

REVERSE LOGISTICS SYSTEMS AND INBOUND AND OUTBOUND TRANSPORTATION SYSTEMS

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ABSTRACT

The transportation system is analyzed and evaluated in terms of specific subsystems or subfactors associated with it. The data were collected from two in-depth case studies. The analysis of these case studies resulted in propositions and insights regarding reverse (RL) logistics operations. The transportation subfactors, propositions, a framework for effective design and implementation of RL operations are provided.

Reverse logistics, inbound and outbound transportation, RL framework, remanufacturing, and recycling.

INTRODUCTION

Reverse logistics (RL), unlike traditional forward logistics, is aptly described as a manufacturing entity that retrieves previously shipped parts and products from the point-of-consumption to the manufacturing entity for possible recycling, remanufacturing, or disposal. The RL system should be accomplished systematically and efficiently for the RL operations to be effective. The role of transportation in RL is essential as transportation systems play two important roles in RL. First, inbound and outbound transportation are the lifeblood of RL operations. Without proper transit of returned goods from the point of consumption to the processing service centers and then shipping the remanufactured products to new customers, RL operations cannot be sustained. Second, transportation costs play an important role in the viability of the entire RL system. If the transportation cost is prohibitive, the viability and profitability of RL systems will be severely curtailed. This is especially important, given that the profit margins for many remanufactured items are usually small.

There are many estimates that highlight the significance of RL operations and its various facets. Blanchard (2007) estimated that product returns cost U.S. manufacturers and retailers \$100 billion every year in lost sales, transportation, handling, processing, and disposal. The author further stated that customer returns could reduce a manufacturer's profitability by an average of 3.8 percent and RL costs are 9 cents of every sales dollar. According to an estimate, RL costs in the US are about \$35 billion per year (Stock 2001). Langnau (2001) stated that over the next few years, analysts predict that the average cost per product return will be \$30-\$35.

RL activities could encompass retailers, manufacturers, and service entities. RL has received a great deal of attention from operations managers as well as the highest level of company executives. RL has significant economic, environmental, managerial, regulatory, and strategic implications for organizations that embark on it. RL could create new products and open new markets that were not envisioned previously.

In addition, the operations of RL activities overlap with several functional areas such as marketing, operations, logistics, distribution and transportation. The RL process also affects other areas such as finance and accounting, customer service, quality and reliability, purchasing, and design/engineering. Because of RL's interdisciplinary and cross-functional nature, this area presents a fertile and attractive research area in the field of operations management. RL also provides for many new opportunities for the business and industrial communities.

RESEARCH QUESTIONS, SCOPE OF THE STUDY, AND RESEARCH METHODOLOGY

It is the objective of this paper to focus on comprehensive design and implementation issues related to transportation in the design and implementation of RL systems. Therefore, the objective of this study is to identify subsystems (subfactors) associated with an RL transportation system. The transportation subfactors will serve as the building blocks for the design and implementation of an RL system with respect to transportation activities. The transportation subfactors that are necessary and critical for effective design and implementation of an RL system are identified through the use of case studies.

This paper has two main research questions. First, *what* are the critical transportation subfactors required in developing effective RL operations? Second, *how* should a firm use these subfactors and the insights gained in order to manage and implement the flow of returned parts/products? The scope of the study focuses on the remanufacture, recycling, and disposal of products in manufacturing companies as opposed to retailers, services, or third-party RL providers. Products could be hazardous or non-hazardous, mechanical, consumer goods, and durable or disposable. This paper also focuses on manufacturing entities that are engaged in RL, for which the returned products constitute a part of their overall business.

The research methodology utilized in this study is "exploratory case study research." This study is applied and the case studies are exploratory where a number of propositions are formulated and evaluated. For further study in case study based research, see Yin (1993, 1994) among many other references.

REVIEW OF LITERATURE

The review of literature in this study focuses on the role of transportation for the overall RL system design and implementation. This focus does not exist in the available literature. This

study has conducted a review of literature to identify common themes in transportation in RL systems.

Inbound and outbound transportation: Products/parts that remain in the in-house remanufacture/recycle flow require inbound transportation for their respective processing facilities. Considerable attention should be given to monitoring and controlling transportation costs as the additional transportation costs to return the products/parts to the warehouse for processing are usually a part of the manufacturer's operations and the overall product costs (Aichlmayr 2000). Efendigil *et al.* (2008) stated that transportation of returned goods have different characteristics compared to forward logistics transportation both in terms of complexity and cost of required operations. Further, Cooke (1991) stated that transportation congestion is one of the two major ways in which environmental concerns influence how logistics managers perform their jobs. Stock and Lambert (2000) have suggested that return goods handling often increases both the complexity and costs of transporting, storing, and handling products.

US companies are spending in excess of \$35 billion per year on handling, transportation, and processing of returned goods (Meyer 1999). Trebilcock (2002a) stated that the successful handling and transportation of returns is as important as filling orders for customers. Anel and Aichlmayr (2002) showed the importance of transportation by using software for inbound and outbound return management modules that automatically determine approval or denial of the return, status changes for tracing products in receiving, inspection, and pre-disposition, etc. Jayaraman and Luo (2007) provided the insight that the delays in transporting, sorting, grading, and disposition of the returned printers only serve to reduce the value remaining in the product. Efendigil *et al.* (2008), Muffatto and Payaro (2004); Krumwiede and Sheu (2002), and Cooke (1997) focused on the role of a third-party transportation system and provided a decision-making model for the feasibility of implementing a third-party transportation system. Cairncross (1992) suggested that initial transportation is affected by whether the customer or waste manager is responsible for collection. Srivastava and Srivastava (2006) explored the role of transportation and modeled transportation unit cost in RL.

CASE STUDIES AND RESEARCH PLANS

The case methodology used in our paper is an explanatory case study in which a number of propositions are evaluated. McCutcheon and Meredith (1993) stated that although a case study may not be viewed as the most powerful theory testing method, it could accomplish this objective in several different ways. There are a large number of investigations that use a single site as the focus of their case study. A list of these references is available upon request from the authors.

Although a single case study is suitable for this study, two companies, an automobile electronic components company (Co. A) and a medical device manufacturer company (Co. B), were selected for an in-depth analysis and evaluation of the propositions. These two companies represent different sizes, products produced, nature of operations, and external competitive factors. These two companies also represent a cross-section of major companies/industries that

are engaged in RL as a secondary part of their overall business. Each case study was treated as a separate self-contained experiment. More detailed information about these two companies and their operational characteristics are available upon request from the authors.

The plan for a case study experiment follows the suggested guidelines developed by Ellram (1996). The details of these guidelines as they pertain to data collection, pilot study, interview protocol, interview coding, content validity, and content reliability are also available upon request from the authors.

ANALYSES, FINDINGS, AND ASSESSMENT OF THE RESULTS

The detailed analyses, findings, assessment of the results, framework, managerial implications, and future research directions are available upon request from S. Dowlatshahi.

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