

Luis Martín Díaz

# **Evaluation of Cooperative Planning in Supply Chains**

An Empirical Approach of the  
European Automotive Industry

With a foreword by Prof. Dr. Peter Buxmann

Deutscher Universitäts-Verlag

# Table of Contents

<b>List of Figures</b> .....	<b>XV</b>
<b>List of Tables</b> .....	<b>XXI</b>
<b>Abbreviations</b> .....	<b>XXVII</b>
<b>1 Introduction</b> .....	<b>1</b>
1.1 Motivation and Research Questions.....	4
1.2 Structure of the Dissertation.....	6
<b>2 Inter-Organizational Cooperation and Supply Chain Management</b> .....	<b>9</b>
2.1 Inter-Organizational Cooperation.....	10
2.1.1 Definition of Cooperation.....	11
2.1.2 Definition of Inter-Organizational Cooperation.....	14
2.1.3 Forms of Inter-Organizational Cooperation.....	16
2.1.3.1 Redistributive and Reciprocal Inter-Organizational Cooperation.....	17
2.1.3.2 X and Y Inter-Organizational Cooperation.....	19
2.1.3.3 Rotering Matrix for Identifying the Type of Inter-Organizational Cooperation.....	21
2.2 Supply Chain Management.....	22
2.2.1 Supply Chain Management as a Field of Research and of Practical Endeavors.....	22
2.2.2 Defining Supply Chain Management.....	24
2.2.3 The Objectives of Supply Chain Management.....	28
2.2.4 Issues Related to Cooperation in the Context of Supply Chain Management.....	32
2.2.4.1 Co-opetition – A Concept Describing Simultaneous Cooperation and Competition.....	33
2.2.4.2 The Bullwhip Effect – A Frequent Problem in Supply Chains with Lower Degree of Cooperation.....	35
2.2.4.2.1 Demand Forecast Updating.....	36
2.2.4.2.2 Order Batching.....	37
2.2.4.2.3 Price Fluctuation.....	38
2.2.4.2.4 Rationing and Shortage Gaming.....	38
2.3 Logistics Planning as Object of Inter-Organizational Cooperation.....	39
2.3.1 Business Logistics – a Supply Chain Management Process.....	39
2.3.2 Logistics Planning as a Hierarchical Planning Problem.....	42

2.3.3	Inter-Organizational Logistics Planning in Supply Chains as a Hierarchical Planning Problem .....	46
2.3.4	Inter-Organizational Planning – The Approach of Wyner and Malone.....	47
<b>3</b>	<b>Cooperation in Supply Chains and SCM Software Use in the European Automotive Industry .....</b>	<b>51</b>
3.1	Cooperative Transportation in Supply Chains.....	51
3.1.1	An Exemplary Decision Category in Logistics: Transportation.....	51
3.1.2	Selected Cooperative Scenarios for Transportation .....	55
3.1.2.1	Cooperation Scenario I: Engaging in a Logistics Alliance.....	56
3.1.2.2	Cooperation scenario II: Supply Chain-Wide Container Management .....	60
3.1.2.3	Cooperation Scenario III: Selling Excess Transportation Capacity to Other Companies.....	60
3.1.2.4	Cooperation Scenario IV: Joint Ownership of Transportation Capacity .....	62
3.1.2.5	Cooperation Scenario V: Multi-Stop Shipping and Sequenced Loading.....	62
3.1.2.6	Cooperation Scenario VI: Merge-in-Transit and Sequenced Loading.....	64
3.1.2.7	Cooperation Scenario VII: Cross Docking and Sequenced Loading .....	67
3.1.2.8	Cooperation Scenario VIII: Sequenced Delivery.....	69
3.2	SCM Software as an Instrument for Cooperative Planning in Supply Chains – An Explorative Survey on the European Automotive Industry.....	71
3.2.1	Information Sharing as Premise for Cooperation in Supply Chains .....	71
3.2.2	Goals of the Survey .....	78
3.2.3	Research Design .....	79
3.2.4	Cooperation in the European Automotive Industry .....	80
3.2.4.1	Fields of Cooperation.....	81
3.2.4.2	Collaborative Planning .....	81
3.2.5	Supply Chain Management Software in the European Automotive Industry.....	84
3.2.5.1	The Status Quo of Using Supply Chain Management Software .....	84
3.2.5.2	Goals of Implementing Supply Chain Management Software.....	86
3.2.5.3	Evaluation of Benefits from Using Supply Chain Management Software.....	88
3.2.5.4	Supply Chain Management Software and Network Effects in the European Automotive Industry .....	90
3.2.6	Summary of Results.....	94
<b>4</b>	<b>The Supply Chain of the Audi A8 V8 4.0l Diesel Engine – A Case Study of Audi AG .....</b>	<b>97</b>
4.1	Exposés of Companies in the Supply Chain of the V8 4.0l Diesel Engine.....	98
4.1.1	Audi AG.....	98
4.1.1.1	General Overview of Audi AG.....	98
4.1.1.2	Supply Chain Related Overview of Audi AG .....	101
4.1.2	Audi Hungaria Motor Kft. ....	104
4.1.3	TCG Unitech Systemtechnik .....	104
4.1.4	Gustav Wahler GmbH u. Co. KG .....	105
4.2	Description and Analysis of the Supply Chain of the Audi A8 V8 4.0l Diesel Engine .....	105
4.2.1	Description of the Supply Chain of the Audi A8 V8 4.0l Diesel Engine .....	106
4.2.2	Analysis of Inventory Levels in the Supply Chain of the Audi A8 V8 4.0l Diesel Engine.....	114
4.2.3	Analysis of Orders Placed by the Companies in the Supply Chain of the Audi A8 V8 4.0l Diesel Engine .....	121
4.3	Evaluation of the Audi AG Supply Chain.....	129

