/Jacobson design method in 1993 that preceded Rational's UML by several years. He has produced more than a dozen multimedia tutorials on object technology, including "COMPREHENSIVE COM" and "Enterprise Architect for Power Users," and is the coauthor of *Use Case Driven Object Modeling with UML* (Addison-Wesley, 1999) and *Applying Use Case Driven Object Modeling with UML* (Addison-Wesley, 2001), both with Kendall Scott, as well as *Extreme Programming Refactored: The Case Against XP* (Apress, 2003) with Matt Stephens, and *Agile Development with ICONIX Process* (Apress, 2005) with Matt Stephens and Mark Collins-Cope.

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Acknowledgments

First and foremost, **thanks to Gary Cornell** for picking up this project midstream.

Thanks to Geoff Sparks and the folks at Sparx Systems for building a great product, for tailoring it to support ICONIX Process, and for helping us with the UML 2.0 tutorial in Appendix A.

Thanks to Philip Nortey for his valuable feedback and his contribution to the chapter on design-driven testing; to Chuck Suscheck for his reviews and insights, especially about the student exercises; and to Mark Collins-Cope for his contribution to the architecture chapter.

And thanks, of course, to the Apress team: Gary; our editor, Jonathan Gennick; “The PM,” Tracy Brown-Collins (Queen of the 48-hour chapter-editing turnaround deadline), without whose schedule this project would have forever remained in “manuscript paralysis”; “The World’s Greatest Copy Editor” (once again), Nicole Flores; Diana Van Winkle for the outstanding design; and our production editor, Laura Cheu.

Preface

Matt's Preface

This book illustrates how to get from use cases to working, maintainable source code in as few steps as possible . . . but without cutting the essential corners. It's also about how to minimize the amount of rework you need to do once you've *gotten* to source code.

Learning by Doing

In this book we've tried to capture the essential qualities of Doug's ICONIX training courses—that is, the “magic qualities” of **learning by doing**. The ICONIX Jumpstart courses are very practical and hands-on; they draw students in by encouraging them to learn new skills by practicing, often on the real projects that they'll be returning to once the course is finished.

This idea of learning by doing has long been recognized as an optimal form of education. Even at the start of the twentieth century, John Dewey, an American psychologist and educational reformer, recognized that learning from experience gives rise to increasing productivity. The key is to engage the brain with practical tasks rather than to fall into the all-too-familiar “study trap” of rote learning. Memorizing long lists of names or API functions might help someone score highly on a test, but it isn't the same as understanding a subject in depth. For one thing, people tend not to retain information for very long if they've simply memorized it.

In this book, we do several things to avoid the “rote learning” trap. We walk through example diagrams, each starting with a blank screen, and show the steps—and, essentially, the thought process—involved in creating the various types of diagrams. Each step in the ICONIX Process finishes with a review. For the review milestones, we've had some fun and created fictional dialogues between a reviewer and a developer, to demonstrate the sorts of issues that reviewers or senior developers should address at each stage. We also highlight the most common (and the most dangerous) mistakes that developers tend to make.

A key part of learning by doing concerns **learning from your mistakes**. From the day we're born, we learn by discovering how *not* to do things, and then trying over and over until we get it right. Experts eventually “perfect” their art because they no longer make mistakes (at least none that they'll admit to!). So again, we've applied the principle in this book and created an Internet Bookstore example that we follow from use cases to source code, making plenty of “deliberate mistakes” along the way, which then get corrected. Also, throughout the book, you'll find **workbook exercises**, **student exercises**, and **inline exercises** within the chapters. (See the “Introduction” section for more information about these different types of exercises.)

The large number of exercises and step-by-step examples should help to explain why this book contains around 400 pages, to describe a process that is essentially “minimal yet sufficient.” You could say that it's a 150-page book at heart, but it's packed with an unusual number of exercises and examples. It's safe to say that after reading this book and completing all the exercises, you'll have a thorough, in-depth understanding of use case-driven object modeling!

