

Contents

Supply Chain Management and Multiagent Systems: An Overview

<i>Thierry Moyaux, Brahim Chaib-draa, Sophie D'Amours</i>	1
1 Introduction	1
2 Supply Chain Management	2
2.1 Industrial Problems in General	2
2.2 A Particular Example of Industrial Problems: The Bullwhip Effect.....	2
2.3 The Concept of Supply Chains as a Solution	4
2.4 Collaboration in Supply Chains.....	5
2.5 Supporting Technologies	7
3 Multi-Agent Systems.....	7
3.1 The Concept of Agents	7
3.2 Comparison with Objects.....	8
3.3 Agent Architectures	8
3.4 Motivations for Multi-Agent Systems	10
3.5 Differences between Multi-Agent Systems and Other Fields	11
3.6 Some Applications of Multi-Agent Systems	12
4 Multi-Agent Systems in Supply Chain Management	14
4.1 Information Technologies in Supply Chain Management.....	15
4.2 Using Multi-Agent Systems in Supply Chain Management: Motivations	16
4.3 Using Multi-Agent Systems in Supply Chains: Examples	18
5 Conclusion.....	21
6 Acknowledgment	21
References	21

eMarketPlace Model: An Architecture for Collaborative Supply Chain Management and Integration

<i>Hamada Ghenniwa, Jiangbo Dang, Michael Huhns, Weiming Shen</i>	29
1 Introduction	29
2 eBusiness Models	31
3 eMarketplaces: Requirements Analysis and Design Issues	32
3.1 Market Structure and Economy Model.....	32
3.2 Supply Chain Management and Integration	33
3.3 Foundation Architecture for Integration.....	35
4 Business-Centric Knowledge-Oriented Architecture.....	36

5	BCKOA-based <i>eMarketplace</i>	38
6	Agent-Oriented <i>eMarketplace</i> Model	40
7	Multi-Attribute Negotiation Service: Coalition Deal Negotiation Model	43
8	<i>eAuction</i> Market Service	46
8.1	The Auction Market System Architecture	46
8.2	Market Session: Vickrey Auction	47
8.2.1	Auction Session Module	49
8.2.2	Agent Architecture	50
9	Agent-Based Supply Chain Integration Service	51
10	Prototype Implementation	54
10.1	Auctioneer-Agent	55
10.2	Bidder-Agent	57
10.3	Supplier-Agent	57
11	Related Work and Discussion	57
12	Conclusions	59
	Acknowledgements	60
	References	60

Software Agents for Electronic Business: Opportunities and Challenges (2005 Re-mix)

Jörg P. Müller, Bernhard Bauer, Thomas Friese, Stephan Roser,

Roland Zimmermann

		63
1	Introduction	63
2	Areas and Challenges of e-Business	65
2.1	Areas of e-Business	65
2.2	e-Business Architecture	66
2.3	Challenges in e-Business	70
2.3.1	Challenge: Semantic Interoperability	70
2.3.2	Challenge: Support for Flexible Organization Structures and Collaborative Business Processes	71
2.3.3	Challenge: Pro-active, Adaptive Processes and Agent Grid Services	71
2.3.4	Challenge: Dynamic IT	72
2.3.5	Challenge: Security, Privacy, and Trust	72
2.3.6	Challenge: Adaptive Decision Making for Evaluation and Selection of Products and Services	73
2.3.7	Challenge: Mobility Support and Context Awareness	73
3	Agent Technology for e-Business	74
3.1	Agents Definitions and Characteristics	74
3.2	Challenges	76
3.2.1	Challenge: Semantic Interoperability	76
3.2.2	Challenge: Support for Flexible Organization Structures and Collaborative Business Processes	78
3.2.3	Challenge: Pro-active, Adaptive Processes and Agent Grid Services	80
3.2.4	Challenge: Dynamic IT	82

