Table of Contents

Table of Contents III

1 Introduction 1

2 Management of Logistics Distribution Networks 5
2.1 Logistics Distribution Networks 5
2.1.1 Supply Chains and Logistics 5
2.1.2 Multi-echelon Logistics Distribution Networks 8
2.1.3 Decisions in Distribution Networks 10
2.1.4 The Performance of Logistics Distribution Networks 12
2.1.5 Challenges in the Management of Distribution Networks . . 16
2.2 Decision Makers' Assistance Supporting Tools 18
2.2.1 The Modelling of Distribution Networks 19
2.2.2 Decision Support Systems and Logistics Assistance Systems 24

3 Optimisation of Distribution Networks 27
3.1 Metaheuristics for Solving Optimisation Problems 27
3.1.1 Optimisation Problems 27
3.1.2 Optimisation Methods 32
3.1.3 Metaheuristic Algorithms for Solving Optimisation Problems 37
3.2 Simheuristics 45
3.3 The Performance of Optimisation Methods 49
3.3.1 Performance Measures of Optimisation Methods 49
3.3.2 Approaches for Increasing the Performance of Optimisation Methods 51
3.4 Comparison between Optimisation Methods 54
3.4.1 Statistical Tests for the Comparison between Optimisation Methods 54
3.4.2 Presenting the Results for the Comparison between Optimisation Methods 58
3.5 A Logistics Assistance System for the Optimisation of a Distribution Network 60
3.5.1 The Architecture of the Logistics Assistance System 61
3.5.2 Action Types and Actions in the Logistics Assistance System 65
3.5.3 Action Plans in the Logistics Assistance System 67
3.6 The Problem Statement and Research Questions 68

3.7 Performance Enhancement Approaches for the Logistics Assistance System 71

4 Enhancement Approach using Domain-specific Information 75
4.1 Type of changes to Enhance the Performance of an Optimisation Algorithm 76
4.1.1 Actions' Changes in a Logistics Distribution Network . . . 76
4.1.2 Adapting an Evolutionary Algorithm to Utilize the Type of Changes in the Construction of Action Plans. 78
4.2 Success to Enhance the Performance of an Optimisation Algorithm 83
4.2.1 Determination of the Success of Actions 83
4.2.2 Utilising Success Values in the Construction of Action Plans 84
4.2.3 Adapting an Evolutionary Algorithm to Utilize Success Values in the Construction of Action Plans in the LAS. . . 88
4.3 Correlation to Enhance the Performance of an Optimisation Algorithm 96
4.3.1 Correlation Concept Between the Actions' Sequence and their Impact on the Performance 96
4.3.2 Constructing Action Plans Based on the Actions' Correlation Relations 100
4.3.3 Adapting an Evolutionary Algorithm to Utilise Correlation Relations in the Construction of Action Plans in the LAS . 107

5 Enhancement Approaches to Reduce the Number of Simulation Runs 115
5.1 Grouping Actions to Reduce the Number of Action Plans 115
5.1.1 The Size of a Search Space 116
5.1.2 Grouping Concept 117
5.1.3 Implementation of Grouping in the LAS 120
5.2 Defining Equivalent Action Plans to Reduce the Number of Evaluations 121
5.2.1 Interchangeable Actions 121
5.2.2 Redundant Actions 126
5.2.3 Implementation of Equivalent Actions in the LAS 131

6 Case Study: Evaluating the Proposed Enhancement Approaches 141
6.1 Thyssenkrupp Material Services 142
6.2 Optimising the Logistics Distribution Network Using the LAS . . 143
6.3 Utilising Domain-specific Information to Enhance the Performance of the LAS 146
6.3.1 Utilising the Type of Changes to Enhance the Performance of the LAS 146
6.3.2 Utilising the Success to Enhance the Performance of the LAS 150

6.3.3 Utilising the Correlation to Enhance the Performance of the LAS. 154
6.4 Grouping of Similar Actions to Enhance the Performance of the LAS 162
6.5 Identifying Equivalent Action Plans to Enhance the Performance of the LAS 164
6.6 Conclusions 166

7 Summary **171**

References **175**

List of Figures **195**

List of Tables **201**

List of Algorithms **205**

List of Abbreviations **207**

List of Symbols **209**

A: Computer Specifications **211**

B: Testing the Utilisation of DSI in Action Plans' Optimisation **213**
B.1 Experiment's Objective Function and Actions' Relations 213
B.2 Constructing Action Plans Utilising Success 215
B.3 Constructing Action Plans Utilising Correlation 217
B.4 Experiments to Optimise the Objective Value Utilising Success . 221
B.5 Experiments to Optimise the Objective Value Utilising Correlation 226

C: Experiments Comparing Methods to Identify Equivalent Solutions **235**
C.1 Timing the Methods for Identifying Similar Solutions 235
C.2 Factors Affecting the Required Number of Simulation 237

D: Case Study Experiments **241**
D.1 The Design of Experiments for the EA Parameters' Selection. . . 241
D.2 Utilising Domain-specific Information in the EA Experiments . . 243
D.3 Utilising Equivalent Action Plans 245