

Software Requirements, Third Edition

Karl Wiegers and Joy Beatty

Contents at a glance

<i>Introduction</i>	xxv	
<i>Acknowledgments</i>	xxxii	
<hr/>		
PART I	SOFTWARE REQUIREMENTS: WHAT, WHY, AND WHO	
CHAPTER 1	The essential software requirement	3
CHAPTER 2	Requirements from the customer's perspective	25
CHAPTER 3	Good practices for requirements engineering	43
CHAPTER 4	The business analyst	61
<hr/>		
PART II	REQUIREMENTS DEVELOPMENT	
CHAPTER 5	Establishing the business requirements	77
CHAPTER 6	Finding the voice of the user	101
CHAPTER 7	Requirements elicitation	119
CHAPTER 8	Understanding user requirements	143
CHAPTER 9	Playing by the rules	167
CHAPTER 10	Documenting the requirements	181
CHAPTER 11	Writing excellent requirements	203
CHAPTER 12	A picture is worth 1024 words	221
CHAPTER 13	Specifying data requirements	245
CHAPTER 14	Beyond functionality	261
CHAPTER 15	Risk reduction through prototyping	295
CHAPTER 16	First things first: Setting requirement priorities	313
CHAPTER 17	Validating the requirements	329
CHAPTER 18	Requirements reuse	351
CHAPTER 19	Beyond requirements development	365
<hr/>		
PART III	REQUIREMENTS FOR SPECIFIC PROJECT CLASSES	
CHAPTER 20	Agile projects	383
CHAPTER 21	Enhancement and replacement projects	393
CHAPTER 22	Packaged solution projects	405
CHAPTER 23	Outsourced projects	415

CHAPTER 24	Business process automation projects	421
CHAPTER 25	Business analytics projects	427
CHAPTER 26	Embedded and other real-time systems projects	439
<hr/>		
PART IV	REQUIREMENTS MANAGEMENT	
CHAPTER 27	Requirements management practices	457
CHAPTER 28	Change happens	471
CHAPTER 29	Links in the requirements chain	491
CHAPTER 30	Tools for requirements engineering	503
<hr/>		
PART V	IMPLEMENTING REQUIREMENTS ENGINEERING	
CHAPTER 31	Improving your requirements processes	517
CHAPTER 32	Software requirements and risk management	537
<hr/>		
<i>Epilogue</i>		549
<i>Appendix A</i>		551
<i>Appendix B</i>		559
<i>Appendix C</i>		575
<i>Glossary</i>		597
<i>References</i>		605
<hr/>		
<i>Index</i>		619

Contents

<i>Introduction</i> .....	.xxv
<i>Acknowledgments</i>	xxxi

PART I SOFTWARE REQUIREMENTS: WHAT, WHY, AND WHO

Chapter 1 The essential software requirement	3
Software requirements defined	5
Some interpretations of "requirement"	6
Levels and types of requirements	7
Working with the three levels	12
Product vs. project requirements	14
Requirements development and management.....	15
Requirements development.....	15
Requirements management.....	17
Every project has requirements	18
When bad requirements happen to good people	19
Insufficient user involvement.....	20
Inaccurate planning.....	20
Creeping user requirements.....	20
Ambiguous requirements.....	21
Gold plating	21
Overlooked stakeholders	22
Benefits from a high-quality requirements process.....	22
Chapter 2 Requirements from the customer's perspective	25
The expectation gap.....	26
Who is the customer?.....	27
The customer-development partnership	29
Requirements Bill of Rights for Software Customers.....	31
Requirements Bill of Responsibilities for Software Customers.....	33

