

Table of Contents

1 What is Active Knowledge Modeling Technology?	1
1.1 Definition of Active Knowledge Modeling	4
1.2 State-of-the-art Overview	7
1.3 Discoveries and Core Concepts	9
1.4 State-of-Practice – An Example	10
1.5 The AKM Products	14
1.6 Enterprise Knowledge Spaces	14
1.7 Active Knowledge Architectures	16
1.7.1 How to Represent Enterprise Knowledge	17
1.7.2 Model-Generated Workplaces (MGWP)	19
1.7.3 Model-Based Holistic Design	20
1.7.4 Model-Based Systems Engineering	21
1.8 The Core Modeling Languages	21
1.9 Towards Enterprise Visual Scenes	22
1.9.1 Visual Scenes and Collaboration Spaces	23
1.9.2 The Powers of Visual Scenes	24
1.10 Implications and Impacts	25
2 Customer Challenges and Demands	27
2.1 Background	27
2.1.1 Structure of Chapter	27
2.1.2 The Evolution of Challenges and Demands	30
2.2 Society and Community Cooperation	30
2.2.1 Developing Digital Libraries	31
2.2.2 Enterprise-Enhanced Learning	33
2.2.3 Developing Operational Enterprise Architectures	34
2.3 Collaborative Business Networking	40
2.3.1 Business Models	41
2.3.2 Reference Models	43
2.4 Interoperable Enterprise Collaboration	47
2.4.1 Virtual Enterprises: Collaboration Spaces	47
2.4.2 Process Structures: Emergence and Evolution	48
2.4.3 Knowledge, Communication and Learning	49

2.4.4 Intelligent Infrastructures: Integration and Customization....	50
2.4.5 Enterprise Interoperability	51
2.4.6 System Engineering Approaches.....	51
2.4.7 Embedded Systems Engineering	52
2.5 Innovation and Holistic Design	55
2.5.1 Industrial Customer Delivery	56
2.5.2 Industrial Innovation	57
2.5.3 Service-team Organization	59
2.5.4 Concurrent Platform Engineering.....	59
2.6 Knowledge and Data Representation.....	60
2.7 Personal Workplaces and Interaction	61
2.7.1 Innovation and Knowledge Repositories.....	62
2.8 Summary	63
3 Industrial Evolutions	65
3.1 History of AKM Development	65
3.2 Experiences from EXTERNAL.....	67
3.2.1 The ICT Layer	67
3.2.2 The Knowledge Representation Layer	69
3.2.3 The Work Performance and Management Layer.....	70
3.2.4 Case 1: The EXTERNAL Project	72
3.2.5 Case 2: The Business Consulting Project Cycle.....	78
3.2.6 Case 3: IT Consulting in an SME Network	80
3.2.7 Final Evaluation Results.....	82
3.3 Experiences from ATHENA.....	82
3.3.1 Telecom Pilot.....	83
3.3.2 Conclusions	89
3.4 Summary.....	90
4 State of the Art of Enterprise Modeling	91
4.1 Industrial Diversity of Meaning and Usage.....	91
4.2 International EM Markets.....	93
4.2.1 The Enterprise Architecture Market	93
4.2.2 The Business Process Management Market	94
4.3 Application Domains	94
4.3.1 Enterprise Engineering and Reengineering Activities.....	95
4.3.2 Product Life Cycle Management.....	99
4.3.3 Choice and Implementation of IT Systems and Solution	100
4.3.4 General Enterprise Architecture and Operations Support ...	101
4.4 Enterprise Modeling Frameworks and Architectures	101
4.4.1 The Zachman Framework for Enterprise Architecture.....	102
4.4.2 GERAM.....	104

