

Contents

Foreword	xix
Preface	xxi
1 Introduction	1
1.1 Business Processes	1
1.2 Business Processes as Enterprise Resource	3
1.3 Virtual Enterprises	4
1.4 Processes and Workflows	7
1.5 Dimensions of Workflow	8
1.6 User Support	9
1.7 Categories of Workflows	10
1.8 Application Structure	13
1.9 Workflow and Objects	14
1.10 Application Operating System	15
1.11 Software Stack	16
1.12 Document/Image Processing	17
1.13 Groupware and Workflow	18
1.14 Different Views of Applications	19
1.15 Transactional Workflow	20
1.16 Advanced Usage	22
1.17 System Requirements	24
1.17.1 Operational Requirements	24
1.17.2 Enterprise Requirements	25
1.18 Relation to Other Technologies	27
2 Business Engineering	30
2.1 Business Modeling	31
2.2 Business Logic	33

2.3	Enterprise Structure	35
2.4	Information Technology Infrastructure	38
2.5	Business Modeling Example	39
2.5.1	ARIS Easy Design	39
2.5.2	Workflow BPR	40
2.6	Business Process Reengineering	41
2.7	Process Discovery	42
2.7.1	Discovery of Activity Sequences	43
2.7.2	Example	45
2.7.3	Outlook	47
2.8	Process Optimization	47
2.8.1	Step Optimization	47
2.8.2	Organization Optimization	48
2.9	Process Analysis	49
2.9.1	Instrumentation	49
2.9.2	Simulation	51
2.9.3	Processing Statistics	51
2.9.4	Time Determination	53
2.9.5	Resource Determination	53
2.9.6	Cost Determination	54
2.9.7	Graphical Representation	55
2.9.8	User Support	55
2.9.9	Process Optimization	55
2.10	Business Engineering and Workflow	56
2.11	Monitoring	58
3	Workflow Management System Basics	61
3.1	Main Components	62
3.2	Types of Users	63
3.3	Buildtime	64
3.3.1	Graphical User Interface	65
3.3.2	Flow Definition Language	66
3.3.3	Support of Modeling Tools	68
3.3.4	Support by Line-of-Business Applications	69
3.3.5	Putting Processes into Production	70
3.3.6	Application Programming Interface	70
3.3.7	Interactive Mode	71
3.3.8	Batch Mode	72
3.4	Metamodel Overview	74
3.4.1	Organization	74
3.4.2	Process Model	78
3.4.3	Subprocess	87

3.4.4	Programs	89
3.4.5	Lists	94
3.4.6	Settings	95
3.4.7	Topology	96
3.4.8	Graphical Representation	96
3.4.9	Versioning	96
3.5	Runtime	97
3.5.1	The Life of a Process	98
3.5.2	The Life of an Activity	99
3.5.3	How Users Work with the System	101
3.5.4	Working with Workitems	102
3.5.5	Working with Processes	104
3.5.6	Working with Activities	105
3.6	Audit Trail	105
3.7	Process Management	106
3.7.1	Process Queries	107
3.7.2	Process Monitoring	108
3.7.3	Process Repair	109
3.7.4	Process History Maintenance	110
3.7.5	Process Analysis	110
3.7.6	Resource Management	111
3.8	Authorization	111
3.9	Application Programming Interface	112
3.10	System Structure	114
3.10.1	Interactions Between Workflow Management Systems	115
3.11	Workflow Standards	117
4	Metamodel	120
4.1	The Notion of a Metamodel	121
4.2	Process Data	122
4.2.1	Data Elements	123
4.2.2	Domains	124
4.2.3	Containers	126
4.3	Activities	128
4.3.1	Activity Implementations	129
4.3.2	Performing an Activity	131
4.3.3	Staff Assignment	132
4.3.4	Exit Conditions	134
4.4	Control Flow	136
4.4.1	Control Connectors	136
4.4.2	Restrictions on Control Connectors	139
4.4.3	Forks and Joins	142

