| Acknowledgments | V | | |
|---|------|--|--|
| Table of contents | | | |
| List of figures | | | |
| List of tables | | | |
| List of Indices and Parameters | | | |
| Abbreviations | xxiv | | |
| Preface | | | |
| 1 Introduction | | | |
| 1.1 Prologue | 1 | | |
| 1.1.1 Supply Chain Players | 2 | | |
| 1.1.2 Issues in Supply Chain | 4 | | |
| 1.2 The concept of agility and its origin | 4 | | |
| 1.3 Agility in different scenarios | 5 | | |
| 1.3.1 Business agility | 6 | | |
| 1.3.2 Enterprise agility | 6 | | |
| 1.3.3 Workforce agility | 6 | | |
| 1.3.4 IT agility | 6 | | |
| 1.3.5 Agile manufacturing | 7 | | |
| 1.3.6 Supply chain agility | 7 | | |
| 1.4 Relevance of supply chain agility | 7 | | |
| 1.5 Enablers to supply chain agility | 8 | | |
| 1.6 Motivation for this research | 9 | | |
| 1.7 Research problem statements | 11 | | |

| 1.8 | Ag | lity in context of case-organization | 13 |
|--------|-------|--|----|
| 1. | 8.1 | Global competition | 14 |
| 1. | 8.2 | Dynamic changes of demand patterns | 14 |
| 1. | 8.3 | Complexity in business environment | 14 |
| 1. | 8.4 | Risk and Uncertainty in business environment | 15 |
| 1.9 | Exp | perts' opinions of the present dissertation | 16 |
| 1.10 | Obj | jectives of the thesis | 19 |
| 1.11 | Sco | ppe of the thesis | 19 |
| 1.12 | Co | ntribution of the thesis | 20 |
| 1.13 | Org | ganization of the thesis | 20 |
| 2 Lite | eratu | ire Review | 24 |
| 2.1 | Intr | roduction to agility | 24 |
| 2.2 | Ag | ility in supply chain | 26 |
| 2.3 | Rel | ationship of agility to other concepts | 28 |
| 2. | 3.1 | Agility and Leanness | 28 |
| 2. | 3.2 | Agility and Flexibility | 31 |
| 2. | 3.2 | Agility and Adaptability | 32 |
| 2. | 3.4 | Agility and Resilience | 33 |
| 2.4 | Cla | ssification of literature on agility | 34 |
| 2. | 4.1 | Modelling the enablers | 34 |
| 2. | 4.2 | Agility assessment | 36 |
| 2. | 4.3 | Agility implementation | 40 |
| 2. | 4.4 | Conceptual framework | 42 |
| 2. | 4.5 | Maximizing agility in supply chain | 44 |
| 2. | 4.6 | Leagility | 45 |

| | 2.5 | Din | nension of agility | 48 |
|---|-----|--------|--|----|
| | 2.6 | Ena | blers of agility | 50 |
| | 2.7 | Agi | lity and Tradeoffs | 53 |
| | 2. | 7.1 | Agility and Efficiency | 54 |
| | 2. | 7.2 | Agility and Reliability | 54 |
| | 2. | 7.3 | Agility and Uncertainty | 54 |
| | 2.8 | Res | earch gaps identified | 55 |
| | 2.9 | Obj | ectives of the thesis | 56 |
| 3 | Too | ols, T | echniques and Methodology | 57 |
| | 3.1 | Inte | rpretive Structural Modelling (ISM) | 58 |
| | 3. | 1.1 | Identification of variables relevant to the problem | 58 |
| | 3. | 1.2 | Developing a contextual relationship among variables | 59 |
| | 3. | 1.3 | Developing a structural self-interaction matrix (SSIM) | 60 |
| | 3. | 1.4 | Developing a reachability matrix | 61 |
| | 3. | 1.5 | Partitioned reachability matrix into different levels | 62 |
| | 3. | 1.6 | Developing conical matrix | 63 |
| | 3. | 1.7 | Formation of ISM based model | 63 |
| | 3. | 1.8 | MICMAC analysis | 64 |
| | 3.2 | Fuz | zy Theory and Decision Making | 65 |
| | 3. | 2.1 | Fuzzy versus Crisp | 66 |
| | 3. | 2.2 | Definition of Fuzzy Sets | 67 |
| | 3. | 2.3 | Definition of Fuzzy Numbers | 67 |
| | 3. | 2.4 | The concept of Generalized Triangular Fuzzy Number | 67 |
| | 3. | 2.5 | Linguistic Variables | 68 |
| | 3. | 2.6 | Fuzzy Number Arithmetic Operations | 68 |