4.4.3 GRAI Framework	109
4.4.4 ARIS (Architecture of Integrated Information Systems)	112
4.4.5 CIMOSA	115
4.4.6 The DoDAF Architecture Methodology	117
4.4.7 TOGAF Architecture Methodology	118
4.4.8 The TEAF Methodology from US Department of Commerce	119
4.4.9 ISO 15745: Framework for Application Integration.....	120
4.4.10 MISSION	122
4.5 Conclusions on Enterprise Architecture Frameworks.....	125
5 Enterprise Knowledge Architecture (EKA).....	129
5.1 Knowledge Architectures	129
5.2 Principles for Active Knowledge Modeling (AKM).....	131
5.3 EKA (Enterprise Knowledge Architecture)	133
5.3.1 Aspects and Multiple Dimensions	135
5.3.2 Reflection and Metamodeling	136
5.3.3 Inheritance.....	136
5.3.4 Expressiveness	136
5.3.5 Simplicity	137
5.3.6 Degrees of Ambiguity, Formality and Uncertainty.....	137
5.3.7 Complex Relationships, Roles and Boundary Management...	138
5.3.8 Identification Schemes and Resolution.....	139
5.3.9 Model Management	140
5.3.10 Versioning, Variants and Configurations.....	140
5.4 AKM Execution: Interactive Behavior	141
5.4.1 Interactive Execution and Evolution.....	141
5.4.2 Basic Modeling Services.....	142
5.4.3 Task Definition and Execution	144
5.4.4 The Execution Context of a Task.....	147
5.5 Summary	150
6 Approaches to Enterprise Solutions	153
6.1 Product-Oriented Business Interoperability Profiles.....	154
6.1.1 Product Document Exchange and Management	155
6.1.2 Product Data Exchange through Mapping	155
6.1.3 Product Data Exchange Based on Reference Models and Semantic Mediation.....	156
6.1.4 Shared Product Information Repository.....	157
6.1.5 Federated Product Knowledge Repository.....	158

6.2 State of the Art and Requirements for Enterprise Solutions.....	159
6.2.1 Product Design and Life Cycle Management.....	159
6.2.2 Life Cycle Knowledge Integration	160
6.2.3 State of the Art in Product Design.....	161
6.3 Product-Based Interoperability Approaches.....	164
6.3.1 XML	166
6.3.2 Web Services	167
6.3.3 BPMI	168
6.3.4 WfMC.....	168
6.3.5 OAGIS GIS	171
6.3.6 OASIS BPEL.....	172
6.3.7 UN/CEFACT BCF	172
6.3.8 RosettaNet	173
6.3.9 OMG.....	175
6.3.10 ISO/IEC 15414: Open Distributed Processing – Reference Model – Enterprise Language	177
6.3.11 W3C.....	178
6.3.12 Base Ontology Technologies.....	180
6.3.13 Semantic Web Services: OWL-S and WSMO	186
6.3.14 WEB 2.0	189
6.4 Summary.....	190
7 Introducing Active Knowledge Modeling in Industry.....	193
7.1 Major Industrial Computing Challenges Revisited	193
7.2 The Customer Delivery Process	194
7.2.1 Description of Methodology Steps	195
7.3 Each C3S3P Step.....	196
7.3.1 Concept Testing.....	197
7.3.2 Scaffolding	198
7.3.3 Scenarios Modeling	200
7.3.4 Solutions Modeling	203
7.3.5 Platform Configuration.....	209
7.3.6 Platform Delivery and Practicing	210
7.3.7 Performance Improvement and Operations	211
7.4 Service Teams.....	212
7.5 Integrated Product and Services Platforms.....	213
7.6 AKM Approach to Customer Projects.....	214
7.6.1 IRTV in Action.....	217
7.6.2 Current Context	222
7.6.3 The IRTV Methodology	223
7.7 Summary.....	225

8 Families of Platforms and Architectures.....	227
8.1 The MAPPER Architecture.....	229
8.2 Component Descriptions.....	231
8.2.1 Metis Enterprise Portal and Repository	231
8.2.2 Workflow Engine – TRMS Client	235
8.2.3 CURE.....	238
8.2.4 Concert Chat	241
8.3 Task Patterns	243
8.3.1 Modeling Task Patterns	244
8.4 Task Management	250
8.4.1 Creating and Starting a Task Pattern.....	250
8.4.2 Task User Interfaces.....	251
8.4.3 Allocating Persons to Roles	253
8.4.4 Task Execution Rules.....	256
8.5 Summary	257
9 Enterprise Design and Development	259
9.1 The CPPD Project Context.....	261
9.1.1 Integrating Life-Cycles	261
9.1.2 Nature of Work-Generative Knowledge	262
9.1.3 The Active Knowledge Architecture	263
9.2 Addressing Industrial Demands	265
9.2.1 Industrial Use of the CPPD Methodology	265
9.2.2 Customer and CPPD Requirements	266
9.2.3 Support for Early Design	267
9.2.4 CPPD Roles and Responsibilities	268
9.3 The AKM Approach to Product Design.....	269
9.3.1 CPPD Development	270
9.3.2 The Voice of the Customers.....	272
9.3.3 The Voice of Business	272
9.3.4 The Voice of Technology	273
9.3.5 Component Development	275
9.3.6 The CPPD Architecture	275
9.4 The CPPD Components	276
9.4.1 Configurable Product Components (CPC).....	279
9.4.2 Configurable Visual Workplaces (CVW).....	280
9.4.3 Configurable Work Processes (CWP).....	281
9.4.4 Configurable Properties and Parameter Sets (CPP).....	282
9.4.5 Configurable Product Structure (CPS).....	284
9.4.6 Configurable Function Deployment (CFD)	285
9.4.7 Configurable Design Language (CDL).....	285
9.4.8 Configurable Idea Bank (CIB).....	286

