

**Optimal Policies for Spares in
Multi-Echelon Repair-Inventory Systems**

by

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**Submitted in fulfilment of the
requirements for the degree of
Doctor of Philosophy**

to the

Indian Institute of Technology, Delhi

October 1980

DEDICATED TO

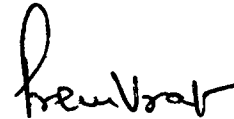
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The thesis entitled 'Optimal Policies for Spares in Multi-Echelon Repair-Inventory Systems' being submitted by Mr. Arjunan Subash Babu to the Indian Institute of Technology, New Delhi, for the award of the degree of Doctor of Philosophy, is a record of bonafide research work carried out by him. He has worked under my guidance and supervision, and has fulfilled the requirements for the submission of this thesis, which has attained the standard required for a Ph.D. degree of the Institute. The results presented in this thesis have not been submitted elsewhere for the award of any degree or diploma.



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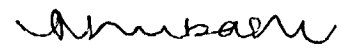
ACKNOWLEDGMENTS

The author is very much indebted to Dr. Prem Vrat, Professor of Industrial Engineering, Department of Mechanical Engineering, Indian Institute of Technology, New Delhi, for the initiative, guidance and encouragement received during the course of this research.

The author thanks the Indian Institute of Technology, New Delhi, for providing the necessary facilities, and Delhi Transport Corporation for extending their help while collecting the data.

The various helps and encouragements extended by Dr. M.K.G. Babu, Mr. K. Kumar, Mr. K.S. Reddy and Mr. B.P. Reddy are gratefully acknowledged and the author feels indebted to them for their kind interest and understanding. The author also takes this opportunity to thank Jayanthi, Shiv, Kumbhar, Banwet and others for their interest.

Thanks are also due to Mr. P.M. Padmanabhan Nambiar, for his excellent typing and Mr. Kapoor for his neat drawings.



A. SUBASH BABU

ABSTRACT

Investigations reported in this thesis consider the problem of optimal provisioning of expensive and slow moving spares in multi-echelon repair-inventory systems pertaining to important public utility sectors, like road transport corporations, with the general theme of achieving total effectiveness by developing integrated logistics systems for such organisations. The thesis consists of ten chapters, divided into six sections.

The first section consists of two chapters. In the first - introductory chapter, the functional importance and types of inventory systems; the relevance, structure, characteristics and parameters of the general multi-echelon and multi-echelon repair-inventory systems are discussed. In the second chapter, the general multi-echelon inventory systems are classified and reviewed in a consolidated manner with pictorial and tabular schemes, whereas, the available literature on multi-echelon repair-inventory systems is reviewed extensively.

In the second section consisting of one chapter, a 'total system cost' model is developed for a two-level repair-inventory system, using which, optimal inventory policies are evaluated to minimise the total system cost for a metropolitan bus transport corporation. The individual and joint impacts of optimal location and maintenance effectiveness of the central facility on the system performance and spare stock are investigated.

The next section consists of four chapters. Here, a computer simulation model is developed for the two-level system. The validity, adequacy, applicability, adaptability and predictability of the model are statistically verified, and the evaluation of optimal policies for the Transport Corporation is carried out. With the help of suitable simulation models, the effects of incorporating cannibalization and transshipment individually and jointly, on the system performance and spare stock are investigated. The observations are statistically analysed using the Analysis of Variance and Spectral Analysis.

The fourth section with one chapter, presents an alternative system in three-level configuration with a total cost model. Optimal inventory policies are evaluated for the proposed system. The effects of configuration and number of echelons on the performance and spare stock of multi-echelon repair-inventory systems are investigated.

In the fifth section consisting of one chapter, the effect of budget constraints on system performance, namely, system availability and total system cost are investigated. Using suitable approximations, mathematical models and solution methodologies are developed to determine optimal inventory policies (spares provisioning/rationing) for various budgetary levels, in order to maximise the system availability and minimise the total system cost.

In the last section, that is in the concluding chapter, the summary of the research/findings is given; the contributions/developments of the research are highlighted; the limitations/shortcomings

are listed and the possible extensions/problems for future research are suggested.

An extensive bibliography is included on the subject. The Appendices of the thesis contain detailed flow charts, computer listing etc. which support the main text.

