

Contents

1. Ontological Engineering: Principles, Methods, Tools and Languages	1
1.1 Introduction.....	1
1.2 What Is an Ontology? Viewpoints from a Philosopher and from an Ontology Engineer	3
1.3 What Are the Main Components of an Ontology?.....	5
1.4 Ontological Engineering	6
1.5 Principles for the Design of Ontologies.....	8
1.6 Ontology Development Process and Life Cycle	9
1.7 Methods, Methodologies, Tools and Languages.....	16
1.7.1 Methods, Methodologies and Tools Used for the Whole Ontology Development Life Cycle	16
1.7.2 Ontology Learning	22
1.7.3 Ontology Alignment and Merging.....	25
1.7.4 Ontology Evolution and Versioning	31
1.7.5 Ontology Evaluation	32
1.7.6 Ontology Implementation	34
1.8 Conclusions.....	38
1.9 Acknowledgements.....	39
References.....	39
2. Using Ontologies in Software Engineering and Technology	49
2.1 Introduction.....	49
2.2 Kinds of Ontologies	50
2.2.1 Heavyweight Versus Lightweight Ontologies	56
2.3 A Review of the Uses in SET	57
2.3.1 Ontology Versus Conceptual Model.....	63
2.3.2 Ontology Versus Metamodel	64
2.3.3 Ontologies in Software Engineering Environments.....	65
2.3.4 Representing Ontologies Using Software Engineering Techniques	67
2.3.5 Experiences and Lessons Learned in Software Engineering Research.....	69

2.4 A Proposal of Taxonomy..... 73
 2.4.1 Ontologies of Domain 74
 2.4.2 Ontologies as Software Artifacts 76
 2.5 Review and Classification of Proposals in the Literature..... 79
 2.5.1 Proposals of Ontologies of Domain..... 79
 2.5.2 Proposals of Ontologies as Software Artifacts 86
 References 95

3. Engineering the Ontology for the SWEBOK: Issues and Techniques..... 103

3.1 Introduction 103
 3.2 History and Principles of the SWEBOK Project 105
 3.2.1 Hierarchical Organization..... 107
 3.2.2 Reference Material and Matrix..... 108
 3.2.3 Depth of Treatment..... 108
 3.3 The Ontology of the SWEBOK from a Conceptual and Consensus-
 Reaching Perspective..... 109
 3.4 The Ontology of the SWEBOK as a Formal Artifact..... 112
 3.5 Fundamental Elements of the Ontology of the SWEBOK 114
 3.5.1 Activities, Artifacts and Agents..... 114
 3.5.2 Models, Specifications and Methods..... 116
 3.5.3 Theoretical Standpoints and Guidelines 117
 3.6 Conclusions 119
 References 120

4. An Ontology for Software Development Methodologies and Endeavours..... 123

4.1 Introduction 123
 4.2 Ontology Architecture 125
 4.2.1 The Communities Involved 125
 4.2.2 Usage and Ontology Domains 127
 4.2.3 Product and Process..... 131
 4.3 Endeavour-Related Concepts..... 133
 4.3.1 High-Level View 134
 4.3.2 The Process Side..... 135
 4.3.3 The Product Side 137
 4.3.4 The Producer Side 140
 4.3.5 Endeavour-Related Concepts: Conclusion 141
 4.4 Method-Related Concepts 142
 4.4.1 Templates and Resources 142
 4.4.2 Duality in the Method Domain..... 143
 4.4.3 Applying the Methodology..... 148

4.5 Conclusion	148
References	149
5. Software Maintenance Ontology.....	153
5.1 Introduction.....	153
5.2 Software Maintenance.....	154
5.3 An Ontology for Software Maintenance	156
5.3.1 Overview of the Ontology.....	157
5.3.2 The System Sub-ontology	158
5.3.3 The Computer Science Skills Sub-ontology	160
5.3.4 The Maintenance Process Sub-ontology	162
5.3.5 The Organizational Structure Sub-ontology	165
5.3.6 The Application Domain Sub-ontology	166
5.4. Validating the Ontology.....	166
5.4.1 Quality Validation.....	167
5.4.2 Relevance Validation	168
5.5 Putting the Maintenance Ontology to Work	169
5.6 Conclusion	171
References	172
6. An Ontology for Software Measurement.....	175
6.1 Introduction.....	175
6.2 Previous Analysis.....	177
6.3 A Running Example.....	178
6.4 The Proposal of Software Measurement Ontology	179
6.4.1 The SMO.....	179
6.5 Conclusions.....	194
References	195
7. An Ontological Approach to SQL:2003	197
7.1 Introduction.....	197
7.2 SQL Evolution	198
7.3 The Ontology for SQL:2003	201
7.3.1 The Data Types Sub-ontology	202
7.3.2 The Schema Objects Sub-ontology.....	204
7.4 Example	209
7.5 Conclusions.....	212
References.....	214
8. The Object Management Group Ontology Definition	
Metamodel	217
8.1 Introduction.....	218

