

STUDY OF SELECT ISSUES OF REVERSE LOGISTICS IN INDIAN CONTEXT

By

RAVI V

Department of Management Studies

Submitted in the fulfillment of the requirements of the degree of

DOCTOR OF PHILOSOPHY

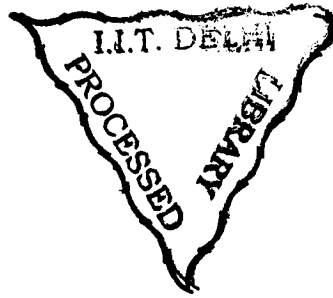
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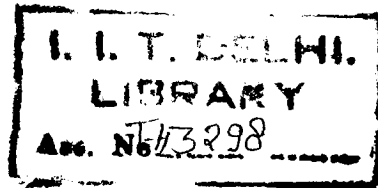
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DECEMBER 2005

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Dedicated to
My Mother and Brother

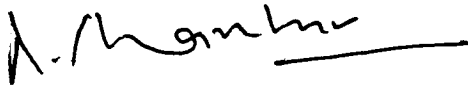
&

Lord Shiva
Goddess Parvati
Lord Ganesha
Lord Muruga

CERTIFICATE

This is to certify that the thesis entitled “**Study of select issues of Reverse Logistics in Indian context**” being submitted by **RAVI V** to the Indian Institute of Technology Delhi for the award of the degree of **Doctor of Philosophy** is a bonafide record of original 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 reached the requisite standard.

The results contained in this thesis have not been submitted, in part or full, to any other University or Institute for the award of any degree or diploma.



(Dr. RAVI SHANKAR)
Associate Professor,
Department of Management Studies,
Vishwakarma Bhavan,
Indian Institute of Technology Delhi,
New Delhi -110 016,
INDIA.

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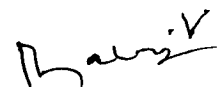
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ABSTRACT

Reverse logistics has emerged as an indispensable part of modern day supply chains. Manufacturers are finding that their job does not end with completion of a sales transaction. In fact, they must deal with an escalating volume of returned, unsold, damaged, end-of-use, and end-of-life products. In the recent times, there has been an increased awareness about the economic and environmental benefits associated with the reverse logistics, which have increased the relevance of reverse logistics to the industries and the academia.

This research has attempted to fill some of the gaps in the contemporary research on reverse logistics. An exhaustive literature review has been conducted to identify the gaps in the existing literature on reverse logistics. This research is aimed at examining the current status of reverse logistics operations in the Indian industries. A questionnaire-based survey has been conducted to gain a broad insight about the various issues related to reverse logistics in select sectors, of Indian industries. The four sectors selected for the purpose of survey in this research are automobile, paper, food & beverage processing and electronics. Subsequently, few hypotheses are framed for which data is collected through the questionnaire instrument. The descriptive statistics from the survey, hypotheses testing and two case studies provide a broad insight about the current status of reverse logistics operations in Indian context. Interpretive Structural Modeling (ISM) has been used to identify the relationships among important barriers of reverse logistics. Another ISM model has been presented which helps in identifying the key enabler variables that contribute to productivity and performance in reverse logistics operations. System Dynamics (SD) modeling of reverse logistics variables has been done to capture the inherent dynamic interactions existing among

them. Subsequently, scenario building and policy experimentation are carried out to examine the behaviour of reverse logistics system under various market scenarios. A combination of Analytical Network Process (ANP) and balanced scorecard approach has been used to design an analytical framework for finding out the best alternative for the conduct of reverse logistics operations. Finally, a model using a combination of ANP and Zero-One Goal Programming (ZOGP) has been presented to select the most suitable reverse logistics projects out of few identified projects having interdependence property according to the operating resource constraints.

The main contributions of this research are as follows.

- An exhaustive review of literature has been conducted to identify the various issues related to reverse logistics in the contemporary research.
- A questionnaire has been designed to identify the key reverse logistics practices in Indian industries.
- Hypotheses related to common reverse logistics issues and sector specific reverse logistics practices are formulated and tested for their validity using statistical tools.
- Two case studies on reverse logistics have been developed and analyzed using Situation, actor, process – Learning, action, performance (SAP-LAP) technique.
- An ISM-based framework has been developed to establish the mutual relationship existing among important barriers of reverse logistics. These can be strategically used by the top management in managing the barriers of reverse logistics.
- Another ISM-based framework has been presented for the ‘enabler’ and ‘result’ variables of reverse logistics so as to identify the key variables to be target upon such

that improved productivity and performance could be achieved in reverse logistics operations.

- SD modeling and simulation have been conducted on some of the key reverse logistics variables found in the literature. Scenario building and policy experimentation have been conducted which could enable top management in taking strategic decisions under various market scenarios.
- An analytical framework, using a combination of ANP and balanced scorecard has been developed for finding out the best alternative for the conduct of reverse logistics operation. This framework is holistic in the sense that it takes into account both the tangible and intangible factors while arriving at the final decision.
- A quantitative model using a combination of ANP and ZOGP has been developed to select the feasible reverse logistics projects having interdependence property among them. This would enable the top management in the careful selection of reverse logistics projects such that there is no waste in the allocation of resources to project that is not profitable.

Keywords: Reverse logistics, Empirical study, Interpretive Structural Modeling, System Dynamics, Scenario building, Policy experimentation, Analytical Network Process, Balanced scorecard, Zero-one goal programming.

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