A substantial part of the research reported in this thesis has been published by the author in various International Journals and Conferences. A list of publications based on the work reported has been given at the end.

CONTENTS

	Page
ABSTRACT	i
LIST OF FIGURES	iv
LIST OF TABLES	viii
NOMENCLATURE	xii
CHAPTER I INTRODUCTION	1
1.1 Inventory Systems	1
1.2 Classifications of Inventory Systems	2
1.3 Multi-Echelon Inventory Systems	7
1.3.1 Definition	7
1.3.2 Terminologies	8
1.3.3 Structures of Multi-Echelon Inventory Systems	9
1.3.4 The Important Aspects of Multi-Echelon Inventory Systems	12
1.3.5 Parameters Significant to Multi-Echelon Inventory Systems	15
1.3.6 Applications of Multi-Echelon Inventory Systems	16
1.4 Multi-Echelon Repair-Inventory Systems	16
1.4.1 Application to Transport Organisations	22
1.5 The Statement of the Problem	23
1.6 The Scope of the Study	23
1.7 Conclusions	25

	Page
CHAPTER II LITERATURE REVIEW	26
2.1 Introduction	26
2.2 The Basis of the Present Review	27
2.3 Review of the Literature on the General Multi-Echelon Inventory Systems	29
2.3.1 The Pictorial Scheme for the Review	30
2.3.2 The Tabular Scheme for the Review	30
2.3.2A The Review of the Deterministic Models	32
2.3.2B The Review of the Stochastic Models	34
2.3.2C The Review of the Planning and Allocation Models	39
2.3.2D The Review of the Application Oriented Papers	46
2.3.2E Overlapping of the Classification	50
2.4 Review of Literature on Multi-Echelon Repair-Inventory Systems	50
2.5 Current State of the Art	76
2.5.1 Deterministic Models	76
2.5.2 Stochastic Models	76
2.5.3 Planning and Allocation Models	78
2.5.4 Application Oriented Models	79
2.5.5 Review Reports	80
2.5.6 Repair-Inventory Models	80
2.6 Limitations of the Existing Models/ Approaches	81
2.6.1 General Multi-Echelon Inventory Systems	82
2.6.2 Multi-Echelon Repair-Inventory Systems	85
2.7 Need for further Research and Areas for Study	87
2.8 An Overview of the Approach	90
2.9 Conclusions	92

		Page
CHAPTER	III MODEL FOR TWO-LEVEL REPAIR-INVENTORY SYSTEM	94
	3.1 Introduction	94
	3.2 The System	95
	3.2.1 The System Structure	95
	3.2.2 The Environmental and Decision Parameters	99
	3.3 The Model	99
	3.3.1 The Assumptions	99
	3.3.2 Model Development	100
	3.4 Application of the Model to a Specific Situation	108
	3.4.1 Data Collection and Parameters Estimation	110
	3.4.2 Results and Analysis	115
	3.5 Effect of the Central Repair-Facility Location on the System Performance	119
	3.5.1 Comparison of System Performance for the Present and Proposed Locations of the Central Repair Facility	126
	3.6 Role of Maintenance Effectiveness in Multi-Echelon Repair-Inventory Systems	128
	3.6.1 Time-Cost Relationship of Maintenance Through-put-time	129
	3.6.2 Impact of the Repair-Echelon Effectiveness on the Transport Corporation's Performance and Spare Stock	131
	3.7 Combined Impact of the Location and Effectiveness of the Repair-Echelon	138
	3.8 Conclusions	142

		Page
CHAPTER	IV COMPUTER SIMULATION MODEL FOR TWO-LEVEL REPAIR-INVENTORY SYSTEM	145
	4.1 Introduction	145
	4.2 The System	147
	4.3 The Simulation Model	147
	4.3.1 The Assumptions	151
	4.3.2 The Logic	152
	4.3.3 The Flow Chart	153
	4.3.4 Generation of Events	153
	4.3.5 The Simulation Run Length	158
	4.4 Testing and Validation of the Simulation Model	163
	4.4.1 Model's Ability to Produce Consistent Results for Various Replications	164
	4.4.2 Sufficiency of the Run Length of the Model	167
	4.4.3 Comparison of Analytical and Simulation Outputs	167
	4.4.3A Aspin-Welch Non-parametric Test	169
	4.4.3B One-way Analysis of Variance	170
	4.5 Results of the Simulation Model	173
	4.6 Predictability of the Simulator	175
	4.6.1 Without Autocorrelation	175
	4.6.2 With Autocorrelation	179
	4.7 Generalisation of the Simulation Model	185
	4.8 Conclusions	197

