

Contents

Abstract	VII
List of Figures	XV
List of Tables	XXI
1 Introduction	1
1.1 Motivation for Beginners	1
1.2 Advanced Risk	5
1.3 The Real Introduction: The Name of the Game . . .	8
1.4 Outline and Course of Discussion	12
I Supply Chain Risk Concepts – Fundamentals	17
2 The Genesis of Supply Chain Risk	19
2.1 Logistics Innovations – A Blessing and a Curse . . .	20
2.2 Supply Chain Disruptions	23
2.2.1 Environmental Disruptions	29
2.2.2 Economic Disruptions	30
2.2.3 Socio-Geopolitical Disruptions	33
2.2.4 Technological Disruptions	34
2.3 Coping with Risk	35
2.3.1 Enterprise Risk	35
2.3.2 Following the footsteps of Management . . .	37

2.3.3	Identification needs Quantification – Quantification needs Definition	40
3	A New Definition of Supply Chain Risk	43
3.1	The Evolution of Risk	45
3.2	Requirements for a Definition of Supply Chain Risk	47
3.3	Existing Approaches of Supply Chain Risk Definitions	48
3.4	Core Characteristics of Supply Chain Risk	50
3.4.1	Risk Objective	52
3.4.2	Risk Exposition	56
3.4.3	Risk Attitude	72
3.5	Re-defining Supply Chain Risk	74
4	Supply Chain Risk Analysis	77
4.1	The Risk of Supply Chain Risk Analysis	79
4.1.1	Biases of Risk Identification	83
4.1.2	Biases of Risk Countermeasures	88
4.1.3	Breaking of Biases	95
4.2	Main Elements of Supply Chain Risk Analysis	96
4.2.1	Analysis of Potential Triggers	96
4.2.2	Analysis of Performance Measurement	107
4.2.3	Analysis of Supply Chain Constitution	117
4.3	Tasks of Supply Chain Risk Analysis	127
5	Supply Chain Risk Analytics	131
5.1	Supply Chain Risk Analytics – Concept Definition	132
5.2	The Value of Supply Chain Risk Analytics	135
5.2.1	Risk Acceptance	137
5.2.2	Risk Reduction Measures	140
5.2.3	Risk Spreading Measures	149
5.3	Quantification Measures for Supply Chain Risk	152
5.3.1	Deviation Measures	153
5.3.2	Downside Risk	153
5.3.3	Expected Values	154
5.3.4	Probability and other measures	155

5.4	Risk-aware Supply Chain Optimization	157
5.4.1	Modeling Approaches	158
5.4.2	Solution Techniques	161
5.5	Research Gaps	161
II	Supply Chain Risk Identification and Assessment – Simulation-based Framework	163
6	Simulation for Supply Chain Analysis	165
6.1	Simulation at a Glance	167
6.1.1	Basics	167
6.1.2	Technical entities of Simulation Tools	171
6.1.3	Simulation Paradigms	172
6.2	Simulation of Supply Chain Problems	175
6.3	Simulation and Optimization	176
7	Design, Metamodeling, and Analysis of Simulation Experiments	181
7.1	Meta-Models	184
7.2	Designs	187
7.2.1	Purpose of Design	188
7.2.2	Classic Factorial Designs	193
7.2.3	Design construction	196
7.3	Analysis	198
7.3.1	Regression Analysis	199
7.3.2	Method of Least Squares	200
7.3.3	Analysis of Variance (ANOVA)	202
7.3.4	Measures of Factor Effects	202
7.4	Illustrative Examples	206
7.4.1	A 2^4 Full Factorial Experiment for the Analysis of Production Characteristics	206
7.4.2	A 2^{4-1}_{IV} Fractional Factorial Experiment for the Analysis of Production Characteristics	211
7.5	Cautions with the Design of Experiments	213

8 A Simulation-based Approach for Supply Chain Risk Analysis	217
8.1 Requirements	218
8.2 A New Approach for Supply Chain Risk Analysis – Basic Models	220
8.2.1 Scenario-based Procedure	220
8.2.2 Screening Procedure	227
8.2.3 Procedure for Risk Quantification	229
8.3 Summarized Main Features of the Approach	233
9 Representative Master Planning Module for Supply Chains	235
9.1 Planning Tasks of Supply Chains	236
9.2 Mathematical formulation of a Master Planning Problem	238
9.2.1 Determinants	241
9.2.2 Objective Function	247
9.2.3 Restrictions	248
10 A Conceptual Information Meta-Model for Supply Chains	261
10.1 Requirements for a Supply Chain Information Meta-Model	262
10.2 Related Work	264
10.3 Modeling Supply Chain Information	266
10.3.1 Concepts	266
10.3.2 Properties	268
10.3.3 Relations	268
10.3.4 Constraints	269
10.4 A Supply Chain Model	271
11 A Real Case Evaluation of the <i>SimSCRF</i> Approach	277
11.1 The Case	279
11.2 Contemporary Risk Quantification	281
11.3 A new View on Supply Chain Risk Analysis	286

11.4 Supply Chain Risk Analysis	288
11.4.1 Work Flow	288
11.4.2 Effect Analysis	300
11.4.3 Risk Line Identification	303
11.5 Conclusions and Outlook	308
 III Strategic Supply Chain Risk Mitigation – Optimization Approaches	 311
 12 Embedding Comprehensive Risk	 313
12.1 Mathematical Model Formulations	316
12.1.1 Notations	316
12.1.2 The Risk-aware Capacitated Plant Location Problem (CPLP-Risk)	319
12.2 Illustrative Example	327
12.2.1 Data Input	328
12.2.2 Solution Plausibility	333
12.2.3 The Value of Risk Consideration	339
12.2.4 Quantification of Supply Chain Risk	343
12.3 Preliminary Computational Results	345
12.4 Model Extensions	354
12.4.1 Model Extensions for the Affected Supply Chain	354
12.4.2 Model Extensions for the Risk Objective	357
12.4.3 Model Extensions for the Risk Attitude	358
12.5 Conclusions and Outlook	360
 13 Conclusions and Outlook	 363
13.1 Conclusions	364
13.2 Outlook	369
 Bibliography	 373