4.4.4	Join Conditions	143
4.4.5	Dead Path Elimination	146
4.5	Data Flow	150
4.5.1	Data Connectors	151
4.5.2	Data Maps with the Same Target	154
4.5.3	Process Model Input and Output	156
4.6	Summary: PM-Graphs	160
4.7	Navigation	162
4.7.1	Reflecting Time	162
4.7.2	Computing Container Instances	163
4.7.3	Activity States	165
4.7.4	Predicate States	167
4.7.5	Dead Activities	168
4.7.6	Executable Activities	169
4.7.7	Returning Process Instances	171
4.7.8	Terminated Activities	172
4.7.9	Completed Activities	173
4.7.10	Selecting Activities for Execution	174
4.7.11	Performing Navigation: Computing Actual Successors	176
4.7.12	Performing Navigation: Managing Workitems	177
4.7.13	Performing Navigation: Informal Description	179
4.8	Summary: G-Instances	183
5	Advanced Functions	185
5.1	Events	185
5.2	Dynamic Modification of Workflows	188
5.3	Advanced Join Conditions	191
5.4	Container Materialization	196
5.5	Object Staging	200
5.6	Context Management	202
5.7	Performance Spheres	203
5.8	Compile Spheres	206
6	Workflows and Objects	209
6.1	Component-based Software Construction	209
6.1.1	Business Objects	210
6.1.2	Scripting	213
6.1.3	Two-Level Programming	217
6.1.4	Scripts and Robustness of Business Objects	219
6.2	Scripts in Object-Oriented Analysis and Design	220
6.3	The Object Request Broker	224
6.4	The OMG Workflow Management Facility	226

6.4.1	Major Interfaces	227
6.4.2	Some Usage Scenarios	229
6.4.3	Relation to Workflow Management Coalition Standards	231
7	Workflows and Transactions	232
7.1	Basic Transaction Concepts	234
7.1.1	The ACID Properties	234
7.1.2	Distributed Transactions	235
7.1.3	Atomic Commitment	236
7.1.4	Transaction Trees	239
7.2	Advanced Transaction Concepts	241
7.2.1	Nested Transactions	242
7.2.2	Sagas	244
7.2.3	ConTracts	245
7.3	Streams	246
7.3.1	Workitem Streams	246
7.3.2	Micro Script Streams	248
7.3.3	Transaction Streams	248
7.3.4	Work Package Streams	249
7.4	Atomic Spheres	251
7.4.1	Reusability and Transaction Boundaries	251
7.4.2	Concept of Atomic Spheres	253
7.4.3	Mechanics of Atomic Spheres	255
7.5	Compensation Spheres	259
7.5.1	Completion versus Correctness	260
7.5.2	How to Repair Pieces of Work	260
7.5.3	Concept of Compensation Spheres	261
7.5.4	The Mechanics of Compensation Spheres	269
7.6	Phoenix Behavior	274
7.6.1	Recoverable Workflows	274
7.6.2	Atomicity Versus Ensured Execution	277
7.6.3	Stratified Transactions	279
7.6.4	Safe Activities	282
8	Advanced Usage	283
8.1	Monitoring Dynamic Integrity Rules	283
8.1.1	How Workflow Can Help	285
8.1.2	Inter-transaction Integrity Rules	286
8.1.3	Clean Environment	289
8.1.4	Build Environment	289
8.1.5	Ad Hoc Environment	290
8.1.6	How Transactions Work	290

