

Contents

Preface	xv
Forward	xvii
1 An Introduction to Web Engineering	1
<i>Gerti Kappel, Birgit Pröll, Siegfried Reich, Werner Retschitzegger</i>	
1.1 Motivation	1
1.2 Categories of Web Applications	4
1.3 Characteristics of Web Applications	7
1.3.1 Product-related Characteristics	8
1.3.2 Usage-related Characteristics	12
1.3.3 Development-related Characteristics	14
1.3.4 Evolution	16
1.4 Objectives and Structure of the Book	17
2 Requirements Engineering for Web Applications	23
<i>Paul Grünbacher</i>	
2.1 Introduction	23
2.2 Fundamentals	24
2.2.1 Where Do Requirements Come From?	24
2.2.2 Requirements Engineering Activities	25
2.3 RE Specifics in Web Engineering	26
2.4 Principles for RE of Web Applications	30
2.5 Adapting RE Methods to Web Application Development	32

2.5.1	Requirement Types	32
2.5.2	Notations	34
2.5.3	Tools	36
2.6	Outlook	37
3	Modeling Web Applications	39
	<i>Wieland Schwinger, Nora Koch</i>	
3.1	Introduction	39
3.2	Fundamentals	40
3.3	Modeling Specifics in Web Engineering	41
3.3.1	Levels	41
3.3.2	Aspects	42
3.3.3	Phases	42
3.3.4	Customization	43
3.4	Modeling Requirements	43
3.5	Content Modeling	45
3.5.1	Objectives	45
3.5.2	Concepts	45
3.6	Hypertext Modeling	46
3.6.1	Objectives	47
3.6.2	Hypertext Structure Modeling Concepts	47
3.6.3	Access Modeling Concepts	49
3.6.4	Relation to Content Modeling	50
3.7	Presentation Modeling	51
3.7.1	Objectives	51
3.7.2	Concepts	51
3.7.3	Relation to Hypertext Modeling	52
3.8	Customization Modeling	53
3.8.1	Objectives	54
3.8.2	Concepts	54
3.8.3	Relation to Content, Hypertext, and Presentation Modeling	58
3.9	Methods and Tools	58

3.9.1	Modeling Methods: An Overview	58
3.9.2	Model-Driven Development	61
3.9.3	Tool Support	61
3.10	Outlook	63
4	Web Application Architectures	65
	<i>Christian Eichinger</i>	
4.1	Introduction	65
4.2	Fundamentals	66
4.2.1	What is an Architecture?	66
4.2.2	Developing Architectures	67
4.2.3	Categorizing Architectures	69
4.3	Specifics of Web Application Architectures	70
4.4	Components of a Generic Web Application Architecture	71
4.5	Layered Architectures	72
4.5.1	2-Layer Architectures	72
4.5.2	<i>N</i> -Layer Architectures	73
4.6	Data-aspect Architectures	79
4.6.1	Database-centric Architectures	80
4.6.2	Architectures for Web Document Management	80
4.6.3	Architectures for Multimedia Data	81
4.7	Outlook	84
5	Technology-aware Web Application Design	85
	<i>Gerhard Austaller, Andreas Hartl, Markus Lauff, Fernando Lyardet, Max Mühlhäuser</i>	
5.1	Introduction	86
5.2	Web Design from an Evolutionary Perspective	89
5.2.1	Background	89
5.2.2	Information Design: An Authoring Activity	90
5.2.3	Software Design: A Programming Activity	92
5.2.4	Merging Information Design and Software Design	93

5.2.5	Problems and Restrictions in Integrated Web Design	94
5.2.6	A Proposed Structural Approach.....	95
5.3	Presentation Design	95
5.3.1	Presentation of Nodes and Meshes.....	96
5.3.2	Device-independent Development Approaches	97
5.4	Interaction Design	98
5.4.1	User Interaction	98
5.4.2	User Interface Organization	100
5.4.3	Navigation Design.....	101
5.4.4	Designing a Link Representation: The Anchor	101
5.4.5	Designing Link Internals: The URL	102
5.4.6	Navigation and Orientation	102
5.4.7	Structured Dialog for Complex Activities	103
5.4.8	Interplay with Technology and Architecture	104
5.5	Functional Design	105
5.5.1	Integration	105
5.5.2	Communication Paradigms and Middleware	105
5.5.3	Distributed Cross-corporate Web Applications.....	106
5.6	Outlook	107
5.6.1	Context-aware Applications	107
5.6.2	Device-independent Applications	108
5.6.3	Reusability	109
5.7	Summary	110
6	Technologies for Web Applications	111
	<i>Martin Nussbaumer, Martin Gaedke</i>	
6.1	Introduction	111
6.2	Fundamentals	112
6.2.1	Markup.....	112
6.2.2	Hypertext and Hypermedia	112
6.3	Client/Server Communication on the Web	113
6.3.1	SMTP – Simple Mail Transfer Protocol.....	113
6.3.2	RTSP – Real Time Streaming Protocol	113
6.3.3	HTTP – HyperText Transfer Protocol	113
6.3.4	Session Tracking	114

