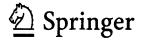
Masataka Yoshimura

## System Design Optimization for Product Manufacturing



## Contents

1	Progression of Product Manufacturing Technologies	
	1.1 Introduction to Product Manufacturing	1
	1.2 Historical Changes in Product Manufacturing Methodology Paradigms.	4
	Exercises	7
2	Evaluative Criteria for Product Manufacturing and Optimization	
F	undamentals	
	2.1 Evaluative Items and Criteria in Product Manufacturing	9
	2.1.1 Product Quality and Product Performance	10
	2.1.2 Manufacturing Cost	10
	2.1.3 Product Demand, Lead Time, Inventory, and Delivery	11
	2.1.4 Items Pertaining to Production Method	13
	2.1.5 Flexibility in Manufacturing	15
	2.1.6 Processing Capability	17
	2.1.7 Safety and Reliability	. 19
	2.1.8 Natural Environment and Natural Resources	20
	2.1.9 Mental Satisfaction Level	21
	2.2 Criteria Requirements	22
	2.3 Relationships Between Criteria and Optimization	26
	Exercises	
	References	33
3	Technologies for Product Manufacturing Innovation	35
	3.1 Generation of Better Products from Wider Feasibilities	35
	3.2 Generation from Conceptual Design Stages	36
	3.3 Concurrent Engineering	37
	3.4 Collaboration	46
	Exercises	55
	References	55
4	Involvement of People in Product Manufacturing	57
	4.1 Roles of Individuals in Product Manufacturing	57
	4.1.1 Human Abilities	57

(

	4.1.2 Relationships Between Customers and Manufacturers	
	4.2 Kansei Engineering	. 60
	4.3 Ergonomics	. 69
	4.4 Collaboration Circumstances	. 74
	Exercises	.77
	References	. 78
5	Product Manufacturing Support Technologies	.79
	5.1 Representative Supporting Systems	
	5.1.1 Product Shape Description Technologies	. 80
	5.1.2 Technologies for Analysis of Performance Characteristics	. 83
	5.1.3 Technologies that Support Generation of Product Ideas	. 85
	5.1.4 Database Technologies	.90
	5.1.5 Manufacturing Support Technologies	.91
	5.1.6 Technologies to Acquire Information Concerning Customer	
	Needs	107
	5.1.7 Technologies Supporting Enterprise Management	110
	5.2 Utilization of Information Technology for Product Manufacturing	111
	Exercises	114
	References	115
6	Optimization Technologies for Product Manufacturing	117
	6.1 Fundamental Optimization Technologies and Difficulties in their	
	Application	
	6.1.1 Linear Programming Problems	
	6.1.2 Nonlinear Programming Problems and Local Optimum Solutions.	
	6.1.3 Multiobjective Optimization Problems	
	6.1.4 Optimization Problems Including Discrete Variables	
	6.1.5 Genetic Algorithms (GAs),	
	6.1.6 Large Scale Optimization Problems	130
	6.2 Fundamental Strategies for Effectively Applying Optimization	
	Methods	
	6.3 Fundamental System Optimization Approaches	134
	6.3.1 Decision-making Sequence Applied to Task Operations and	
	Optimization of Evaluative Characteristics	
	6.3.2 Two Stage Integrated Optimization	
	6.4 System Design Optimization Strategies	
	6.4.1 Features of Machine Product Characteristics and Fundamental	
	Optimization Strategies	
	6.4.2 Priority Relationships among Characteristics	148
	6.4.3 Creation of Hierarchical Optimization	
	6.4.4 Conflicting Relationships Between Characteristics	
	6.4.5 Construction of Hierarchical Optimization Procedures	
	6.4.6 Practical Procedures for Product Optimization	155

	6.4.7 Discussion Concerning System Design Optimization	. 162
	6.5 Optimum Selection Method for Alternative Design Solutions	
	Exercises	.167
	References	.167
7	Decision-making Methods	.171
	7.1 Decision-making Difficulties and Fundamentals of Decision-making	.171
	7.1.1 Decision-making Difficulties	.171
	7.1.2 Fundamental Schemes to Facilitate Decision-making	.172
	7.2 Fundamentals of Decision-making	
	7.2.1 Method for Selecting the Best Alternatives when There Are	
	Many Evaluative Factors	.173
	7.2.2 Calculation of Weighting Coefficients for Attributes Using	
	the Pair Comparison Method	.173
	7.2.3 Finding the Best Alternative from Among Several Alternatives	
	Using the Analytic Hierarchy Process (AHP) Method	.176
	7.2.4 Decision-making Using Subjective Probability Under Uncertain	
	Circumstances	.177
	7.2.5 Decision-making Considering Personal Preferences of	
	a Decision-maker	
	7.3 Methodologies for Decision-making in Collaborative Circumstances	.181
	Exercises	
	References	. 184
8	Design Optimization for Creativity and Balance	. 185
	8.1 Creativity Optimization Based on Collaborative Effort	. 185
	8.2 Cultural Impact of Product Manufacturing	. 189
	Exercises	. 190
	References	. 191
In	1dex	.193

-

.

۴