

Contents

List of abbreviations	xxiii
1 Introduction	1
1.1 The new paradigm.....	1
1.1.1 Manufacturer's viewpoint.....	7
1.1.2 Customer's viewpoint.....	8
1.2 Goals of a sustainable product life cycle management.....	9
1.3 Approach of the book.....	10
1.4 References concerning chapter 1	11
2 Life cycle modelling	13
2.1 Process network	18
2.1.1 PSL (Process Specification Language).....	20
2.1.2 XPDL (XML Process Definition).....	20
2.1.3 BPMN (Business Process Modelling Language)	21
2.1.4 UML (Unified Modelling Language)	21
2.1.5 EPC (Event Process Chain)	21
2.1.6 OPM (Object Process Methodology)	22
2.2 Framework for a networked life cycle management	22
2.2.1 Defining the product life cycle modelling framework	23
2.2.2 Modelling product life cycle data	25
2.3 Product models.....	27
2.3.1 Definition of product modelling	27
2.3.2 Types of information representation.....	28
2.3.3 Existing standards	32
2.4 Applications using product condition data	34
2.4.1 Conception of the product condition model.....	35
2.4.2 Class structure of the condition model.....	37
2.4.3 Shifting viewing levels	37
2.4.4 Implementation of the product condition model.....	39
2.4.5 Product model for manufacturing	39
2.4.6 Product model from the market life cycle perspective.....	47
2.4.7 Case study of a life cycle product model	48
2.5 Interim summary of life cycle modelling	50
2.6 References concerning chapter 2	50
3 Life cycle evaluation.....	55
3.1 Economical assessment of product life cycles	56
3.1.1 Life cycle costing.....	58
3.1.2 Strategic portfolio for optimising life cycle costs	60
3.1.3 Standardised worksheet for evaluating life cycle costs.....	62
3.1.4 Case study of a life cycle cost calculation for a machine tool	63
3.1.5 Continuous life cycle cost controlling	66
3.1.6 Life cycle cost contracts	76
3.2 Ecological evaluation	78

3.2.1 The application of life cycle assessment.....	78
3.2.2 Further studies on ecological assessment.....	79
3.3 Interim summary of life cycle evaluation.....	79
3.4 References concerning chapter 3.....	80
4 Life cycle information support.....	83
4.1 Reliable data for transparent product life cycles	84
4.2 Digital product tracking.....	85
4.3 Boosting utilisation performance	90
4.3.1 The phase of product design	90
4.3.2 The phase of product utilisation.....	91
4.3.3 The phase of upgrading and recycling	100
4.4 Product data management for high data continuity	101
4.4.1 Using field data to close information loops	103
4.4.2 Enduring design records	106
4.4.3 Digital Enterprise Technology for life cycle controlling	108
4.4.4 Examples of life cycle controlling functions	109
4.5 Interim summary of life cycle information support.....	111
4.6 References concerning chapter 4.....	111
5 Customer supply networks.....	117
5.1 Customer lifetime value	118
5.2 Cooperation for life cycle benefit.....	119
5.3 Integrated product-service systems	123
5.3.1 Developing product service systems.....	123
5.3.2 Supporting activities and modules	125
5.4 Selling the benefit instead of the equipment	127
5.5 Industrial prototypes and practical examples	129
5.5.1 Example of the implementation of LCC methodology	129
5.5.2 Example of online process monitoring	131
5.5.3 Example of process monitoring for intelligent services.....	133
5.6 Interim summary of life cycle customer supply	134
5.7 References concerning chapter 5.....	134
6 Method for the design of life cycle concepts	137
6.1 Approaches from a retrospective point of view.....	137
6.2 New requirements call for a new approach	141
6.3 Methodological approach	143
6.3.1 Objectives for the design of life cycles.....	144
6.3.2 Requirements for the design of life cycles.....	147
6.3.3. Definition of life cycle concepts	148
6.4 Fields of action in life cycle design.....	148
6.4.1 Material recycling	149
6.4.2 Remanufacturing.....	149
6.4.3 Services.....	150
6.5 Prognosis	152
6.5.1 Creation of life cycle scenarios	155
6.5.2 Use of life cycle scenarios	157

6.6 Development of life cycle concepts	159
6.6.1 Idea generation.....	159
6.6.2 Idea assessment.....	164
6.3.3 Creation of life cycle concepts.....	167
6.7 Life cycle concept assessment and selection.....	170
6.7.1 Costs and revenues throughout the life cycle.....	171
6.7.2 Costs and revenues analysis.....	183
6.7.3 Users	186
6.7.4 Ecological assessment through LCA	189
6.7.5 Optimisation of life cycle concepts.....	190
6.7.6 Selection of a life cycle design	191
6.8 Synthesis and exemplification.....	192
6.8.1 Synthesis of the method for the design of life cycle concepts	192
6.8.2 Exemplification of the method	195
6.9 Conclusion and outlook of the methodological approach	198
6.10 References concerning chapter 6.....	200
7 Summary.....	205
Index	207