6.4	Client-side Technologies	116
6.4.1	Helpers and Plug-ins	116
6.4.2	Java Applets.....	116
6.4.3	ActiveX Controls	116
6.5	Document-specific Technologies	117
6.5.1	HTML – Hypertext Markup Language	117
6.5.2	SVG – Scalable Vector Graphics	117
6.5.3	SMIL – Synchronized Multimedia Integration Language.....	118
6.5.4	XML – eXtensible Markup Language	118
6.5.5	XSL – eXtensible Stylesheet Language	122
6.6	Server-side Technologies	126
6.6.1	URI Handlers	126
6.6.2	Web Services.....	129
6.6.3	Middleware Technologies	130
6.7	Outlook	132
7	Testing Web Applications	133
	<i>Christoph Steindl, Rudolf Ramler, Josef Altmann</i>	
7.1	Introduction	133
7.2	Fundamentals	134
7.2.1	Terminology	134
7.2.2	Quality Characteristics	135
7.2.3	Test Objectives	136
7.2.4	Test Levels	136
7.2.5	Role of the Tester	137
7.3	Test Specifics in Web Engineering.....	138
7.4	Test Approaches.....	140
7.4.1	Conventional Approaches	140
7.4.2	Agile Approaches	140
7.5	Test Scheme.....	142
7.5.1	Three Test Dimensions	142
7.5.2	Applying the Scheme to Web Applications	143
7.5.3	Examples of Using the Test Scheme	145
7.6	Test Methods and Techniques	145

7.6.1	Link Testing	147
7.6.2	Browser Testing	147
7.6.3	Usability Testing	148
7.6.4	Load, Stress, and Continuous Testing	148
7.6.5	Testing Security	149
7.6.6	Test-driven Development	150
7.7	Test Automation	150
7.7.1	Benefits and Drawbacks of Automated Tests	150
7.7.2	Test Tools	151
7.7.3	Selecting Test Tools	152
7.8	Outlook	152
8	Operation and Maintenance of Web Applications	155
	<i>Arno Ebner, Birgit Pröll, Hannes Werthner</i>	
8.1	Introduction	155
8.2	Challenges Following the Launch of a Web Application	156
8.3	Promoting a Web Application	157
8.3.1	Newsletters	158
8.3.2	Affiliate Marketing	158
8.3.3	Search Engine Marketing	159
8.3.4	Content-related Marketing	162
8.3.5	Domain Management	162
8.4	Content Management	163
8.4.1	Content Update Rate and Demand on Currency	164
8.4.2	Content Syndication	165
8.5	Usage Analysis	165
8.5.1	Usage Analysis Techniques	165
8.5.2	Statistical Indicators	167
8.5.3	User Behavior Analysis	168
8.6	Outlook	169
9	Web Project Management	171
	<i>Herwig Mayr</i>	
9.1	From Software Project Management to Web Project Management	171

9.1.1	Objectives of Software Project Management	171
9.1.2	The Tasks of Software Project Management	172
9.1.3	Conflicting Areas in Projects	173
9.1.4	Specifics of Web Project Management	173
9.2	Challenges in Web Project Management	175
9.2.1	General Challenges in Software Development	175
9.2.2	Development-related Challenges in Web Projects	176
9.2.3	Product-related Challenges in Web Projects	179
9.3	Managing Web Teams	182
9.3.1	Software Development: A Human-centered Task	182
9.3.2	The Web Project Team	183
9.3.3	The Web Project Manager	184
9.4	Managing the Development Process of a Web Application	185
9.4.1	Deploying the Tools	185
9.4.2	Measuring Progress	188
9.4.3	Project Risks	190
9.4.4	Risk Management	193
9.5	Outlook	194
10	The Web Application Development Process	197
	<i>Gregor Engels, Marc Lohmann, Annika Wagner</i>	
10.1	Motivation	197
10.2	Fundamentals	198
10.3	Requirements for a Web Application Development Process	201
10.3.1	Handling Short Development Cycles	201
10.3.2	Handling Changing Requirements	201
10.3.3	Releases with Fixed Deadlines and Flexible Contents	203
10.3.4	Parallel Development of Different Releases	203
10.3.5	Reuse and Integration	204
10.3.6	Adapting to Web Application's Complexity Level	204
10.3.7	Summary	205
10.4	Analysis of the Rational Unified Process	205
10.4.1	Introduction	205
10.4.2	General Suitability for Web Application Development	208
10.4.3	Does RUP meet the Requirements of Web Applications?	209