ICONIX: A Pluggable Process

ICONIX Process is a “cookbook” process in that it describes a series of specific steps that we’ve found work really well on many different projects. However, it doesn’t prescribe the project life-cycle side of things in the way that most other development methodologies do.

So the decision of whether to do just a little bit of up-front modeling before code (one use case at a time) or model all the use cases first before coding is entirely yours to make. You can be as agile (with short iterations and quick, successive releases) or as “waterfall” (first writing all the requirements, then doing all the design, and then writing all the code) as befits your project, and still be following ICONIX Process.¹

For this reason, the process should plug neatly into other development methodologies, as it covers the analysis and design steps but doesn’t make any fixed assumptions about the project life cycle. But however you choose to apply the process to your own projects, we hope you’ll start to see positive results very quickly.

Matt Stephens

Software Reality, www.softwarereality.com

Doug’s Preface

It was 13 or 14 years ago, somewhere around 1992 or 1993, when one of my first training clients, Dan Mosten of Philip Morris in New York, said to me, “You should write a cookbook on how to design for OO. My people like cookbooks.”

At that time, Grady Booch was at Rational, Jim Rumbaugh was at GE writing books about OMT, and Ivar Jacobson was in Sweden working on his Objectory CASE Tool. There was no UML, no Java language, no C#/.NET, and the Internet itself largely existed only in universities. Smalltalk and C++ were the dominant object-oriented (OO) languages. The ancestor of Rational Rose was being developed by Jon Hopkins at Palladio Software as a Booch diagramming tool for the PC. There was no eXtreme Programming (jumping too quickly to code was known as “hacking” back then), and no Agile Manifesto had yet declared tools and process to be second-class citizens.

The More Things Change, the More They Stay the Same

At ICONIX, we were trying to make some sense out of OO analysis and design (like everybody else), and our efforts produced a tool called ObjectModeler, which supported Booch, Rumbaugh (OMT), and Jacobson (Objectory) methods. We got into training because we had to—nobody would buy our object-oriented analysis and design (OOAD) tool if they didn’t understand OOAD.

We synthesized what is now known as ICONIX Process (and was originally called “A Unified Object Modeling Approach”) from what we felt were the best aspects of the three methodologies that were combined a few years later to form the UML. As we did this, *it seemed clear that the art of driving object models from use cases ought to be the core of our approach*, and

1. Most projects benefit from being somewhere between these two extremes. We show how to fit ICONIX Process into an “ideal medium” agile project life cycle in this book’s companion volume, *Agile Development with ICONIX Process* (Apress, 2005).

as we gained experience in teaching it to clients, it became obvious that Jacobson's approach (use cases, robustness diagrams, and sequence diagrams) really worked pretty well.

In fact ***it continually amazed us how well it worked on a wider and wider range of projects***. Experience in teaching the process convinced us that the “missing link” between requirements and design was the robustness diagram, and when UML was created and this diagram got relegated to an obscure appendix in the UML specification, we were seriously concerned that it would become a lost art form.

Our training business was given a bit of a boost when UML came into existence, as suddenly a lot more people were interested in how to do OOAD using a combined Jacobson/Rumbaugh/Booch approach, while our tools business (being Macintosh-based) didn't fare as well.

So ICONIX became a training company instead of a tools company, and, as our experience delivering training grew, there eventually came an opportunity to write a book: *Use Case Driven Object Modeling* (UCDOM), which I wrote with Kendall Scott. One of the reviewers of that book, Greg Wilson of *Dr. Dobbs Journal*, suggested that we write an example-intensive companion workbook, which we did. *Applying Use Case Driven Object Modeling* (AUCDOM), built around the Internet Bookstore example, was published a few years later.

The Truth About Disambiguation

Meanwhile, we continued to deliver training, year after year, and (as far as we could tell) our clients continued to succeed with it. At least, they kept hiring us back to teach additional classes, which was the best metric we could think of for judging this.

