Chapter 2.9
Modeling of Green Supply Chain Logistics

Hsin-Wei Hsu
National Tsing Hua University, Taiwan, ROC

Hsiao-Fan Wang
National Tsing Hua University, Taiwan, ROC

ABSTRACT

The green supply chain management has drawn researchers' attention in recent years, but most of the proposed models for green topics on the subject are case based, and for this reason, they lack generality. In this work, the design of a supply chain network is studied. In this chapter, we try to overcome this limitation and a generalized model is proposed, in which a logistics chain network problem is formulated into a 0-1 mixed integer linear programming model and the decisions for the function of manufactures, distribution centers, and dismantlers will be suggested with minimum cost. A numerical example is provided for illustration.

DOI: 10.4018/978-1-60960-472-1.ch209

INTRODUCTION

While the competition among companies has been globally and rapidly intensified, the worldwide consensus on environmental protection is increasing. In the European Union (EU), the regulations have clearly demanded the companies to meet the green criteria of their products (e.g., Schultmann, Moritz, & Otto, 2006). Among these regulations, the so called "green supply chain" (GSC) conditions are particularly emphasized because the configuration of conventional supply chain has been the one affected the most in this changes during a product's life cycle. Since it's necessary to satisfy GSC for companies under society pressure and decrees, how we can reduce the system cost from the logistics viewpoint in order to improve the company's competence has become an important issue.

The GSC comprises two parts, forward supply chain and reverse supply chain. Apart from the conventional supply chain, GSC has an additional role called dismantlers which makes the functions of a green logistics possesses different behaviors, like recover and recycling. Schultmann et al. (2006), Baumgarten, Christian, Annerous, and Thomas (2003) and Lu, Vivi, Julie, and Taylor (2000) have provided excellent reviews of the related literature.

Before we proceed to our discussion, let us define the reverse logistics as below.

Definition 1 (REVLOG, 1999)

Reverse logistics is the process of planning, implementing, and controlling flows of raw materials, in process inventory and finished goods, from the point of use back to a point of recovery or point of proper disposal.

Based on this concept, many researches are devoted to this issue, but they assumed the dismantlers or recover facilities' capacity to be infinite (e.g., Pochampally, Surendra, & Sagar, 2004). Because of this unrealistic assumption, we shall consider limitation of the recovery or recycling capacity in this study. In addition, it is the basic difference between conventional supply chain and green supply chain that conventional supply chain considers only forward logistics; whereas green supply chain take both forward and reverse routings into consideration. Therefore, to minimize the total operation cost, considering both routings simultaneously in one model is necessary (Fleischmann et al., 1997). To achieve these goals, a close-loop green supply chain logistics model is proposed in this study to minimize the total system's cost when the capacity and routing in the system are considered.

Due to the uncertainty of recovery and landfilling rates, sensitivity analysis will be conducted to facilitate the effective management.

BACKGROUND

Green supply chain refers to all those activities associated with the transformation and flows of goods and services, including their information flows from the sources of materials to end users. According to De Groene and Hermans (1998), integrated supply chain management aims to close material cycles and prevent leakage of the materials in the chain. Similar to integrating supply chains, Green Supply Chain Management (GSCM) refers to the integration of all these activities, both internal and external to the firm (Bowersox & Closs, 1996).

Fleischmann et al. (1997) mentioned that GSC includes the members of the forward channel (e.g., traditional manufacturers, retailers, and logistics service providers) or specialized parties (e.g., secondary material dealers and material recovery facilities). One of the key aspects to green supply chain is to improve both economic and environmental performance simultaneously throughout the chains by establishing long-term relationships between buyers and suppliers (Zhu & Raymond, 2004). Therefore, building a stable close-loop logistics in a chain to include the activities of all of involved roles is necessary when the object of minimizing the total cost is desired from both the companies and environment aspects.

A supply chain can be described by a network of suppliers, manufacturing sites, distribution centers (DCs), and customer locations through logistics. The logistics are focused on the routing of the shipping units throughout the networks. In a GSC logistics problem, there is an important module, dismantlers or recyclers, to be incorporated into a supply chain network. These dismantlers handle the recover resources into many different types for further uses or dispose (Baumgarten et al., 2003). That is, if at dismantler sites, the recycled resources can be used again, the resource should be shipped to a manufacture for reproduction; otherwise, the un-useful resources must be landfilled (e.g., Schultmann et al., 2006).

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