3.2.5	Challenge: Security, Privacy, and Trust	83
3.2.6	Challenge: Adaptive Decision Making for Evaluation and Selection of Products and Services	83
3.2.7	Challenge: Mobility Support and Context Awareness	84
4	Agent-Enabled e-Business Applications: Case Studies.....	85
4.1	Agent-Enabled Supply Chain Event Management	85
4.1.1	Problem Description	85
4.1.2	Technology Used	86
4.1.3	Application Context/Validation	89
4.2	Decentral Business Resource Management.....	89
4.2.1	Problem Description	89
4.2.2	Technology Used	90
4.2.3	Application Context/Validation	92
4.3	Model-Driven Development and Integration.....	94
4.3.1	Problem Description	94
4.3.2	Technology Used	94
4.3.3	Application Context/Validation	95
5	Discussion, Conclusions, and Outlook.....	99
	References	101

Global Supply Chain Networks and Risk Management: A Multi-Agent Framework

<i>Anna Nagurney, Jose M. Cruz, June Dong</i>	103
1 Introduction	104
2 The Global Supply Chain Network Model with Risk Management.....	105
2.1 The Behavior of the Manufactures and their Optimality Conditions.....	106
2.2 The Behavior of the Distributors and their Optimality Conditions.....	110
2.3 The Retailers and their Optimality Conditions.....	113
2.4 The Equilibrium Conditions	116
2.5 The Equilibrium Conditions of the Global Supply Chain	117
3 Qualitative Properties.....	119
4 The Algorithm	127
5 Numerical Examples	128
6 Summary and Conclusions.....	132
7 Acknowledgments.....	133
References	133

RedAgent: An Autonomous, Market-based Supply-Chain Management Agent for the Trading Agents Competition

<i>Doina Precup, Philipp W. Keller, Felix-Olivier Duguay</i>	135
1 Introduction	135
2 Overview of TAC SCM	136
3 Architecture of RedAgent	137
4 Internal Markets and Auctions	138
5 Order Agents	139

6 Assembler Agents	141
7 Component and Production Agents	143
8 Bidder Agent	145
9 Internal Behavior	146
10 Competition Performance	148
11 Discussion	151
Acknowledgments	154
References	154

A Framework of Optimization Agent for Supply Chain Management

<i>Jae Kyu Lee, Yong Sik Chang</i>	155
1 Introduction	155
2 Review of Model Management for Optimization Agent	157
3 Structure of Optimization Models in the Supply Chain	158
3.1 Primitive Model of M-VRTPW	159
3.2 Options of the Objective Function	160
3.3 Objective-Driven Constraints	161
3.4 Optional Constraints for the Target Problem	162
4 Architecture of Optimization Agents	162
4.1 Identification of a Base Model	164
4.2 Identification of a Target Model	165
4.3 Canonical Representation of the Target Model	167
4.4 Formulation of the Target Model for the IP Solver	169
5 Illustrative Automatic Modeling Procedure with AGENT-OPT2	169
5.1 Identification of a Base Model	169
5.2 Identification of a Target Model	171
5.3 Canonical Representation of the Target Model	173
5.4 Formulating a Target Model for Solver LINGO	174
6 Conclusion: Toward Ontology for Supply Chain Model	
Warehouse Services	176
References	177

Multi-Agent Modeling and Fuzzy Task Assignment for Real-Time Operation in a Supply Chain

<i>Umesh Deshpande, Arobinda Gupta, Anupam Basu</i>	179
1 Introduction	179
2 Related Works	182
3 Agent based System Model of the Supply Chain	183
3.1 The Architecture of a Node	183
3.2 Modeling of the Functional Unit (FU)	185
3.3 The Local State	185
4 The Real-Time Scheduler at each FU	186
4.1 Estimated Latest Start Time (ELST) Computation	188
5 Task Assignment under Imprecision	188
5.1 Multiobjective Decision Making using Fuzzy Logic	188

5.2 A Procedure for Determining the Importance of the Objectives..... 190
 5.3 The Computation of the Objectives for the Supply Chain Operation... 191
 6 Performance Evaluation..... 194
 6.1 Comparison with the Heuristic Algorithm 197
 7 The Hybrid Algorithm..... 199
 8 Conclusions 201
 References 202