OO technologies such as CORBA and COM appeared on the scene, followed by Java, DCOM, EJBs, C#, and .NET, and our use case-driven approach just kept right on working without skipping a beat. Occasionally we'd sit back and ponder why it hadn't broken, and it seemed like we (following in Ivar Jacobson's footsteps) had hit on a systematic approach that provided the answers to some fundamentally important questions that addressed the issue of how to get from use cases to code. This approach involved things like understanding all the scenarios and user interactions (both sunny- and rainy-day scenarios) before trying to do design; taking a little bit of extra time to disambiguate the behavior requirements before attacking detailed design issues; and focusing on “object discovery” first and “behavior allocation” (assigning operations to classes) later.

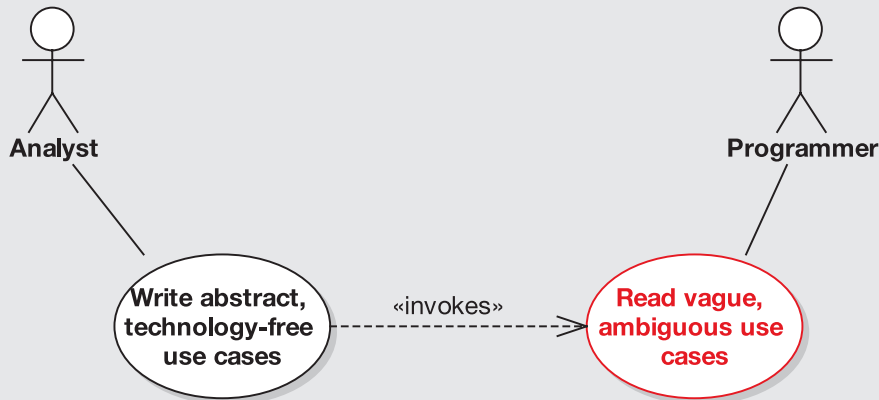
As the years went by and the number of training classes grew from dozens to hundreds, it became increasingly obvious that the notion of ***disambiguating behavior requirements using robustness diagrams*** was one of the most important “fundamental truths” that had emerged from Jacobson's work.

We can state that fundamental truth as follows: ***one of the main reasons that programmers get frustrated by attempts to bring analysis and design (and especially use cases) into their projects is that they are generally given vague and ambiguous requirements to design against***. And the reason for so much ambiguity in use cases is that so many of the books and gurus out there preach “abstract, essential, technology-free, and implementation-independent” as the right way to write use cases.

To carry it one small step further, I'll make the following claim: if you hand a programmer an abstract, technology-free, implementation-independent, “essential” use case, that programmer will find the use case to be vague, ambiguous, incomplete, and therefore incorrect.

FOOTLOOSE AND TECHNOLOGY-FREE

Without disambiguation, analysts write “essential, abstract, technology-free, and implementation-independent” use cases. The programmers who must read these use cases are, from their perspective, reading “vague, ambiguous, incomplete, and incorrect” use cases.



These use cases don't have enough detail to allow programmers to get to code while driving the OO design from the use cases. So, the use case-driven process doesn't work very well without robustness analysis (a technique we describe in detail in this book).

ICONIX Process seems to resonate better with programmers than many other approaches to use cases and UML/OOAD because it actually **forces the use cases into concrete, tangible, and specific statements of required system behavior** that programmers can deal with efficiently. If there's a secret to all of this, that's it.

What's New

I took a writing detour for a few years (while continuing to deliver training in ICONIX Process) and Matt Stephens and I wrote *Extreme Programming Refactored: The Case Against XP*² and *Agile Modeling with ICONIX Process*³ for Apress. Matt and I discovered that we work pretty well together, so he's joined me for the current effort. Meanwhile, *Use Case Driven Object Modeling* continues to sell and reached somewhere around 45,000 copies, including Chinese, Japanese, and Korean editions the last time I checked.

