

Chapter 8

Using of Fuzzy SWARA and Fuzzy ARAS Methods to Solve Supplier Selection Problem

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ABSTRACT

As the performance of suppliers directly or indirectly affects the performance of the companies with which they engage, working with the most suitable supplier has become the key to success for companies. When solving the supplier selection problem, many different criteria involving qualitative and quantitative criteria are considered. Therefore, the supplier selection problem is considered an MCDM problem. These criteria can include uncertain and imprecise data. Additionally, the judgments of many managers are considered in supplier selection problems. Thus, in this chapter, a fuzzy group integrated model including Fuzzy SWARA (step-wise weight assessment ratio analysis) and Fuzzy ARAS (additive ratio assessment) is proposed to select the best supplier. This study contributes to the extant literature since these two methods were not used in the past to solve any problems together. The proposed model is applied to a Turkish textile company.

INTRODUCTION

In today's competitive environment, the aim of companies is to use all their resources efficiently and productively. The efficient use of these resources will enable companies to meet demands of their customers in a timely and complete manner. Companies must ensure their products or services are accepted by their customers to ensure increased profitability is achieved over time. Therefore, firms must strike a balance among certain elements such as speed, flexibility, quality, technological adaptability and so forth. It is not sufficient for the companies simply to assess only their processes in order to ensure the balance of these elements. Simultaneously, the firm's alliances (e.g., suppliers) must collaborate well to build a solid structure of the company.

DOI: 10.4018/978-1-5225-8458-2.ch008

Over time, supply chain alliances and agreements have become increasingly critical in order to reduce costs, to capture market opportunities, and to increase profitability. Efficient and strong supply chains are the creation of a network that includes suppliers, producers, warehouses, customers, and transportation links, among others. In a supply chain where relationships are not structured well, it is unlikely to be successful and productive in terms of information, product and material flow. Hence, cooperation and collaboration among the members of the supply chain are indispensable key factors.

Manufacturing companies in the supply chain environment have noticed in recent years that they will not be able to optimize performance factors such as low price, high quality products, on-time delivery and so forth by themselves. Therefore, outsourcing has become an inevitable activity for such organizations. Purchasing is one of the most important aspects of outsourcing and suppliers are a key factor. For most industries, approximately 70% of the cost of a product consists of the costs of raw materials and parts (Ghobadian et al., 1993). Therefore, the selection of the supplier, which is the key member of the supply chain in purchasing and outsourcing, is a very important decision.

As long as the companies are operating, they are faced with decision-making problems at every stage of operation and supplier selection is one of these major challenges. This is a well-known multi-criteria decision making (MCDM) problem where a number of different criteria including qualitative and quantitative criteria are considered. Generally, there are conflicting criteria in supplier selection problems. For example, when the delivery time of the material requested by the supplier is shortened, extra costs can be incurred in transportation costs. Conversely, when cheap transportation is selected, product quality may be reduced. As supplier selection has both critical value and conflicting criteria, detailed and advanced methods need to be used instead of using traditional methods to solve this problem.

Information related to real-world problems is not usually precisely known and this ambiguity makes the decision-making process much more complicated (Ghorabae et al., 2016).

The supplier selection problem also includes uncertain and imprecise information due to human judgement. To overcome this uncertainty, there are many methods including fuzzy set theory (FST), grey theory, and rough set theory as proposed in the extant literature. FST was developed by Zadeh (1965) to handle imprecise and uncertain information. Additionally, the judgements of many managers are considered in supplier selection problems. Therefore, in this study, a fuzzy group integrated model including fuzzy SWARA (Step-wise Weight Assessment Ratio Analysis) and fuzzy ARAS (Additive Ratio Assessment) are used to solve the supplier selection problem.

Fuzzy SWARA and fuzzy ARAS methods are preferred since they are easy to use and provide quick data collection. These two methods (fuzzy SWARA and fuzzy ARAS) were not previously used to solve any problem simultaneously. Therefore, the contribution of this study to the extant literature is to develop a new fuzzy group integrated model to solve supplier selection problem. To identify criteria weights, fuzzy SWARA is used, while fuzzy ARAS is employed to assess suppliers' performance and to rank the suppliers respecting their performance.

BACKGROUND

Suppliers are one of the most crucial members of the supply chain as they can affect the performance of the entire supply chain. Problems caused by suppliers, such as delays in delivery, delivery of defective products, delivery of products with low-quality standards, and purchase of high-cost components or raw materials, adversely affect the performance of an entire supply chain, especially the manufacturer. The

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