

Chapter 12

Bi-Objective Supply Chain Optimization With Supplier Selection

Kanika Gandhi

University of Skövde, Sweden

P. C. Jha

University of Delhi, India

ABSTRACT

Supplier selection is one of the most important decisions within SCM since suppliers have emerged as value adding partners in industrial relationship. In the current study, supplier selection on the basis of information pertaining to quality and delivery time is explained. The cost aspects are taken care while coordinating procurement and distribution in the echelons. The deteriorating nature of the product creates imprecision in demand and fuzziness in different stages of the coordination. A fuzzy bi-objective mixed integer non-linear model is developed, where the first objective minimizes the combined cost of holding, processing, and transportation in all the echelons and the second objective maximizes combination of lot acceptance percentage and on-time delivery percentage. The solution process converts the model into crisp form and solves using a fuzzy goal programming technique.

INTRODUCTION

Supply chain management is termed as synchronization of the requirements of key business processes from ultimate customer through ultimate supplier with the flow of product, service and information in order to create a balance among high customer service, low transportation & inventory management and low unit cost. Keeping good synchronization as priority, supplier selection can be regarded as one of the most important activities. A careful assessment with respect to strengths and weakness of suppliers is required before ranking them. In the supply chain coordination most, appropriate suppliers should be selected as per their performance and hence, can have a potential capability to increase customers' satisfaction. A big part of company's financial resources are consumed in selecting the best supplier,

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therefore, selecting suppliers with good price may become a challenge for supply chain coordination. To reduce the transportation cost, it has to be depended upon capacity of vehicle with third party logistics (3PL) providers. Since numerous criteria can be appraised during the decision-making process in supply chain (SC) coordination, this problem shows more complexities in presence of multiple products, transportation policies and suppliers' performance. Thus, the problem is a bi-objective problem with several conflicting aspects such as cost, quality, and delivery.

Hence, to improve the overall performance firms have to collate all the actions of the supply chain in a coordinated method. In real business world, the information of parameters & variables and the objective function are often uncertain since most of the input information is not precisely known. With the imprecise demand, fuzzy set theory can be used to handle uncertainty and vagueness. The fuzzy set theory is used during solution process of integrated model for procurement, inventory management, transportation policy and selection of supplier to procure goods. The goods are transported on the basis of vehicle capacity. Here 3PL provides flexible approach based on cost of full vehicle (truck) and transportation cost per weight. On the other side, selection of supplier also plays a vital role in improving the efficiency and reduced cost. To summarize the coordination of inventory, procurement and transportation mechanism to minimize the costs incurred, our work includes: (1) constructing a fuzzy bi-objective two stage optimization model that involves the computation of cost incurred during holding, procurement, transportation and inspection; (2) process to choose best supplier on the basis of maximum delivery time percentage and acceptance percentage; (3) fuzzy set theory to manage many imprecise parameters in the model; (4) proposing transportation policy based on overhead quantity and truck capacity; (5) finding strategies to minimize inventory as well as ensuring no shortage.

BACKGROUND

The supplier selection in its nature is a multi-criteria decision-making (MCDM) problem as many inconsistent criteria may influence valuation and selection of suppliers.. Dickson (1966) identified and ranked 23 criteria for selecting the supplier. The top six criteria were respectively quality, delivery, performance history, warranty policy, production facilities and capacity, and price. However in practice, the importance of those criteria may change from one industry to another. The methodologies on supplier selection stated by Ho, Xu, and Prasanta (2010) were divided into two main groups such as individual approaches and integrated approaches. An improved integrated approach for supplier selection problem is discussed by Bhattacharya, Geraghty, and Young (2010). The approach consisted of AHP, quality function deployment (QFD) and cost factor measure (CFM). Further, a multi-objective model for supplier selection in multi-service outsourcing is developed by Feng, Fan, and Li (2011). An approach based on ANP under fuzzy environment within multi-person decision-making schema is developed (Büyüközkan and Çiftçi, 2011). An integrated method including DEMATEL, ANP and TOPSIS in fuzzy environment for green supplier evaluation is proposed by Büyüközkan and Çiftçi (2012). Two optimization mathematical models for supplier clustering and selection are constructed by Che (2012). For solving the first model, integrated k-means and simulated annealing algorithm with the Taguchi method were proposed and for solving the second model, simulated annealing algorithm was used with the weights obtained from AHP method. For constructing the structure of criteria, AHP is used by (Chen and Chao 2012) and then for the decision matrices, they used consistent fuzzy preference relations (CFPR). They made an application in an electronic company regarding 15 criteria. Kuo and Lin (2012) presented a

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