When we decided to do an update, we determined that there were a number of things that we could do that might justify a new edition (aka this book), including the following:

2. See www.softwarereality.com/ExtremeProgrammingRefactored.jsp.
3. See www.softwarereality.com/AgileDevelopment.jsp.

- Merge UCDDOM and AUDDOM into a single title, all based around the Internet Bookstore example
- Add student exercises, with the idea that some universities might start using the book as a text
- Create “top 10 to-do” lists, in addition to the “top 10 error” lists we already had
- Carry the Internet Bookstore forward all the way through code and test
- Update the process with a few new tricks we’ve learned over the years, and fully leverage some advances in modeling tools
- Update the book to be current with the new UML 2.0 specification (and with Ivar Jacobson’s new ideas on aspect-oriented programming [AOP])

As you’ll see, these goals have resulted in a typical chapter structure that’s in three parts: “Theory” (the process explained, using the Internet Bookstore as a running example), “Practice” (workbook exercises), and “More Practice” (student exercises). Matt went ahead and implemented a small Internet bookstore in Java, complete with unit tests driven from the use cases, which has allowed us to extend the book both in breadth and depth over the original titles (thanks, Matt).

We think that we’ve improved upon the original books in a number of ways, and we hope that you agree and like the result.

Doug Rosenberg
ICONIX, www.iconixsw.com

Introduction

The difference between “theory” and “practice” is that in theory there is no difference between theory and practice, but in practice, there is.

Doug has been using this phrase to open each and every training class for so long now that he’s forgotten where he first heard it. Matt did some research and found that it’s commonly credited to a Jan L. A. van de Snepscheut, who, in addition to having a wonderful name, was quite a distinguished professor at Caltech.⁴

Matt also found the quote attributed to Yogi Berra, who said, “In theory there is no difference between theory and practice. In practice there is.”⁵ This makes us wonder if Professor Snepscheut might have been a baseball fan, or if Yogi made a practice of attending lectures at Caltech in the off-season, but no matter—they were both right.

Regardless of who said it first, we like to apply this statement to UML modeling, because, to be blunt, **UML is way too big**. A project trying to ingest all of UML into its working practices resembles a python that has just swallowed a pig. It’s going to take an awfully long time to digest, and your project probably can’t afford it.

The Unified Modeling Language User Guide by Grady Booch, James Rumbaugh, and Ivar Jacobson (Addison-Wesley, 1998) tells us that “**you can do 80% of your modeling with 20% of the UML**” somewhere after page 400.⁶ They would have saved the industry many millions (billions?) of dollars and horrific cases of analysis paralysis (see the upcoming sidebar titled “The Mysterious Case of Analysis Paralysis”) if they had said that in the Introduction, but they didn’t. To compound the felony, **they never tell us which 20% of UML is the useful part**.

Most people that we meet *usually* want to apply UML in the up-front stages of their project. And most of them *usually* want to start their analysis process with use cases. So, in our search for the “**minimal, yet sufficient**” **core subset** of UML, we focus on the question, **How do you get from use cases to code?**

So, in *theory*, everything in the UML is useful, but in *practice*, a whole lot of people and projects need to know how to drive an OO software design from use cases. And they also need to know which diagrams from the UML directly help to accomplish this.

This book explains the minimalist, core subset of UML and the thought process behind using it to drive OO software designs from use cases (collectively referred to as ICONIX Process), with an eye toward the practical as opposed to the theoretical. We hope the journey will be both informative and entertaining.

4. Read Edgser W. Dijkstra’s “In Memoriam” for Professor Snepscheut at www.cs.utexas.edu/users/EWD/transcriptions/EWD11xx/EWD1177.html.

5. More Yogi-isms can be found here: http://en.wikiquote.org/wiki/Yogi_Berra. Yogi also said, “It’s tough to make predictions, especially about the future,” which clearly applies to software cost estimation, and “It was hard to have a conversation with anyone; there were so many people talking,” which is applicable to the “all the programmers in one big room” XP working environment.