10.5	Analysis of Extreme Programming	211
10.5.1	Introduction	211
10.5.2	Does XP meet the Requirements of Web Application Development?	214
10.6	Outlook	216
11	Usability of Web Applications	219
	<i>Martin Hitz, Gerhard Leitner, Rudolf Melcher</i>	
11.1	Motivation	219
11.2	What is Usability?	220
11.3	What Characterizes the Usability of Web Applications?	222
11.4	Design Guidelines	225
11.4.1	Response Times	225
11.4.2	Interaction Efficiency	225
11.4.3	Colors	226
11.4.4	Text Layout	227
11.4.5	Page Structure	228
11.4.6	Navigation Structure	228
11.4.7	Multiculturality	230
11.4.8	Confidence-generating Measures	231
11.4.9	Other Design Criteria	232
11.5	Web Usability Engineering Methods	232
11.5.1	Requirements Analysis	234
11.5.2	Design	237
11.5.3	Implementation	238
11.5.4	Operation	238
11.6	Web Usability Engineering Trends	239
11.6.1	Usability Patterns	239
11.6.2	Mobile Usability	241
11.6.3	Accessibility	243
11.7	Outlook	245
12	Performance of Web Applications	247
	<i>Gabriele Kotsis</i>	
12.1	Introduction	247
12.2	What Is Performance?	248

Contents**xiii**

12.3	What Characterizes the Performance of Web Applications?	250
12.4	System Definition and Indicators	251
12.5	Characterizing the Workload	252
12.6	Analytical Techniques	254
12.6.1	Operational Analysis	254
12.6.2	Queuing Networks and Simulation Models	255
12.6.3	Measuring Approaches	257
12.7	Representing and Interpreting Results	258
12.8	Performance Optimization Methods	259
12.8.1	Acceleration Within a Web Application	260
12.8.2	Reducing Transmission Time	261
12.8.3	Server Tuning	263
12.9	Outlook	263
13	Security for Web Applications	265
	<i>Martin Wimmer, Alfons Kemper, Stefan Seltzsa</i>	
13.1	Introduction	265
13.2	Aspects of Security	266
13.3	Encryption, Digital Signatures and Certificates	268
13.3.1	Symmetric Cryptography	268
13.3.2	Asymmetric Cryptography	270
13.3.3	Digital Signatures	271
13.3.4	Certificates and Public Key Infrastructure	272
13.4	Secure Client/Server-Interaction	272
13.4.1	Point-to-Point Security	272
13.4.2	End-to-End Security	274
13.4.3	User Authentication and Authorization	276
13.4.4	Electronic Payment Systems	278
13.5	Client Security Issues	279
13.5.1	Preserving Privacy	279
13.5.2	Mobile Code Security	281
13.5.3	Phishing and Web Spoofing	282
13.5.4	Desktop Security	283
13.6	Service Provider Security Issues	285

13.6.1	Cross-Site Scripting	285
13.6.2	SQL Injection	287
13.6.3	Security of CGI Programs	289
13.6.4	Service Availability	290
13.6.5	Host Security	291
13.7	Outlook	292
14	The Semantic Web – The Network of Meanings in the Network of Documents	293
	<i>Wernher Behrendt, Nitin Arora</i>	
14.1	Fundamentals of the Semantic Web	293
14.1.1	The Role of Software Agents	294
14.1.2	The Role of Semantic Markup	296
14.1.3	The Role of Ontologies	297
14.2	Technological Concepts	298
14.2.1	Agents According to the FIPA Standard	298
14.2.2	Ontologies	300
14.2.3	Semantic Markup on the Web	303
14.3	Specifics of Semantic Web Applications	308
14.3.1	Semantic Markup	308
14.3.2	Agents	309
14.3.3	Ontologies	309
14.3.4	Semantic Web Services	310
14.3.5	Integration into Web Engineering	313
14.4	Tools	314
14.5	Outlook	315
	Glossary	317
	Author’s Bios	329
	Bibliography	337
	Credits	357
	Index	359