

Chapter 11

Managing Transportation in Supply Chain: Metaheuristics for Solving a Capacitated Fixed-Charge Transportation Problem

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ABSTRACT

Supply chain management is the managing of all processes of goods, services, and information from suppliers to customers. Transportation network design is an important part of effective supply chain management. This chapter presents the two-stage fixed-charge transportation problem in a supply chain to minimize the total cost containing the opening cost of distribution centers, transportation cost from manufacture to distribution centers and from distribution centers to customers, and fixed cost for transportation from distribution centers to customers. There are the capacity constraints on distribution centers in order to consider real life situations in this chapter. A constructive based algorithm and a population-based algorithm are proposed to solve this complex optimization problem. Taguchi experimental design is applied for determining the best combinations of parameters. The experimental studies are conducted to compare the performance of the proposed algorithms according to solution quality.

INTRODUCTION

In the early 1980s, supply chain management (SCM) was introduced with increasing competition among companies (Oliver and Webber, 1982). With the increasing number of companies in the following years, the importance of managing operations with integrated supply chain management approach was understood and the use of supply chain management expanded instead of managing operations separately. Sunil and Peter (2013) pointed that ‘A supply chain consists of all stages involved, directly or indirectly, in fulfilling a customer request. The supply chain not only includes the manufacturer and suppliers, but

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also transporters, warehouses, retailers, and customers themselves. Within each organization, such as a manufacturer, the supply chain includes all functions involved in receiving and filling a customer request. These functions include, but are not limited to, new product development, marketing, operations, distribution, finance, and customer service.' The Council of Supply Chain Management Professionals defined SCM to be "The process of planning, implementing and controlling the operations of the supply chain in an efficient way." To reach the aim of managing supply chain effectively, companies coordinate production, inventory, location, transportation participants in a supply chain. A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers. Ghiani, Laporte and Musmanno (2004) defined SCM as "a complex logistics system in which raw materials are converted into finished products and then distributed to final users (consumers or companies)." And conversely, Hugos (2011) depicted that some differences exist between logistics management and SCM. SCM includes logistics management and logistics management is as the art of bringing the right amount of the right product to the right place at the right time (Tilanus, 1997). SCM considers other operations such as marketing, customer relationship, and finance as well. As can be seen from the difference between SCM and logistics management, logistics costs make up a large percentage of the total cost. Companies focus on reducing transportation costs through determining optimal routes with the aim of minimizing time, cost, and time, while maintaining their quality level and meeting due date in a global environment. A change in our distribution system will result in the customer not being delivered on time and customer dissatisfaction. Transportation has become much more strategic for organizations in determining their ability to compete in the growing and complex global marketplace. Using different modes of transportation and location of facilities (manufacturers, distribution centers, suppliers, customers) in a supply chain, designing routes and networks for moving parts are really important factor to provide desired profit rate and timely delivery. For this reason, the transportation network design is very crucial in supply chain management to determine the transportation / logistics activities that can give the least cost. Hitchcock (1941) introduced a well-known transportation network design. Typically, transportation network design problem is the core problem used for making strategic transportation network investments. The objective is to determine the best way of transporting raw materials, semi-products, and products from a number of destinations to final destinations for minimizing the total cost. Determining the best location of distribution centers which are opened regarding to satisfy customer demands at minimum opening cost, transportation cost and fixed cost is one of factors affect the efficiency of logistics system.

In this paper, two stage fixed-charge transportation problem is considered. The main aim of this problem is to design transportation network to meet customer demands at minimum cost subject to distribution centers capacity. There are candidate distribution centers which are supplied demands of customers from manufacturer and each distribution center to serve customers. To more realistic, each potential distribution center has a specific and different capacity to store. This problem is minimizing of total cost. Total cost includes transportation cost from manufacturers to distribution centers, opening cost for candidate distribution center, transportation cost from distribution centers to customers, and fixed cost for transportation from distribution centers to customers. Two different algorithms are proposed to find the best solution.

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