8.2 Why a MOF Ontology Metamodel?	219
8.2.1 Why a Metamodel?.....	219
8.2.2 Why MOF?.....	220
8.2.3 Why Not UML?.....	221
8.3 The Ontology Development Metamodel	222
8.3.1 RDF/OWL Metamodel.....	224
8.3.2 Topic Maps.....	228
8.3.3 Common Logic.....	231
8.3.4 General Structure of Metamodels.....	233
8.4 Profiles and Mappings	235
8.4.1 The Need for Translation.....	235
8.4.2 UML Profiles.....	236
8.4.3 Mappings	238
8.4.4 Mapping CL.....	240
8.4.5 Interaction of Profiles and Mappings	241
8.5 Extendibility	242
8.5.1 Metaclass Taxonomy.....	242
8.5.2 Semantic Domain Models	243
8.5.3 <i>n</i> -ary associations	244
8.6 Discussion.....	244
8.7 Acknowledgments	245
References	246
9. Ontologies, Meta-models, and the Model-Driven Paradigm	249
9.1 Introduction	249
9.2 Models and Ontologies.....	253
9.2.1 What’s in a Model?	253
9.2.2 What’s in an Ontology?.....	255
9.3 Similarity Relations and Meta-modelling.....	257
9.3.1 Meta-models.....	258
9.3.2 Metameta-models	260
9.3.3 The Meta-pyramid, the Modelling Architecture of MDE	261
9.4 MDE and Ontologies.....	262
9.4.1 Domain and Upper-Level Ontologies.....	263
9.4.2 Relationship of Ontologies and System Models on Different Meta-levels	264
9.4.3 Employing Domain Ontologies in the MDA.....	265
9.4.4 Conceptual Benefits of an Ontology-Aware Meta-pyramid..	267
9.4.5 Tools Based on an Ontology-Aware Meta-pyramid.....	268
9.4.6 The mega-Model of Ontology-Aware MDE	269
9.5 Related Work.....	270
9.6 Conclusions	271

9.7 Acknowledgments.....	271
References.....	271
10. Use of Ontologies in Software Development Environments.....	275
10.1 Introduction.....	275
10.2 From SDE to DOSDE.....	277
10.3 Domain-Oriented Software Development Environment.....	279
10.3.1 Domain Ontology in DOSDE.....	279
10.3.2 Task Ontology in DOSDE.....	280
10.3.3 Mapping Domain and Task.....	287
10.3.4 Using Knowledge Throughout the Software Development.....	288
10.4 From DOSDE to EOSDE.....	292
10.5 Enterprise-Oriented Software Development Environments.....	294
10.5.1 Enterprise Ontology.....	296
10.6 Tools in DOSDE and EOSDE.....	300
10.6.1 Domain Theory Browser.....	301
10.6.2 Sapiens: A Yellow Page's Software Tool.....	302
10.6.3 RHPlan: A Software Tool for Human Resource Planning.....	304
10.7 Conclusion.....	305
References.....	306
11. Semantic Upgrade and Publication of Legacy Data.....	311
11.1 Introduction and Motivation.....	311
11.2 Global Approach to Database-to-Ontology Mapping.....	314
11.3 Mapping Situations between Databases and Ontologies.....	315
11.4. The R ₂ O Language.....	319
11.4.1 A Mapping Description Specified in R ₂ O.....	320
11.4.2 Description of Database Schemas.....	321
11.4.3 Definition of Concept Mappings.....	322
11.4.4 Describing Conditions and Conditional Expressions.....	324
11.4.5 Describing Transformations.....	325
11.4.6 Attribute and Relation Mappings.....	326
11.5 The ODEMapster Processor.....	330
11.6 Experimentation: The Fund Finder Application.....	330
11.6.1 Ontologies in the Funding Domain.....	332
11.6.2 The Presentation Part: Semantic Publishing and Navigation.....	334
11.7 Conclusions and Future Work.....	335
11.8 Acknowledgements.....	337
References.....	337