Rainer Kleber

Dynamic Inventory Management in Reverse Logistics

With 55 Figures and 20 Tables

4y Springer

Contents

Intr	oducti	on	1		
1.1	Object	tive and Motivation •	. 1		
1.2	Inventory Management in Reverse Logistics				
1.3	Methodology				
1.4	Outlin	e of the Thesis	7		
AB	asic Q	Quantitative Model for Medium and Long Range	0		
Pro	duct F	Recovery Planning	. 9		
2.1	Overvi	Iew	. 9		
2.2	A Bas	ic Quantitative Model of Dynamic Product Recovery	9		
2.3	Soluti	on of the Model Without Initial Inventories.	.13		
	2.3.1	Solution Methodology.	13		
	2.3.2	Necessary Conditions.	.14		
	2.3.3	The Structure of an Optimal Solution	. 17		
	2.3.4	Optimal Transitions Between Cases and Subcases	.20		
	2.3.5	Properties of Optimal Return Collection Intervals	.22		
	2.3.6	Solution Algorithm	25		
2.4	Dealir	ng with Initial Inventories	27		
2.5	Nume	merical Examples			
2.6	Comparison of Holding Cost and Discounted Cash Flow		.34		
	2.6.1	Holding Cost Results	34		
	2.6.2	A Comparison of Different Approximations	35		
2.7	Manag	gerial Insights •	. 39		
2.8	Proofs	s and Derivations	.40		
On	the Ef	ffects of Capacity Constraints in Product Recovery	[,] 47		
3.1	Motiv	ation	. 47		
3.2	Limited Production Capacity.				
	3.2.1	Changes to the Basic Model	49		
	3.2.2	Properties of an Optimal Solution	49		
	3.2.3	Pure Effects of a Manufacturing Constraint	57		

XIV Contents

	3.3 3.4	 3.2.4 Mixed Effects of a Manufacturing Constraint. 3.2.5 Numerical Examples. 3.2.6 Managerial Insights. Limited Remanufacturing Capacity. 3.3.1 Changes to the Basic Model. 3.3.2 Properties of an Optimal Solution. 3.3.3 Pure Effects of a Remanufacturing Constraint. 3.3.4 Managerial Insights. Proofs. 	62 68 68 68 69 76 86 86
4	Kno	wledge Acquisition and Product Recovery	95
•	4.1	Motivation	95
	4.2	A Model with Remanufacturing Knowledge Acquisition	.98
	4.3	Optimality Conditions and General Results.	.100
	4.4	Optimal Policies in Specific Situations	.108
		4.4.1 Optimal Policy with a Zero Interest Rate	.108
		4.4.2 Optimal Policy with'a Positive Interest Rate	.110
	4.5	Numerical Examples	.114
	4.6	Conclusions and Managerial Insights.	.121
	4.7	Proofs	.121
5	Tec 5.1	hnology Selection in the Context of Reverse Logistics Motivation	127 127
	5.2	A Dynamic Modeling Environment for Strategic Decision	120
	52	Making.	.129
	5.5	5.3.1 Valuation of Investment Project (a) Design for Single	.155
		Use	134
		Use,	.134
		 5.3.1 Valuation of Investment Project (a) - Design for Single Use 5.3.2 Investment Project (b) Design for Reuse	.134 .135
		 5.3.1 Valuation of Investment Project (a) - Design for Single Use	.134 .135 .139
	5.4	 5.3.1 Valuation of Investment Project (a) - Design for Single Use	.134 .135 .139 .146
	5.4 5.5	 5.3.1 Valuation of Investment Project (a) - Design for Single Use	.134 135 .139 146 .152
	5.4 5.5 5.6	 5.3.1 Valuation of Investment Project (a) - Design for Single Use	134 135 139 146 152 154
	5.4 5.5 5.6 5.7	 5.3.1 Valuation of Investment Project (a) - Design for Snigle Use	134 135 139 146 152 154 155
6	5.4 5.5 5.6 5.7 Co	 5.3.1 Valuation of Investment Project (a) - Design for Single Use	134 135 139 146 152 154 155 .167
6 Lis	5.4 5.5 5.6 5.7 Cor t of	 5.3.1 Valuation of Investment Project (a) - Design for Single Use	134 135 139 146 152 154 155 .167 .169
6 Lis	5.4 5.5 5.6 5.7 Con t of	5.3.1 Valuation of nivestifient Project (a) - Design for Reuse 5.3.2 Investment Project (b) Design for Reuse 5.3.3 Investment project (c) - Design for Reuse with Strategic Inventory. A Numerical Investigation	134 135 139 146 152 154 155 .167 .169 .173
6 Lis Lis	5.4 5.5 5.6 5.7 Col t of t of	5.3.1 Valuation of nivestifient Project (a) - Design for Reuse 5.3.2 Investment Project (b) Design for Reuse 5.3.3 Investment project (c) - Design for Reuse with Strategic Inventory. A Numerical Investigation	134 135 139 146 152 154 155 .167 .169 .173
6 List List List	5.4 5.5 5.6 5.7 Con t of t of	 5.3.1 Valuation of Investment Project (a) - Design for Single Use	134 135 139 146 152 154 155 .167 .169 .173 .175