Multi-Agent based Supply Chain Modelling with Dynamic Environment

Toshiya Kaihara 203
 1 Introduction 203
 2 VE Business Model in Supply Chain Environment..... 204
 2.1 VE Concept..... 204
 2.2 Business Model..... 206
 3 Agent Definitions..... 207
 3.1 Unit Structure..... 207
 3.2 Negotiation Algorithm..... 207
 3.3 Vertically Integrated VE Model 209
 3.4 Horizontally Specialised VE Model 210
 3.5 Hybrid VE Model 211
 4 Experimental Results 212
 5 Conclusions 214
 References 215

Agent-Based Technological Framework for Dynamic Configuration of a Cooperative Supply Chain

Alexander V. Smirnov, Leonid B. Sheremetov, Nikolai Chilov,
Christian Sanchez-Sanchez..... 217
 1 Introduction 217
 2 CSC Configuration Task 219
 3 Partner Choice as a Coalition Game 221
 3.1 Cooperative Games with Fuzzy Coalitions 222
 3.2 Construction of a Coalition Membership Function 224
 3.3 Solution of a Coalition Game with Genetic Algorithm 225
 4 Ontological Model of the CSC Based on Object-Oriented
 Constraint Networks..... 225
 4.1 Object-Oriented Constraint Network..... 226
 4.2 Construction of the Request Ontology 227
 5 Methods for Resource Allocation Task Solution..... 230
 5.1 Genetic Algorithm 230
 5.2 Constraint Satisfaction Problem 231
 6 Multi-agent Framework Description..... 232
 6.1 Coalition Game for Partner Selection..... 233
 6.2 Evolver Interface Integration..... 234
 6.3 Adaptive Agents for Resource Allocation..... 236
 7 Case Study Description 237
 7.1 Fuzzy Coalition Game Model of the Case Study 238

7.2 Results of the Constraint Satisfaction Approach	240
7.3 Comparison of Experimental Results	241
8 Related Research and Discussion.....	241
Conclusions	244
Acknowledgments	245
References	245

Design, Implementation and Test of Collaborative Strategies in the Supply Chain

<i>Thierry Moyaux, Brahim Chaib-draa, Sophie D'Amours</i>	247
1 Introduction	247
2 Methodology	249
2.1 Notations	249
2.2 Explanation of the Algorithms.....	251
3 Case Study: Do Companies in a Supply Chain Agree to Share Demand Information?	254
3.1 The Bullwhip Effect: A Problem of Supply Chain Management.....	254
3.2 One Cause and its Solution to the Bullwhip Effect	258
3.3 Simulation Model	262
3.4 Agent Strategies	263
3.5 Results and Analysis.....	264
3.6 Discussion on the Case Study	266
4 Discussion on the Methodology	267
5 Conclusion.....	270
6 Acknowledgment	270
References	270

MAGNET: A Multi-Agent System using Auctions with Temporal and Precedence Constraints

<i>John Collins, Maria Gini</i>	273
1 Introduction	273
2 Decision Processes in a MAGNET Customer Agent.....	275
2.1 Agents and their Environment	275
2.2 Planning	276
2.3 Planning the Bidding Process	277
2.4 Composing a Request for Quotes	281
2.5 Evaluating Bids.....	285
2.6 Awarding Bids	288
3 Solving the MAGNET Winner-Determination Problem	288
3.1 Bidtree Framework	289
3.2 A* Formulation.....	291
3.3 Iterative Deepening A*	294
4 Search Performance.....	296
4.1 Experimental Setup.....	297
4.2 Characterizing the Iterative Deepening A* Solver.....	300

5	Related Work.....	306
5.1	Multi-Agent Negotiation.....	306
5.2	Combinatorial Auctions.....	308
5.3	Deliberation Scheduling.....	309
6	Conclusions.....	309
	References.....	311

