International Journal of Engineering Business Management

OPEN ACCESS
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A Reverse Logistics Network Model for Handling Returned Products

Regular Paper

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Received 22 Apr 2014; Accepted 28 Jun 2014

DOI: 10.5772/58827

Abstract Due to the emergence of e-commerce and the proliferation of liberal return policies, product returns have become daily routines for many companies. Considering the significant impact of product returns on the company's bottom line, a growing number of companies have attempted to streamline the reverse logistics process. Products are usually returned to initial collection points (ICPs) in small quantities and thus increase the unit shipping cost due to lack of freight discount opportunities. One way to address this issue is to aggregate the returned products into a larger shipment. However, such aggregation increases the holding time at the ICP, which in turn increases the inventory carrying costs. Considering this logistics dilemma, the main objectives of this research are to minimize the total cost by determining the optimal location and collection period of holding time of ICPs; determining the optimal location of a centralized return centre; transforming the nonlinear objective function of the proposed model formulation by Min et al. (2006a) into a linear form; and conducting a sensitivity analysis to the model solutions according to varying parameters such as shipping volume. Existing models and solution procedures are too complicated to solve real-world problems. Through a series of computational experiments, we discovered that the linearization model obtained the optimal solution at a fraction of the time used by the traditional nonlinear model and solution procedure, as well as the ability to handle up to 150 customers as compared to 30 in the conventional nonlinear model. As such, the proposed linear model is more suitable for actual industry applications than the existing models.

Keywords Reverse Logistics, Optimization, Linear Transformation

1. Introduction

Returned products come in all different sizes, shapes, and conditions. Many of them are received damaged, without original packages, and mixed up with other products. As such, returned products are more difficult and costly to handle than original products. Indeed, the logistics of handling returned products accounts for nearly 1% of the total U.S. gross domestic product (Gecker, 2007). To elaborate, a study conducted by the Reverse Logistics