

OntoCAPE

A Re-Usable Ontology for Chemical Process Engineering

Bearbeitet von
Wolfgang Marquardt, Jan Morbach, Andreas Wiesner, Aidong Yang

1. Auflage 2010. Buch. xvii, 481 S. Hardcover

ISBN 978 3 642 04654 4

Format (B x L): 15,5 x 23,5 cm

Gewicht: 1930 g

[Weitere Fachgebiete > Technik > Verfahrenstechnik, Chemieingenieurwesen, Lebensmitteltechnik > Chemische Verfahrenstechnik](#)

schnell und portofrei erhältlich bei

The logo for beck-shop.de features the text 'beck-shop.de' in a bold, red, sans-serif font. Above the 'i' in 'shop' are three red dots of increasing size. Below the main text, the words 'DIE FACHBUCHHANDLUNG' are written in a smaller, red, all-caps, sans-serif font.

beck-shop.de
DIE FACHBUCHHANDLUNG

Die Online-Fachbuchhandlung beck-shop.de ist spezialisiert auf Fachbücher, insbesondere Recht, Steuern und Wirtschaft. Im Sortiment finden Sie alle Medien (Bücher, Zeitschriften, CDs, eBooks, etc.) aller Verlage. Ergänzt wird das Programm durch Services wie Neuerscheinungsdienst oder Zusammenstellungen von Büchern zu Sonderpreisen. Der Shop führt mehr als 8 Millionen Produkte.

Contents

1	Introduction	1
1.1	The Need of Knowledge-Based Systems	1
1.2	The Role of Ontologies	4
1.3	The Reusability-Usability Trade-off Problem	5
1.4	Objective and Outline of the Book	7
1.5	References	9
2	Scientific Background	11
2.1	Ontology in Philosophy	11
2.2	Ontology in Computer Science	12
2.3	Representation of Formal Ontologies	14
2.3.1	Classes and Individuals	14
2.3.2	Relations	15
2.3.3	Attributes	17
2.3.4	Axioms	17
2.3.5	Modularization	18
2.3.6	Notation of Modeling Elements	19
2.4	Informal and Formal Specification of an Ontology	20
2.5	What an Ontology Is and Isn't	22
2.6	Classification of Ontologies	24
2.7	Summary	28
2.8	References	29
3	Overview on OntoCAPE	35
3.1	Overview and Structure	35
3.1.1	Abstraction Layering	35
3.1.2	Modularization	37
3.2	Representation and Dissemination	40
3.3	The Meta Model	41
3.3.1	Fundamental Concepts	41
3.3.2	Data Structures	42
3.3.3	Mereology	43
3.3.4	Topology	44
3.4	The Upper Layer	44
3.5	The Conceptual Layer	46
3.5.1	Supporting Concepts	46
3.5.2	Material	48

3.5.3	Chemical Process System	49
3.5.4	Mathematical Model	50
3.6	The Application Layers	51
3.7	References	53
4	Meta Model	57
4.1	Introduction	57
4.2	Fundamental Concepts	61
4.2.1	Usage	66
4.2.2	Concept Descriptions	68
4.3	Mereology	70
4.3.1	Usage	74
4.3.2	Concept Descriptions	76
4.4	Topology	77
4.4.1	Mereotopology	79
4.4.2	Connectors	80
4.4.3	Representation of Graphs	81
4.4.4	Directed Graphs	84
4.4.5	Usage	86
4.4.6	Concept Descriptions	88
4.5	Data Structures	89
4.5.1	Binary Tree	90
4.5.2	Multiset	94
4.5.3	Array	96
4.5.4	Linked List	98
4.5.5	Loop	101
4.6	References	105
5	Upper Level	109
5.1	System	110
5.1.1	Basic Axioms of Systems Theory	110
5.1.2	Inter-System Relations	111
5.1.3	Subsystems and Supersystems	111
5.1.4	Levels of Decomposition	114
5.1.5	Topological Connectivity of Systems	115
5.1.6	Model	116
5.1.7	Representation of Viewpoints	116
5.1.8	System Environment	118
5.1.9	Properties of Systems	119
5.1.10	Backdrop	121
5.1.11	Physical Quantity	122
5.1.12	Physical Dimension	124
5.1.13	Qualitative Value	126
5.1.14	The hasCharacteristic Relation	127

5.1.15	Physical Constant.....	128
5.1.16	Internal and External Properties.....	129
5.1.17	Property Set.....	130
5.1.18	Concept Descriptions	130
5.2	Network System	136
5.2.1	Usage	139
5.2.2	Concept Descriptions	140
5.3	Technical System	141
5.3.1	Function and Requirements	142
5.3.2	Realization	143
5.3.3	Behavior.....	144
5.3.4	Performance	145
5.3.5	Implementation of the Technical System in OntoCAPE.....	146
5.3.6	Relations between Aspect Systems	147
5.3.7	Concept Descriptions	148
5.4	Coordinate System	151
5.4.1	Concept Descriptions	152
5.5	Tensor Quantity	153
5.5.1	Concept Descriptions	157
5.6	References	159
6	Supporting Concepts.....	163
6.1	Mathematical Relation	163
6.1.1	Usage	166
6.1.2	Concept Descriptions	168
6.2	Physical Dimension (Partial Model).....	170
6.2.1	Physical Dimension (Ontology Module)	171
6.2.2	Derived Dimensions.....	174
6.3	SI Unit (Partial Model).....	175
6.3.1	SI Unit (Ontology Module).....	175
6.3.2	Derived SI Units	179
6.4	Space and Time	179
6.4.1	Concept Descriptions	183
6.5	Geometry	185
6.5.1	Usage	189
6.5.2	Concept Descriptions	190
6.6	References	193
7	Material.....	195
7.1	Material (Partial model)	195
7.1.1	Relation Between ‘Phase System’ and ‘Material Amount’ ..	197
7.1.2	Material (Ontology Module).....	198