| 3.2.7 Euclidean Distance Method | 69 | | |
|---|----|--|--|
| 3.2.8 Ranking of Generalized Triangular Fuzzy Number | 70 | | |
| 3.3 Multi Criteria Decision Making (MCDM) | 71 | | |
| 3.3.1 Analytical Hierarchy Process (AHP) as MCDM | 71 | | |
| 3.3.2 Steps involved in AHP | 72 | | |
| 3.3.3 Basic principles of AHP | 73 | | |
| i Hierarchy Construction | 73 | | |
| ii Comparative Judgment | 73 | | |
| iii Priority analysis | 74 | | |
| 3.3.4 Test of Consistency | 75 | | |
| 3.4 Goal Programming (GP) | 76 | | |
| 3.4.1 Terminology and Concepts | 76 | | |
| 3.4.1.1 Decision maker(s) | 77 | | |
| 3.4.1.2 Decision variable | 77 | | |
| 3.4.1.3 Deviation variable | 77 | | |
| 3.4.1.4 Objective function | 77 | | |
| 3.4.1.5 Constraint | 77 | | |
| 3.4.2 General Structure of the Goal Programming Methodology | 78 | | |
| 3.4.3 Categorization of the Goal Programming Model | 79 | | |
| 3.4.3.1 Lexicographic (Pre-emptive) Goal Programming Model | 79 | | |
| 3.4.3.2 Weighted Goal Programming Model | 80 | | |
| 3.4.4 Advantages of Goal Programming Model | 80 | | |
| 4 Understanding the Interrelationship of ASC Enablers | 81 | | |
| 4.1 Identification of ASC enablers | | | |
| 4.2 Developing a contextual relationship among enablers | | | |

| 4.3 | Developing a Structural Self-Interaction Matrix (SSIM) | 86 |
|---|--|-----|
| 4.4 | Developing a reachability matrix | 87 |
| 4.5 | Partitioned reachability matrix into different levels | 89 |
| 4.6 | Developing conical matrix | 91 |
| 4.7 | Formation of ISM-based model | 92 |
| 4.8 | MICMAC analysis | 95 |
| 4.9 | Significance of the findings of MICMAC analysis | 96 |
| 4.10 | Justification of doing the MICMAC analysis | 97 |
| 4.11 | Utilization of findings of chapter 4 further in the context of thesis | 97 |
| 4.12 | Concluding remarks | 98 |
| 5 Eva | aluation of agility in Supply Chain | 99 |
| 5.1 | Framework for agility evaluation | 101 |
| 5.2 | Conceptual model for agility evaluation | 101 |
| 5.3 | An illustrative example | 103 |
| 5.3.1 Linguistic scale for assessing the performance ratings and importance weights of agile capabilities | | |
| 5. | 3.2 Collection of ASC assessment data | 107 |
| 5. | 3.3 Approximation and aggregation of fuzzy ratings and weights of ASC | 107 |
| 5. | 3.4 Calculation of FAI | 111 |
| | 5.3.4.1 Calculation of AI at an attribute level | 112 |
| | 5.3.4.2 Calculation of AI at the enabler level | 113 |
| | 5.3.4.3 Determination of FAI | 114 |
| 5. | 3.5 Determination of Euclidean distance to match FAI with an approximate agility level | 115 |
| 5.4 | Analysis and identification of barriers for improving the agility level | 117 |
| 5.5 | Sensitivity of the barriers list to the threshold value | 120 |

| | 5.6 | 5 Signification of findings organization to be "Very Agile" | | |
|---|-------|---|--|-----|
| | 5.7 | Cost benefit trade-offs with agility | | |
| | 5.8 | 3 Significance of the finding of the barriers | | |
| | 5.9 | Gen | erality of the findings obtained from this chapter | 124 |
| | 5.10 | Con | cluding remarks | 125 |
| 6 | Allo | ocatio | on of Weight to Agility Enablers | 127 |
| | 6.1 | Wei | ghting the agility enablers: An AHP approach | 127 |
| | 6.2 | Pert | forming AHP analysis | 129 |
| | 6. | 2.1 | Collection of data for pair-wise comparison | 130 |
| | 6. | 2.2 | Priority weights for criteria and priority weights for enablers with | 133 |
| | 6. | 2.3 | Calculation of consistency ratio for the each of the comparison | 136 |
| | 6. | 2.4 | matrices Estimation of global and local scores | 137 |
| | 6.3 G | enera | ality of the findings obtained from comparisons of enablers and criteria | 139 |
| | 6.4 | Con | nparison of results obtained from ISM and AHP | 141 |
| | 6.5 | Con | cluding remarks | 142 |
| 7 | Ma | ximiz | ration of the Agility Deploying the Yearly Budget Resources | 143 |
| | 7.1 | Dev | elopment of AHP-Goal Programming model | 143 |
| | 7.2 | App | plication of the combined model | 147 |
| | 7. | 2.1 | Deriving the AHP weights | 147 |
| | 7. | 2.2 | The combined AHP-GP model | 147 |
| | 7. | 2.3 | Formulation of the model | 150 |
| | 7. | 2.4 | Solution of the combined model | 152 |
| | 7.3 | Sen | sitivity analysis | 154 |
| | 7. | 3.1 | Sensitivity of the variations in P_1 , P_2 and P_3 | 154 |
| | 7. | 3.2 | Sensitivity of the variations in C, M, E, and A | 156 |
| | | | | |

| | 7.4 | Concluding remarks | 157 |
|---|---|--|-----|
| 8 | Co | clusion and Future Scope | 158 |
| | 8.1 | Summary of Findings | 158 |
| | 8.2 | Managerial Implications | 160 |
| | 8.3 | Limitations of the present work | 162 |
| | 8.4 | Scope for future work | 163 |
| References | | 164 | |
| Appendix A : Performance ratings of agile capabilities given by six experts | | 185 | |
| Appendix B : Importance weights of agile capabilities given by six experts | | 187 | |
| A | Appendix C : Average performance ratings and importance weights of agile capabilities | | 190 |
| A | ppend | lix D : Fuzzy Performance Importance Index (FPII) and Ranking Score of all ASC sub-attributes | 192 |
| Li | List of papers published/ accepted for publication | | |