

Object-Oriented Analysis and Design for Information Systems

Modeling with UML, OCL,
and IFML

Raul Sidnei Wazlawick



AMSTERDAM • BOSTON • HEIDELBERG • LONDON
NEW YORK • OXFORD • PARIS • SAN DIEGO
SAN FRANCISCO • SINGAPORE • SYDNEY • TOKYO
Morgan Kaufmann is an imprint of Elsevier



Contents

Acknowledgments	xv
About the Author	xvii
Foreword	xix
Preface	xxi
CHAPTER 1 Introduction	1
1.1 This book	1
1.2 Object-oriented systems development	2
1.3 Unified Modeling Language (UML)	3
1.4 Unified Process (UP)	3
1.5 The process so far	6
1.6 Questions	6
CHAPTER 2 Business Modeling	7
2.1 Introduction to business modeling	7
2.2 General view of the system	9
2.3 Business use cases	13
2.3.1 Business actors and business workers	15
2.3.2 Automation opportunities	15
2.4 Business activity diagram	18
2.4.1 Basic elements	18
2.4.2 Control flow nodes	20
2.5 State-dependent aspects of a business	23
2.6 Remarks	27
2.7 The process so far	27
2.8 Questions	28
CHAPTER 3 High-Level Requirements	29
3.1 Introduction to high-level requirements	29
3.2 System actors	30
3.3 System use cases	31
3.3.1 Single session	33
3.3.2 Interactive	35
3.3.3 Consistent result	35
3.3.4 Essential	36
3.3.5 Brief	37
3.3.6 System boundary	37

3.4	How to find system use cases in the business model	38
3.5	Requirements	41
3.5.1	Requirements elicitation	41
3.5.2	Eliciting requirements is not design!	42
3.5.3	Requirements challenges	44
3.5.4	Evident and hidden functional requirements	45
3.5.5	Nonfunctional requirements	45
3.5.6	Permanence and transience of nonfunctional requirements	46
3.5.7	Mandatory and desired requirements	47
3.5.8	Supplementary requirements	47
3.6	Preliminary conceptual model	52
3.7	The process so far	57
3.8	Questions	57
CHAPTER 4 Use Case Based Project Planning (Online Chapter)		59
CHAPTER 5 Expanded Use Cases		61
5.1	Introduction to expanded use cases	61
5.2	Main flow	62
5.3	Alternate flows	64
5.3.1	Scenarios	65
5.3.2	Variants	66
5.3.3	Exception handling	69
5.4	Writing recommendations	74
5.4.1	Essential versus real use case	75
5.4.2	Explicit information	76
5.4.3	Identification and selection	77
5.4.4	Mandatory steps	77
5.4.5	Complementary steps	81
5.4.6	Unsuitable steps	82
5.5	Included use cases and fragments	83
5.6	Expansion of stereotyped use cases	84
5.6.1	Report expanded	85
5.6.2	CRUD expanded	86
5.7	Other sections of an expanded use case	89
5.7.1	Stakeholders	91
5.7.2	Preconditions	91
5.7.3	Success post-conditions	92
5.7.4	Open issues	92
5.8	System sequence diagrams	92
5.8.1	Elements of a sequence diagram	93
5.8.2	Expanded use cases as system sequence diagrams	95

5.8.3	Connecting the interface to the façade-controller.....	97
5.8.4	Stateless strategy.....	101
5.8.5	Stateful strategy.....	103
5.8.6	Alternate flows in system sequence diagrams.....	104
5.9	The process so far.....	110
5.10	Questions.....	111
CHAPTER 6	Conceptual Modeling: Fundamentals.....	113
6.1	Introduction to conceptual modeling.....	113
6.2	Attributes.....	115
6.2.1	Attribute types.....	116
6.2.2	Initial values.....	116
6.2.3	Derived attributes.....	117
6.2.4	Enumerations.....	118
6.2.5	Primitive types.....	119
6.3	Concepts.....	120
6.3.1	Unique attributes.....	121
6.3.2	System control class.....	121
6.4	Associations.....	122
6.4.1	Role multiplicity.....	124
6.4.2	Association direction.....	126
6.4.3	Derived association.....	126
6.4.4	Aggregation and composition.....	129
6.4.5	<i>n</i> -ary associations.....	130
6.5	Collections.....	132
6.5.1	Set.....	133
6.5.2	Ordered set.....	134
6.5.3	Bag.....	134
6.5.4	Sequence.....	134
6.5.5	Map.....	135
6.5.6	Partition.....	136
6.5.7	Relation.....	137
6.6	Organization of the conceptual model.....	138
6.6.1	Generalization, specialization, and inheritance.....	139
6.6.2	Association classes.....	141
6.6.3	Modal classes.....	144
6.7	Invariants.....	149
6.8	Iterative construction of the conceptual model.....	152
6.8.1	How to find concepts and attributes.....	152
6.8.2	Dependent and independent concepts.....	156
6.8.3	How to find associations.....	157
6.8.4	Example of iterative construction of the conceptual model.....	159