Creating a culture that respects requirements	36
Identifying decision makers	38
Reaching agreement on requirements	38
The requirements baseline.....	39
What if you don't reach agreement?	40
Agreeing on requirements on agile projects	41
Chapter 3 Good practices for requirements engineering	43
A requirements development process framework	45
Good practices: Requirements elicitation.....	48
Good practices: Requirements analysis.....	50
Good practices: Requirements specification	51
Good practices: Requirements validation.....	52
Good practices: Requirements management	53
Good practices: Knowledge	54
Good practices: Project management.....	56
Getting started with new practices	57
Chapter 4 The business analyst	61
The business analyst role.....	62
The business analyst's tasks	63
Essential analyst skills.....	65
Essential analyst knowledge	68
The making of a business analyst.....	68
The former user	68
The former developer or tester	69
The former (or concurrent) project manager	70
The subject matter expert	70
The rookie	71
The analyst role on agile projects	71
Creating a collaborative team.....	72

PART II REQUIREMENTS DEVELOPMENT

Chapter 5 Establishing the business requirements	77
Defining business requirements.....	78
Identifying desired business benefits.....	78
Product vision and project scope	78
Conflicting business requirements	80
Vision and scope document	81
1. Business requirements	83
2. Scope and limitations	88
3. Business context.....	90
Scope representation techniques.....	92
Context diagram.....	92
Ecosystem map.....	94
Feature tree.....	95
Event list.....	96
Keeping the scope in focus.....	97
Using business objectives to make scoping decisions.....	97
Assessing the impact of scope changes.....	98
Vision and scope on agile projects	98
Using business objectives to determine completion	99
Chapter 6 Finding the voice of the user	101
User classes	102
Classifying users.....	102
Identifying your user classes	105
User personas	107
Connecting with user representatives.....	108
The product champion	109
External product champions	110
Product champion expectations.....	111
Multiple product champions	112

Selling the product champion idea	113
Product champion traps to avoid	114
User representation on agile projects	115
Resolving conflicting requirements	116
Chapter 7 Requirements elicitation	119
Requirements elicitation techniques	121
Interviews	121
Workshops	122
Focus groups	124
Observations	125
Questionnaires	127
System interface analysis	127
User interface analysis	128
Document analysis	128
Planning elicitation on your project	129
Preparing for elicitation	130
Performing elicitation activities	132
Following up after elicitation	134
Organizing and sharing the notes	134
Documenting open issues	135
Classifying customer input	135
How do you know when you're done?	138
Some cautions about elicitation	139
Assumed and implied requirements	140
Finding missing requirements	141
Chapter 8 Understanding user requirements	143
Use cases and user stories	144
The use case approach	147
Use cases and usage scenarios	149
Identifying use cases	157

Exploring use cases	158
Validating use cases.....	160
Use cases and functional requirements.....	161
Use case traps to avoid	163
Benefits of usage-centric requirements	164
Chapter 9 Playing by the rules	167
A business rules taxonomy	169
Facts	170
Constraints.....	170
Action enablers.....	171
Inferences	173
Computations.....	173
Atomic business rules	174
Documenting business rules.....	175
Discovering business rules.....	177
Business rules and requirements	178
Tying everything together.....	180
Chapter 10 Documenting the requirements	181
The software requirements specification	183
Labeling requirements	186
Dealing with incompleteness.....	188
User interfaces and the SRS	189
A software requirements specification template	190
1. Introduction	192
2. Overall description.....	193
3. System features	194
4. Data requirements.....	195
5. External interface requirements	196
6. Quality attributes.....	197
7. Internationalization and localization requirements.....	198
8. [Other requirements]	199

Appendix A: Glossary	199
Appendix B: Analysis models	199
Requirements specification on agile projects	199
Chapter 11 Writing excellent requirements	203
Characteristics of excellent requirements.....	203
Characteristics of requirement statements	204
Characteristics of requirements collections.....	205
Guidelines for writing requirements	207
System or user perspective.....	207
Writing style	208
Level of detail	211
Representation techniques.....	212
Avoiding ambiguity.....	213
Avoiding incompleteness	216
Sample requirements, before and after	217
Chapter 12 A picture is worth 1024 words	221
Modeling the requirements	222
From voice of the customer to analysis models	223
Selecting the right representations	225
Data flow diagram	226
Swimlane diagram.....	230
State-transition diagram and state table	232
Dialog map.....	235
Decision tables and decision trees.....	239
Event-response tables	240
A few words about UML diagrams.....	243
Modeling on agile projects.....	243
A final reminder.....	244