7.2	Substance (Partial Model)	198
7.2.1	Substance (Ontology Module)	200
7.2.2	Molecular Structure	209
7.2.3	Polymers	214
7.2.4	Chemical Species	217
7.2.5	Atoms	218
7.2.6	Macromolecules	219
7.2.7	Substance Class	219
7.2.8	Reaction Mechanism	220
7.2.9	Reaction Type	225
7.3	Phase System	226
7.3.1	High-Level Concepts	227
7.3.2	Properties of Phase Systems	228
7.3.3	Physical Context	231
7.3.4	Reactions in Phase Systems	232
7.3.5	Concept Descriptions	233
7.4	References	239
8	Chemical Process Systems	241
8.1	Chemical Process System (Partial Model)	241
8.1.1	Chemical Process System (Ontology Module)	243
8.2	CPS Function	246
8.2.1	Process	247
8.2.2	Process Control	257
8.2.3	Controller	262
8.3	CPS Realization	262
8.3.1	Plant	263
8.3.2	Process Control System	271
8.4	Plant Equipment	274
8.4.1	Fixture	274
8.4.2	Apparatus	275
8.4.3	Machine	276
8.5	Process Control Equipment	276
8.5.1	Measuring Instrument	277
8.5.2	Controlling Instrument	278
8.6	CPS Behavior	278
8.6.1	Behavior	279
8.7	CPS Performance	304
8.7.1	Economic Performance	304
8.8	Process Units	313
8.8.1	Heat Transfer Unit	315
8.9	References	319

9	Mathematical Models.....	323
9.1	Mathematical Model (Ontology module).....	324
9.1.1	High-Level Concepts	324
9.1.2	Modeling of Decomposition	325
9.1.3	Modeling of Connectivity	326
9.1.4	Usage	327
9.1.5	Concept Descriptions	329
9.2	Equation System.....	331
9.2.1	Usage	333
9.2.2	Concept Descriptions	333
9.3	Numerical Solution Strategy	336
9.3.1	Concept Descriptions	338
9.4	Cost Model	340
9.4.1	Concept Descriptions	340
9.5	Process Model	342
9.5.1	Concept Descriptions	344
9.6	Laws	345
9.7	Property Models	348
9.8	Process Unit Models.....	350
9.9	References	351
10	Design Principles of OntoCAPE.....	353
10.1	Coherence.....	353
10.2	Conciseness	355
10.3	Intelligibility.....	357
10.3.1	Clarity	358
10.3.2	Homogeneity.....	359
10.3.3	Thorough Documentation	359
10.4	Adaptability.....	361
10.4.1	Extensibility	361
10.4.2	Customizability	362
10.5	Minimal Ontological Commitment	364
10.6	Efficiency	364
10.7	Conclusions	366
10.8	References	366
11	Related Work on Ontologies for Engineering Applications	369
11.1	History of OntoCAPE	369
11.1.1	VeDa.....	370
11.1.2	CLiP	371
11.1.3	OntoCAPE 1.0	372
11.2	Work by Other Research Groups.....	374
11.2.1	EngMath.....	376
11.2.2	YMIR.....	376

11.2.3	PhysSys.....	377
11.2.4	MDF.....	378
11.2.5	Plant Ontology and Functional Ontology	379
11.2.6	ISO 15926.....	381
11.2.7	Conclusions.....	382
11.3	References.....	383
12	Evolutionary Improvement and Validation through Applications.....	391
12.1	Process Modeling	392
12.1.1	Component-Based Process Modeling.....	392
12.1.2	Conceptual Process Modeling.....	394
12.1.3	Lessons Learned	396
12.2	Knowledge Management in Engineering Design.....	397
12.2.1	Introduction.....	397
12.2.2	Approach	398
12.2.3	The Core Ontology	400
12.2.4	Implementation of the PDW	402
12.2.5	Lessons Learned	404
12.3	Integration of Design Information.....	405
12.3.1	Introduction.....	405
12.3.2	Approach	407
12.3.3	Implementation	411
12.3.4	Lessons Learned	412
12.4	Some Measures of Improvement.....	412
12.4.1	Statistical Data	413
12.4.2	Improvement in Coherence.....	414
12.4.3	Improvement in Conciseness	415
12.5	References.....	416
13	Conclusions	425
13.1	OntoCAPE in a Nutshell	425
13.2	Design Rationale	426
13.3	Ontology Evolution by a Continuous Improvement Process	427
13.4	From Product to Process	428
13.5	Semantic Technologies in Engineering – Dream or Reality?.....	430
13.6	References.....	432
14	Bibliography	435
	Index	464
	Index of Concept Descriptions	473