Incentive Compatible Supply Chain Auctions

	<i>Moshe Babaioff, William E. Walsh.....</i>	315
1	Introduction.....	315
2	Supply Chain Formation Problem.....	317
2.1	Supply Chain Model.....	317
2.2	Allocations.....	320
3	Two-Sided, Single-Good.....	320
4	Linear Supply Chains.....	322
5	Unique Manufacturing Technology Supply Chains.....	324
5.1	UMT Trade Reduction Auction Allocation.....	325
5.2	UMT Trade Reduction Auction Payments.....	327
5.3	Auction Properties with the Known Single-Minded Model.....	328
5.4	Auctions for the Unknown Single-Minded Model.....	330
5.5	Computational Complexity of the UMT Auction.....	334
5.6	Distributed Implementation.....	336
6	Supply Chains without the Unique Manufacturing Technologies Constraint.....	338
7	Discussion and Open Problems.....	339
	Acknowledgments.....	340
	References.....	340
	Appendix A.....	341
	Appendix B.....	344

Supply Chain Coordination by Means of Automated Negotiations Between Autonomous Agents

	<i>Andreas Fink.....</i>	351
1	Introduction.....	351
2	The Coordination Problem.....	352
3	The Negotiation Protocol.....	355
3.1	Contract Generation.....	357
3.2	Acceptance Criteria.....	357
4	Computational Experiments.....	361
4.1	Scenario A: Two Decision Making Units.....	364
4.2	Scenario B: Three Decision Making Units.....	367
5	Conclusions.....	369
	References.....	370

Business Process Support in a Seaport Automobile Terminal — a Multi-Agent Based Approach

<i>Torsten Fischer, Hermann Gehring</i>	373
1 Introduction and Problem Description	373
2 Business Processes in a Seaport Automobile Terminal	374
2.1 Logistics Supply Chain for Vehicle Transport	375
2.2 Representation of the Underlying Business Processes	376
2.2.1 Business Process “Vehicle Takeover” (Im1)	376
2.2.2 Business Process “Vehicle Storage” (Im2)	377
2.2.3 Business Process “Vehicle Delivery” (Im3)	378
2.3 Description of the Planning Processes	378
2.4 Analysis of Critical Points	380
3 Vehicle Transshipment Optimization Problem	381
4 Multi-Agent System for Planning Support	382
4.1 Representation of the Planning Problem via Autonomous Agents	383
4.2 Operation of the Multi-Agent-System	384
4.2.1 Departure Time Estimation	385
4.2.2 Deployment Scheduling (Coarse Grained Scheduling)	386
4.2.3 Storage Allocation	387
4.2.4 Deployment Scheduling (Fine Grained Scheduling)	388
4.2.5 Updating the Parking Area Reservation List	388
5 Evaluation of the Multi-Agent Based Planning Approach	388
5.1 Results from an Operational Point of View	389
5.2 Results from a Strategic Point of View	391
5 Conclusions	392
References	393

Commitment Based Sense-and-Respond Framework for Manufacturing Supply Chain

<i>Jun-Jang (JJ) Jeng, Markue Ettl, Jen-Yao Chung</i>	395
1 Introduction	395
2 Scenarios	397
3 Framework	403
4 Commitment Based Manufacturing Supply Chain	407
5 Architecture	414
6 Related Work and Discussion	416
7 Conclusion	416
References	417

A Multi-Agent Approach to Supply Chain Management in the Chemical Industry

<i>Rajagopalan Srinivasan, Mukta Bansal, I.A. Karimi</i>	419
1 Introduction	421
1.1 Petroleum Refinery Supply Chain	421
1.2 Distinguishing Features of Chemical Supply Chains	423
2 Literature Review	424

3	G2-Multi-Agent Development Environment	427
4	Refinery Supply Chain Management.....	430
5	Agent Modeling of Refinery Supply Chain	432
6	Case Studies	442
6.1	Study 1: Normal Scenario.....	443
6.2	Study 2: Transportation Disruption	445
6.3	Study 3: Demand High	447
7	Discussion	447
	References	448