Chapter 13 Specifying data requirements	245
Modeling data relationships.....	.245
The data dictionary.....	.248
Data analysis .....	.251
Specifying reports.....	.252
Eliciting reporting requirements.....	.253
Report specification considerations .....	.254
A report specification template.....	.255
Dashboard reporting .....	.257
Chapter 14 Beyond functionality	261
Software quality attributes .....	.262
Exploring quality attributes.....	.263
Defining quality requirements .....	.267
External quality attributes .....	.267
Internal quality attributes.....	.281
Specifying quality requirements with Planguage .....	.287
Quality attribute trade-offs.....	.288
Implementing quality attribute requirements.....	.290
Constraints .....	.291
Handling quality attributes on agile projects .....	.293
Chapter 15 Risk reduction through prototyping	295
Prototyping: What and why .....	.296
Mock-ups and proofs of concept.....	.297
Throwaway and evolutionary prototypes.....	.298
Paper and electronic prototypes .....	.301
Working with prototypes.....	.303
Prototype evaluation .....	.306

Risks of prototyping	307
Pressure to release the prototype.....	308
Distraction by details.....	308
Unrealistic performance expectations	309
Investing excessive effort in prototypes	309
Prototyping success factors	310
Chapter 16 First things first: Setting requirement priorities	313
Why prioritize requirements?	314
Some prioritization pragmatics	315
Games people play with priorities	316
Some prioritization techniques	317
In or out.....	318
Pairwise comparison and rank ordering	318
Three-level scale.....	319
MoSCoW	320
\$100	321
Prioritization based on value, cost, and risk.....	322
Chapter 17 Validating the requirements	329
Validation and verification.....	331
Reviewing requirements	332
The inspection process	333
Defect checklist	338
Requirements review tips	339
Requirements review challenges.....	340
Prototyping requirements.....	342
Testing the requirements.....	342
Validating requirements with acceptance criteria.....	347
Acceptance criteria	347
Acceptance tests.....	348

Chapter 18 Requirements reuse	351
Why reuse requirements?	352
Dimensions of requirements reuse	352
Extent of reuse	353
Extent of modification.....	354
Reuse mechanism.....	354
Types of requirements information to reuse	355
Common reuse scenarios	356
Software product lines	356
Reengineered and replacement systems.....	357
Other likely reuse opportunities	357
Requirement patterns	358
Tools to facilitate reuse	359
Making requirements reusable.....	360
Requirements reuse barriers and success factors	362
Reuse barriers	362
Reuse success factors.....	363
Chapter 19 Beyond requirements development	365
Estimating requirements effort	366
From requirements to project plans	369
Estimating project size and effort from requirements	370
Requirements and scheduling	372
From requirements to designs and code	373
Architecture and allocation	373
Software design	374
User interface design.....	375
From requirements to tests.....	377
From requirements to success	379

PART III REQUIREMENTS FOR SPECIFIC PROJECT CLASSES

Chapter 20 Agile projects	383
Limitations of the waterfall	384
The agile development approach	385
Essential aspects of an agile approach to requirements	385
Customer involvement	386
Documentation detail	386
The backlog and prioritization	387
Timing	387
Epics, user stories, and features, oh my!	388
Expect change	389
Adapting requirements practices to agile projects	390
Transitioning to agile: Now what?	390
Chapter 21 Enhancement and replacement projects	393
Expected challenges	394
Requirements techniques when there is an existing system	394
Prioritizing by using business objectives	396
Mind the gap	396
Maintaining performance levels	397
When old requirements don't exist	398
Which requirements should you specify?	398
How to discover the requirements of an existing system	400
Encouraging new system adoption	401
Can we iterate?	402
Chapter 22 Packaged solution projects	405
Requirements for selecting packaged solutions	406
Developing user requirements	406
Considering business rules	407
Identifying data needs	407