6.9	The process so far.....	162
6.10	Questions.....	163
CHAPTER 7	Conceptual Modeling: Patterns.....	165
7.1	Introduction to conceptual model patterns.....	165
7.2	High cohesion.....	165
7.3	Specification classes.....	168
7.4	Quantity.....	170
7.5	Measure.....	171
7.6	Strategy.....	172
7.7	Composite.....	173
7.8	Organizational hierarchy.....	174
7.9	Object joining.....	175
7.9.1	Copy and replace.....	176
7.9.2	Superseding.....	176
7.9.3	Essence/Appearance.....	177
7.9.4	Undoing a join.....	177
7.10	Account/Transaction.....	178
7.11	Range.....	182
7.12	Temporal patterns.....	183
7.12.1	Effectivity.....	185
7.12.2	History.....	185
7.12.3	Temporal.....	186
7.12.4	Bitemporal.....	187
7.13	Discussion.....	189
7.14	The process so far.....	189
7.15	Questions.....	190
CHAPTER 8	Functional Modeling with OCL Contracts.....	193
8.1	Introduction to functional modeling.....	193
8.2	Preconditions.....	196
8.2.1	Parameter guarantee.....	197
8.2.2	Complementary constraints.....	198
8.2.3	Precondition assurance.....	199
8.2.4	Preconditions and exceptions versus invariants.....	200
8.3	Transient associations.....	200
8.4	Query return.....	201
8.5	Postconditions.....	203
8.5.1	Changing an attribute value.....	205
8.5.2	Creating an instance.....	206
8.5.3	Adding a link.....	207

8.5.4	Destroying an instance	209
8.5.5	Removing a link	209
8.5.6	Well-formed postconditions	210
8.5.7	Combinations of Postconditions	211
8.5.8	Former values	212
8.5.9	Postconditions covering collections of objects	213
8.5.10	Postconditions and real-world events	214
8.6	Exceptions	214
8.7	Pattern contracts for CRUD	216
8.7.1	<i>Create</i> contract	217
8.7.2	<i>Update</i> contract	218
8.7.3	<i>Delete</i> contract	218
8.7.4	<i>Retrieve</i> contract	221
8.8	Pattern contracts for listing objects	222
8.9	Contracts related to use cases	223
8.10	The process so far	224
8.11	Questions	225
CHAPTER 9	Domain Tier Design	227
9.1	Introduction to domain tier design	227
9.2	Object responsibility distribution	229
9.3	Visibility	232
9.3.1	Visibility by association	232
9.3.2	Visibility by parameter	240
9.3.3	Locally declared visibility	242
9.3.4	Global visibility	244
9.4	Dynamic modeling based on postconditions	245
9.4.1	Instance creation	246
9.4.2	Link addition	249
9.4.3	Attribute value modification	250
9.4.4	Instance destruction	250
9.4.5	Removing and replacing a link	251
9.4.6	Conditional postconditions	253
9.4.7	Exceptions	255
9.4.8	Postconditions over collections	255
9.5	System queries	257
9.6	Delegation and low coupling	259
9.7	Design class diagram	262
9.8	The process so far	265
9.9	Questions	267

CHAPTER 10	Code Generation (Online Chapter)	269
CHAPTER 11	Testing	271
11.1	Introduction to testing.....	271
11.2	Functional testing.....	272
11.2.1	Equivalence partitioning.....	272
11.2.2	Limit value analysis.....	274
11.3	Stubs and drivers.....	274
11.4	Test-driven development.....	275
11.5	Unit testing.....	276
11.6	System operations testing.....	280
11.7	Use case testing (System, acceptance, and business cycle tests).....	282
11.8	The process so far.....	285
11.9	Questions.....	288
CHAPTER 12	Interface Tier Design with IFML	289
12.1	Introduction to interface tier design.....	289
12.2	Interaction flow modeling language (IFML).....	289
12.3	View components.....	290
12.3.1	Details.....	291
12.3.2	Multiple details.....	293
12.3.3	Simple list.....	294
12.3.4	List.....	295
12.3.5	Checkable List.....	297
12.3.6	Forms.....	297
12.3.7	Hierarchies.....	298
12.4	Pages.....	301
12.5	Flows.....	302
12.5.1	Normal navigation flow.....	302
12.5.2	Data flow.....	304
12.5.3	Parameter binding.....	304
12.5.4	Multivalued parameter binding.....	305
12.6	Hypertext organization.....	305
12.6.1	Site views.....	307
12.6.2	Areas.....	308
12.6.3	Home, landmark, and default.....	309
12.7	Web Interface Patterns.....	309
12.7.1	Cascade Index.....	309
12.7.2	Filtered index.....	312
12.7.3	Guided tour.....	313
12.7.4	Viewpoints.....	313

12.7.5 Overview plus detail.....	313
12.7.6 Top-level navigation.....	314
12.8 Modeling operations in the interface.....	317
12.8.1 Create operation.....	319
12.8.2 Delete operation.....	319
12.8.3 Update operation.....	322
12.8.4 Connect, disconnect, and reconnect operations.....	323
12.9 IFML models for CRUD operations.....	325
12.10 Use case interface modeling with IFML.....	329
12.11 The process so far.....	332
12.12 Questions.....	334
CHAPTER 13 Data Persistence (Online Chapter).....	335
Postface.....	337
References.....	339
Index.....	343