6. See page 431 of the first edition.

THE MYSTERIOUS CASE OF ANALYSIS PARALYSIS

It was a blustery, cold, rainy night at our flat on Baker Street. The howl of the wind whipping raindrops against the windows could be heard over Holmes' violin as I read the paper in front of the fireplace. Mrs. Hudson had just cleared away the dishes from our late supper of pork pie and beans, when Holmes suddenly paused in the aria he was playing, sat bolt upright in his chair, and exclaimed, "Watson, the game's afoot!"

A few moments later, our good friend Inspector Lestrade from Scotland Yard clattered up the stairs and burst in the doorway, exclaiming, "Thank goodness you're home, Mr. Holmes—you've got to come quickly!"

"Come in, Lestrade. Pray take a seat by the fire and tell us every detail," said Holmes.

"They're all dead, Mr. Holmes, every one of them—the whole project's dead! And no signs of violence, not a mark on any of them!" said Lestrade.

"Who's dead?" I asked.

"The entire staff of Scotland Yard's new automated fingerprint recognition system," Lestrade responded. "The whole technical staff . . . sitting dead right in the conference room . . . as if they'd been frozen to their chairs!"

"Has anything been touched?" asked Holmes.

"No, I've left the strictest instructions that the conference room be completely sealed off until you could inspect it," said Lestrade.

"Most excellent," murmured Holmes. "You are learning, Lestrade. Come along, Watson." Grabbing our coats and hats, we hastened down to Lestrade's waiting hansom cab.

We arrived shortly at Scotland Yard and were escorted to the conference room, where we were confronted by a bizarre and grisly death scene. Still in their seats, but struck down by some mysterious assassin, was the entire staff of the new automated fingerprint recognition project. Holmes walked around the room excitedly, his highly trained senses alert for any sort of clue. He paused at the whiteboard, and again at a stack of UML books on the table.

"You see, Mr. Holmes, they're all dead, and not a mark on any of them. How could a whole project just die like that?" asked Lestrade.

"Elementary, my dear Lestrade. A clear case of that obscure poison from the Amazon jungle known as *analysisparalysisflagrantis*. Perhaps you've seen my monograph on the topic? No? Tut, tut," murmured Holmes.

"But Holmes, how can you be sure?" I queried. "All I can see is these UML books scattered around the table. Here's one called **Fully Dressed Use Cases: The Hallway Closet Approach** by Professor Moriarty. It suggests you should stuff everything you can think of into your use cases, just like you do with the hallway closet," I said.

"You *see*, Watson, but you do not *observe*. Notice the three-day growth of beard on all the corpses, and the scrawls of <<includes>> and <<extends>> on the whiteboards?" asked Holmes.

"Sure enough, Mr. Holmes," said Lestrade. "Even the women have grown beards!"

"Great Scott!" I exclaimed. "Gives me the shivers."

"Analysis paralysis, Watson," said Holmes. "The second fastest killer of software projects, after *DoingTheSimplestThingThatCanPossiblyWork*, and nearly as dangerous. It's caused by a lethal overdose of formality and strict adherence to the UML semantics documentation. Moriarty's been up to his evil tricks again. You see the hollow expressions on the victims' faces, caused by interminable meetings spent debating topics of marginal uselessness. The despair and the anguish. The feverish search for a practical approach instead of highbrow theories. And all so easily avoidable," he sighed. "Come along, Watson, we have arrived too late."

We headed homeward toward Baker Street and the fireplace.

Theory, in Practice

Each chapter in this book starts with the theory, and then explores said theory using the Internet Bookstore project. Over the course of the book, we'll demonstrate, in practice, the theory of getting from use cases to source code, using the Internet Bookstore as the main example throughout.

The practice doesn't stop there, though. This book also contains practical exercises of various types, which we describe here.

Workbook Exercises

It's been clear for some time that the process of reviewing models is critically important and not well understood by many folks. So, in this book, we dissect the design of the Internet Bookstore, step by step, in great detail. This involves showing many common mistakes, and then showing the relevant pieces of the model with their mistakes corrected.