Defining quality requirements	408
Evaluating solutions	408
Requirements for implementing packaged solutions	411
Configuration requirements	411
Integration requirements	412
Extension requirements	412
Data requirements	412
Business process changes	413
Common challenges with packaged solutions	413
Chapter 23 Outsourced projects	415
Appropriate levels of requirements detail	416
Acquirer-supplier interactions	418
Change management	419
Acceptance criteria	420
Chapter 24 Business process automation projects	421
Modeling business processes	422
Using current processes to derive requirements	423
Designing future processes first	424
Modeling business performance metrics	424
Good practices for business process automation projects	426
Chapter 25 Business analytics projects	427
Overview of business analytics projects	427
Requirements development for business analytics projects	429
Prioritizing work by using decisions	430
Defining how information will be used	431
Specifying data needs	432
Defining analyses that transform the data	435
The evolutionary nature of analytics	436

Chapter 26 Embedded and other real-time systems projects	439
System requirements, architecture, and allocation.....	440
Modeling real-time systems	441
Context diagram.....	442
State-transition diagram.....	442
Event-response table.....	443
Architecture diagram.....	445
Prototyping.....	446
Interfaces	446
Timing requirements	447
Quality attributes for embedded systems	449
The challenges of embedded systems	453

PART IV REQUIREMENTS MANAGEMENT

Chapter 27 Requirements management practices	457
Requirements management process.....	458
The requirements baseline	459
Requirements version control.....	460
Requirement attributes	462
Tracking requirements status	464
Resolving requirements issues	466
Measuring requirements effort	467
Managing requirements on agile projects.....	468
Why manage requirements?.....	470
Chapter 28 Change happens	471
Why manage changes?	471
Managing scope creep.....	472
Change control policy	474
Basic concepts of the change control process.....	474

A change control process description	475
1. Purpose and scope	476
2. Roles and responsibilities	476
3. Change request status	477
4. Entry criteria	478
5. Tasks	478
6. Exit criteria	479
7. Change control status reporting	479
Appendix: Attributes stored for each request	479
The change control board	480
CCB composition	480
CCB charter	481
Renegotiating commitments	482
Change control tools	482
Measuring change activity	483
Change impact analysis	484
Impact analysis procedure	484
Impact analysis template	488
Change management on agile projects	488
Chapter 29 Links in the requirements chain	491
Tracing requirements	491
Motivations for tracing requirements	494
The requirements traceability matrix	495
Tools for requirements tracing	498
A requirements tracing procedure	499
Is requirements tracing feasible? Is it necessary?	501
Chapter 30 Tools for requirements engineering	503
Requirements development tools	505
Elicitation tools	505
Prototyping tools	505
Modeling tools	506

Requirements management tools	506
Benefits of using an RM tool	506
RM tool capabilities.....	508
Selecting and implementing a requirements tool	510
Selecting a tool.....	511
Setting up the tool and processes	511
Facilitating user adoption.....	513

PART V IMPLEMENTING REQUIREMENTS ENGINEERING

Chapter 31 Improving your requirements processes	517
How requirements relate to other project processes.....	518
Requirements and various stakeholder groups.....	520
Gaining commitment to change	521
Fundamentals of software process improvement.....	522
Root cause analysis.....	524
The process improvement cycle.....	526
Assess current practices	526
Plan improvement actions	527
Create, pilot, and roll out processes.....	528
Evaluate results.....	529
Requirements engineering process assets	530
Requirements development process assets.....	531
Requirements management process assets	532
Are we there yet?	533
Creating a requirements process improvement road map	535
Chapter 32 Software requirements and risk management	537
Fundamentals of software risk management.....	538
Elements of risk management.....	538
Documenting project risks.....	539
Planning for risk management	542

Requirements-related risks	542
Requirements elicitation.	543
Requirements analysis.	544
Requirements specification	545
Requirements validation.	545
Requirements management.	546
Risk management is your friend.	546
<i>Epilogue</i>	549
<i>Appendix A</i>	551
<i>Appendix B</i>	559
<i>Appendix C</i>	575
<i>Glossary</i>	597
<i>References</i>	605
<i>Index</i>	619