4.3.1	The Bullwhip Effect in the Supply Chain of the Audi A8 V8 4.0l Diesel Engine .....	129
4.3.2	Evaluation of the Cooperation Scenarios for Transportation in the Supply Chain of the Audi A8 V8 4.0l Diesel Engine.....	135
4.3.2.1	Cooperation Scenario I: Engaging in a Logistics Alliance.....	135
4.3.2.2	Cooperation Scenario II: Supply Chain-wide Container Management.....	138
4.3.2.3	Cooperation Scenario III: Selling Excess Transportation Capacity to Other Companies.....	139
4.3.2.4	Cooperation Scenario IV: Joint Ownership of Transportation Capacity .....	140
4.3.2.5	Cooperation Scenario V: Multi-Stop Shipping and Sequenced Loading.....	140
4.3.2.6	Cooperation Scenario VI: Merge-in-Transit and Sequenced Loading.....	141
4.3.2.7	Cooperation Scenario VII: Cross Docking and Sequenced Loading .....	141
4.3.2.8	Cooperation scenario VIII: Sequenced delivery.....	142
4.3.3	Evaluation of the Implementation of Supply Chain Monitoring in the Audi AG Supply Chain: Real-time Exchange of Information on Capacity, Inventory, and Demand.....	143
4.4	Summary of Results .....	152
<b>5</b>	<b>SCOptimizer – A Prototype for Quantifying Benefits of Cooperative Planning in Supply Chains .....</b>	<b>159</b>
5.1	Prototypical Implementation .....	161
5.1.1	The SCOptimizer Architecture .....	161
5.1.2	Prototypical Implementation of the Evaluation of Cooperative Distribution Planning with the SCOptimizer.....	169
5.1.2.1	Planning Background.....	169
5.1.2.2	Description from the Planner's Point of View .....	174
5.1.3	Prototypical Implementation of the Evaluation of the Bullwhip Effect .....	190
5.1.3.1	Planning Background.....	190
5.1.3.2	Description from the Planner's Point of View .....	198
5.2	Computational Study on Cooperative Distribution – An Exemplary Evaluation of Cooperative Planning Using the SCOptimizer.....	222
5.2.1	Approach of the Computational Study.....	223
5.2.2	Selected Results of the Computational Study.....	228
5.2.2.1	Total Costs.....	229
5.2.2.2	Vehicle Costs .....	236
5.2.2.3	Distance Costs .....	238
5.2.2.4	Capacities.....	240
5.2.2.5	Relative Results.....	244
5.2.3	Summary of Results .....	248
<b>6</b>	<b>Summary and Conclusions .....</b>	<b>253</b>
6.1	Summary of the Findings and Implications.....	254
6.2	Outlook and Further Research .....	257
	<b>References .....</b>	<b>261</b>