9.5 Example of CVW	286
9.5.1 Current Workplaces	288
9.6 Summary	299
10 Realizing the Knowledge Economy	301
10.1 Background	302
10.2 Networked Business Theories	304
10.2.1 Value Chain Analysis	305
10.2.2 Schumpeterian Innovation	307
10.2.3 Network Economics	308
10.2.4 Transaction Cost Economics	313
10.3 Realization Approaches	314
10.4 EU Research	316
10.4.1 Business Requirements	317
10.4.2 Assessment of Networked Organizations and Value Models	317
10.5 AKM Contributions	318
10.5.1 Industrial Communities	319
10.5.2 From Paper to Models and Knowledge Architectures	320
10.5.3 From Process Flows to Workspaces	320
10.5.4 One Integrated Product Model	321
10.5.5 Collaborative Holistic Design	322
10.5.6 Data and Knowledge Management	323
10.5.7 Project Design	324
10.5.8 Changes in Management	325
10.6 Building Industrial Platforms	325
10.7 Impacts and Consequences	327
10.7.1 Industrial Communities	328
10.7.2 Business Economics	328
10.7.3 Industrial Research	329
10.7.4 Scientific Research	329
10.7.5 Education and Training	329
10.7.6 Future Directions	330
10.8 Outlook	331
11 Towards Enterprise Visual Scenes	333
11.1 Main Principles for Enterprise Visual Scenes	333
11.1.1 The Powers of Visual Scenes	334
11.2 Three-Dimensional Model Applications in Industry	335
11.2.1 Early Virtual Reality Experiments	336
11.2.2 BIM Models	336
11.2.3 NASA Concurrent Design	342

11.2.4 Maritime Applications	343
11.3 Nonindustrial Applications	344
11.3.1 Virtual Environments	344
11.4 Real Virtuality and Augmented Reality	348
11.4.1 Metal and Plastic Printing	350
11.4.2 Augmented Reality	350
11.5 New Modeling and Visualization Techniques	353
11.5.1 Three-Dimensional Modeling	353
11.5.2 Annotated Maps	354
11.6 Future Solutions	356
11.6.1 Croquet: An Example Environment	357
11.7 Summary	358
12 Scientific Foundations of AKM Technology	359
12.1 Epistemology	359
12.2 Human Learning, Pedagogy and Psychology	363
12.3 Natural Language, Linguistics and Semiotics	371
12.4 Process Design and Engineering	376
12.4.1 Transformational PMLs	377
12.4.2 Conversational Process Modeling	377
12.4.3 Declarative and Constraint-Based Process Modeling	378
12.4.4 Roles and Their Interaction	378
12.4.5 System Dynamics	379
12.4.6 Object-Oriented Process Modeling	380
12.4.7 Other Explicit Process Representations	380
12.5 Organizational Development and Learning	380
12.6 Product Design and Engineering	383
12.7 Systems Engineering	384
12.8 Summary	386
13 Enterprise Knowledge Spaces	387
13.1 Enterprise Knowledge Spaces Revisited	387
13.2 Modeling of Enterprise Knowledge Spaces	388
13.2.1 Personal Workspace	388
13.2.2 Innovation Space	390
13.2.3 Business Networking Space	391
13.2.4 Community Space	391
13.2.5 Overview	392
13.2.6 Knowledge Architectures	393
13.2.7 Reflection Across Knowledge Spaces	395
13.3 Summary	397

14 Summary and Directions.....	399
14.1 Core Principles and Solutions.....	400
14.2 Addressing the Main Challenges	405
14.3 Industrial Exploitation	407
14.4 The Way Ahead	409
References.....	411
Terminology and Abbreviations.....	425
Index	433