8.1.7	The Ingredients Needed	293
8.1.8	Summary	293
8.2	Software Distribution	294
8.3	Security Management	300
8.4	Business-Process-Oriented Systems Management	301
9	Application Topologies	306
9.1	Dependent Applications	306
9.1.1	Data Dependency	307
9.1.2	Flow Dependency	309
9.2	Client/Server Structures	310
9.2.1	Client/Server Topologies	310
9.2.2	Multitier Structures	312
9.3	TP Monitors	314
9.3.1	Stored Procedures	315
9.4	Communication Paradigms	317
9.4.1	Remote Procedure Call	317
9.4.2	Messaging	319
9.5	Message Monitors	323
9.5.1	Message Queue Manager	323
9.5.2	Message Monitor	326
9.5.3	Application Clustering	329
9.6	Message Broker	331
9.6.1	Application Bridging	331
9.6.2	Message Routing	332
9.6.3	Message Brokering	333
9.6.4	Complex Requests	336
9.6.5	The Message Broker Stack	338
9.7	Object Brokers	339
9.7.1	Client/Server Structures in ORBs	339
9.7.2	TP-Monitor Aspects of an ORB	340
9.8	Distributed Applications	341
9.9	Web Applications	342
9.10	Workflow-based Applications	345
9.10.1	Customization	347
9.10.2	Integration	347
9.10.3	Wrapping	349
10	Architecture and System Structure	351
10.1	Architectural Principles	351
10.1.1	Availability	351
10.1.2	Fault Detection	353

10.1.3	Client Recovery	354
10.1.4	Server Recovery	354
10.1.5	Hot Pooling	356
10.1.6	Calculating the Availability Class of a Hot Pool	357
10.1.7	Clustering Hot Pools	358
10.1.8	Takeover of Hot Pool	359
10.1.9	Spraying	360
10.1.10	Continuous Availability	361
10.1.11	Scalability	363
10.1.12	Using Stratified Transactions	363
10.2	System Structure	364
10.2.1	Tier Structures	367
10.2.2	Accessing the Database	368
10.3	Servers	369
10.3.1	Transactions	369
10.3.2	Hot Pooling	370
10.3.3	Multiple Instances	370
10.3.4	Administration Server	370
10.3.5	Workflow Execution Server	372
10.3.6	Scheduling Server	372
10.3.7	Cleanup Server	372
10.3.8	Modeling Server	373
10.3.9	Gateway Server	373
10.3.10	Event Server	374
10.3.11	Dead Letter Queue Server	374
10.4	Client	375
10.4.1	Interface Styles	375
10.4.2	Languages	375
10.4.3	Components	376
10.4.4	Ultrathin Clients	377
10.4.5	Object Environment	377
10.5	Program Execution	378
10.5.1	Request Processing	378
10.5.2	Internal Structure	379
10.5.3	Program Execution Agent	380
10.5.4	Program Execution Server	380
10.5.5	User-Supplied Program Execution	381
10.5.6	DLL Support	381
10.5.7	Ensured Invocation	382
10.5.8	Safe Applications	384
10.6	System Group	386
10.7	Domains	388

10.7.1	Domain Management	389
10.7.2	Remote Subprocesses	392
10.7.3	Remote Workitems	392
10.8	System Tuning	394
10.9	Workload Management	396
10.9.1	Hot Pool Management	396
10.9.2	Performance Spheres	396
10.9.3	Load Distribution	398
10.10	Systems Management	398
10.10.1	Code Distribution	399
10.10.2	Automatic Restart Management	399
10.10.3	Enterprise Console Support	399
10.10.4	Application Response Measurement	400
10.11	Exploiting Parallel Databases	401
10.11.1	Characteristics of Parallel Databases	402
10.11.2	Exploiting Parallel Database Support	403
10.11.3	Internal Properties	404
10.11.4	External Properties	405
10.11.5	Setup	406
10.12	Server Implementation Aspects	407
10.12.1	Server Framework	407
10.12.2	Request Processing	409
10.12.3	Message Layer	411
10.12.4	Database Access Layer	411
10.13	Navigation	412
10.14	Message Queuing Usage	419
10.15	Process Compiler	421
11	Development of Workflow-based Applications	428
11.1	Development Environment Blueprint	428
11.2	Component Generation	431
11.2.1	Characteristics of Parts	431
11.2.2	Parts Usage	432
11.2.3	Container Parts Generation	433
11.2.4	Database Access Part Generation	434
11.3	Testing	435
11.4	Animation	437
11.5	Debugging Activity Implementations	441
11.6	Application Database Design	444
11.7	Application Tuning	445
11.8	Optimization	447

A	Travel Reservation Example	449
B	List of Symbols	463
	Bibliography	465
	Index	471