		Page
CHAPTER	V EFFECT OF CANNIBALIZATION ON SYSTEM PERFORMANCE AND SPARE STOCK	199
	5.1 Introduction	199
	5.2 Cannibalization	200
	5.3 Cannibalization in the Two-level System Considered	201
	5.4 The Simulation Model for Cannibalization	203
	5.5 Results and Analyses	204
	5.5.1 Investigation with Analysis of Variance	204
	5.5.2 Investigation with Spectral Analysis	210
	5.5.3 Effect of Various Levels of Cannibalization Activity	214
	5.6 Conclusions	216
CHAPTER	VI EFFECT OF TRANSHIPMENT ON SYSTEM PERFORMANCE AND SPARE STOCK	218
	6.1 Introduction	218
	6.2 Transshipment	219
	6.3 Transshipment in the Two-level System Considered	220
	6.4 The Simulation Model for Transshipment	221
	6.5 Results and Analyses	222
	6.5.1 Investigation with Analysis of Variance	222
	6.5.2 Investigation with Spectral Analysis	230
	6.6 Conclusions	233

		Page
CHAPTER	VII JOINT IMPACT OF TRANSHIPMENT AND CANNIBALIZATION ON SYSTEM PERFORMANCE AND SPARE STOCK	235
	7.1 Introduction	235
	7.2 Combined Transshipment and Cannibalization in the Two-level System Considered	235
	7.3 The Simulation Model for Transshipment - Cannibalization Combination	237
	7.4 Results and Analysis	237
	7.5 Conclusions	242
CHAPTER	VIII MODEL FOR THREE-LEVEL REPAIR-INVENTORY SYSTEM	244
	8.1 Introduction	244
	8.2 The Three-level System	245
	8.2.1 The System Structure	245
	8.2.2 The Environmental and Decision Parameters	246
	8.3 The Model	248
	8.3.1 The Assumptions	248
	8.3.2 Model Development	249
	8.4 An Application	254
	8.5 Effect of Number of Echelons on System Performance	258
	8.5.1 Holding Cost	259
	8.5.2 Shortage Cost	263
	8.5.3 Total Cost	263
	8.6 Choice of an Optimal Structure for Repair-Inventory Systems	264
	8.7 Conclusions	265

		Page
CHAPTER	IX EFFECT OF BUDGET CONSTRAINTS ON SYSTEM PERFORMANCE AND SPARE STOCK	267
	9.1 Introduction	267
	9.2 Relevance of Budget Constraints	267
	9.3 Maximising System Availability under Budget Constraints	272
	9.3.1 System Availability and Spare Stock	272
	9.3.2 The Model and Solution Methodology	275
	9.3.3 The Applications	278
	9.3.3A The Single-item case	278
	9.3.3B The Two-items case	279
	9.3.4 Analyses of Results	280
	9.4 Minimising the Total System Cost under Budget Constraints	299
	9.4.1 Total System Cost as a Function of Total System Stock	299
	9.4.1A The Model and Solution Methodology	299
	9.4.1B The Applications	302
	i. Single-item case	302
	ii. Two-items case	302
	9.4.1C Results and Analyses	309
	9.4.2 Total System Stock as a Function of Location-Stocks	316
	9.4.2A The Model and Solution Methodology	316
	9.4.2B The Application	319
	9.4.2C Results and Analysis	322
	9.5 Minimising Total System Cost under Budget Constraints in a General Multi-level, Multi-item System	322
	9.5.1 The Model and Solution Methodology	322

	Page
9.5.2 The Application	326
9.5.3 Results and Analysis	328
9.6 Conclusions	331
CHAPTER X CONCLUSIONS	333
10.1 The Purpose of this Chapter	333
10.2 Summary of the Research and Findings	334
10.3 Significance, Developments and Contributions of the Research	342
10.4 Limitations	347
10.5 Extensions and Suggestions for Future Research	349
BIBLIOGRAPHY	352
APPENDICES (1 - 8)	381
CURRICULUM VITAE	
LIST OF PUBLICATIONS	