We've been teaching workshops using the Internet Bookstore example for many years, and as a result we have a rich source of classroom UML models with real student mistakes in them. We've collected some of our favorite mistakes—that is, the kinds of mistakes we saw repeated over and over again—and turned these into workbook exercises that you can find at the end of many of the chapters.

The following aspects are common to each set of exercises:

- There's an example diagram, with some errors intentionally left in.
- There's **a corrected version of the diagram a few pages later**. Corrections to the errors presented on the associated “bad” page are explicitly indicated; **explanations of the mistakes are provided in detail**.

Student Exercises

At the end of most chapters in the “More Practice” section, you'll find student exercises to help you to test whether you truly “got” what the chapter is about. These exercises are in the form of more traditional numbered questions, and can thus be assigned as tasks for students.

For this reason, we don't provide the answers to these exercises in the book, although of course it's possible to *learn* the answers by reading and understanding the chapters! We do plan to provide some sort of “teacher's guide” material on the book's website, www.iconixprocess.com. The exact form of this teacher's guide has yet to be determined, so check the website for details.

Inline Exercises Within the Chapters

Getting things right first time is great, but getting something wrong initially and then **learning from your mistakes** is a *much* better way to learn. Because of the way your brain is wired, you end up with a deeper understanding of the subject that way.

As we develop the example Internet Bookstore application through the course of the book, we don't just show the right thing to do next. We slip some “deliberate” mistakes into the diagrams, and then discover and correct them later (usually in the review chapters). However, unlike the “More Practice” exercises (where we do reveal the errors, in great detail), we don't

tell you precisely what the mistake is for these inline exercises. Instead, we provide a clue as to the nature of the error, and then invite you to scrutinize the diagram (and the relevant review chapter) and figure out what's wrong with it.

Trying to figure out what's wrong in the diagram is a good way to learn, but there's another element to this. Notice that we didn't say "the answer can be found on page 141" or "check the list of answers at the end of this chapter," as that would be too easy. An important part of the learning process is in searching through the next chapter, looking for the paragraph that reveals the answer. You'll be surprised how well you learn while you're hunting down the solution to a particular problem.

Cool set of premises, aren't they? We're not aware of another book like this one, and we're hoping you'll find it useful in your efforts to apply use case-driven object modeling with UML.

Top 10 Things People Who Use ICONIX Process Like About It

Each chapter in this book kicks off with a top 10 list of guidelines, and the first half of each chapter is structured around its top 10 list. For this Introduction, we've put together a list of the top 10 comments that we've heard from clients who've applied ICONIX Process on their own projects.

10. *The process uses a core subset of UML.*

(We'd rather learn 4 diagrams than 14 . . .)

9. *It actually gets me all the way to code.*

(I have 13 use case books on my shelf that don't get within 50 miles of code.)

8. *It's traceable from one step to the next.*

7. *It addresses both sunny- and rainy-day scenarios.*

(If another one of my programmers tells me they're "Doing The Simplest Thing That Could Possibly Work" [DTSTTCPW], I think I'm gonna scream.)

6. *It assumes that the requirements I'm initially given are vague, ambiguous, incomplete, and incorrect.*

(Have Doug and Matt actually met our business analysts?)

5. *It actually drives the OO design from the use cases.*

(I know RUP says that it's use case-driven, but I get lost somewhere around the Elaboration phase.)

4. *It works well in an "agile" (short iteration, small increment) environment.*

(I wish somebody would write a book on how to do Agile/ICONIX, though.)⁷

7. We did: *Agile Development with ICONIX Process* (Apress, 2005).

3. *It doesn't drown me in five-syllable buzzwords.*

(What about multiple polymorphic inheritance, anyway?)⁸

2. *It operates at a tangible level where the use cases talk about what the users are doing on the screens, and there are no huge use case templates.*

(In other words, the use cases aren't abstract, essential, technology-free, or implementation independent.)

1. *It's a practical approach that's been proven to work in the real world, on hundreds of projects.*

8. Although we do have fun making up new buzzwords and phrases, like “disintermangling dysfunctional requirements.”

