Chapter 7
The Extension of MAIRCA Based on Fuzzy Number:
Smart Supplier Selection

Hatice Kübra Özensel
Necmettin Erbakan University, Turkey

Burak Efe
Necmettin Erbakan University, Turkey

ABSTRACT

Supplier selection, which is one of the phases of supply chain management, was examined in this chapter. In the line of four expert opinions and literature review, four main criteria, including environmental, economic, social, and smart criteria, and 18 sub-criteria were evaluated in this study. An interval-valued q-rung orthopair fuzzy (IVqROF) number based MAIRCA (multi attributive ideal-real comparative analysis) method is proposed for the ranking of 5 alternative suppliers. In this chapter, fuzzy number was proposed for the MAIRCA method, but unlike the literature, IVqROF number was applied to the MAIRCA method. It has been seen that the IVqROF number, which is the extension of the q-rung orthopair fuzzy number obtained by developing the intuitionistic fuzzy number and the Pythagorean fuzzy number, provides an advantage in evaluating expert opinions. In addition, Industry 4.0 criteria were examined under the smart criterion and contributed to the supplier selection problem. The study examined the smart supplier selection problem of an automotive sub-industry company.

INTRODUCTION

The retail market is growing day by day by becoming global, and the product produced in one continent can be used as raw material in another continent and sold to other continents. In addition to the advantages that this globalization brings, it also makes supply chain management more complex and difficult for companies. It pushes businesses to seek more systematic, technological and faster ways for sustainable supply chain management. Businesses that can build these systematic, sustainable supply

chains and realize their competitiveness with error-free supply processes as well as the right product, provide a competitive advantage over other businesses in the same sector. Despite the importance of the supply chain, it is also seen that until a certain time, not many empirical studies have been carried out by experts on the definition and integration of supply chain management within all other business policies. Supplier selection is the first and one of the most significant links in the supply chain to reduce costs. Many businesses aim to establish strong ties and cooperate with their suppliers in order to rise their competitiveness, to comply with the planned delivery dates given to their customers with the least deviation, and to increase the effectiveness of management (Shin et al., 2000).

Supplier selection has become one of the most important management issues. Supplier selection aims to identify the supplier with the highest performance to consistently meet the needs of the business. Choosing the best supplier among many possible suppliers with various qualifications is a complex task (Guarnieri and Trojan, 2019).

Since customer and supplier relationships are very important in businesses, choosing the right suppliers requires much more than cost comparison and the choices are predicted by various quantitative and qualitative factors. Once a supplier is fully integrated into an adequately run and organized supply chain, that relationship has a long-term impact on the competitiveness. Therefore, the supplier selection problem has a very important role in organizing an effective system for the supply chain. The supplier selection problem aims to decrease purchasing risk, maximize value for the customer, and establish short and long term connections between the consumer and suppliers. Developments in smart technologies over the years inevitably affect supply chains. Advanced smart technologies positioned as components of Industry 4.0, such as the internet of things, cyber systems, big data and artificial intelligence, ensure that all links forming the supply chain are more perceptible, interpretable, predictable, controllable and optimized. Supply chains where these smart technologies are integrated are defined as smart supply chains.

Supply chains are subject to increasingly faced with natural, human-induced or technological risks such as natural disasters, transportation accidents, worker strikes, terrorist attacks due to globalization. The consequences of these factors cause supply chain disruptions due to losses in productivity, profit, competition and revenue. Therefore, making supply chains smart and sustainable has become a necessity to protect the customer from shortages and interruptions. A business with a sustainable supply chain perspective needs to both communicate with the supplier and satisfy the customer, government and shareholders. In addition, in order to produce sustainable products in a sustainable supply chain, sustainability criteria must be taken into consideration when selecting suitable suppliers (Hosseini and Khaled, 2019).

In smart supply chain management, smart technologies are used at every stage, from transportation to the analysis of operators' working processes, to provide higher sustainability in social, environmental and economic terms. Sustainable supplier selection is one of the most significant components for the continuity of this sustainability. Because the actions of suppliers have great importance for sub-companies to achieve sustainable competitive advantage. It is very important to use smart technologies in evaluation process to achieve this sustainability in selection of suppliers (Chen et al., 2020; Ghadimi et al., 2019).

Traditional supplier selection is largely based on criteria such as affordable price and close distance. With the use of smart information technologies in supply chains, that smart supplier selection criteria such as supplier information management, warehouse automation, digitalization in the logistics system and data security, have emerged (Hasan et al., 2020; Torğul and Paksoy, 2023).

In general, decision makers face many uncertain factors when providing decision preferences for on-demand suppliers. Supplier selection depends on cost, quality, performance, technology, etc. It is a complex problem involving many criteria. Therefore, in order to obtain a systematic supplier selection

Related Content

Modelling Spatial Decision Support Systems Focused on the Development of a Data Warehouse: Applying Software Engineering
Concepción M. Gascueñaand Rafael Guadalupe (2014). *International Journal of Decision Support System Technology (pp. 43-64).*
www.irma-international.org/article/modelling-spatial-decision-support-systems-focused-on-the-development-of-a-data-warehouse/124321

Multi-Attribute Group Decision Making (MAGDM) Using Fuzzy Linguistic Modeling Integrated With the VIKOR Method for Car Purchasing Model
Soni Kumari, Bhavdeep Nakum, Din Bandhuand Kumar Abhishek (2022). *International Journal of Decision Support System Technology (pp. 1-20).*
www.irma-international.org/article/multi-attribute-group-decision-making-magdm-using-fuzzy-linguistic-modeling-integrated-with-the-vikor-method-for-car-purchasing-model/286185

3rd Order Analytics Demand Planning: A Collaboration of BI and Predictive Analytics Tools
Keith McCormick, Richard Creethand Scott Mutchler (2017). *Decision Management: Concepts, Methodologies, Tools, and Applications (pp. 856-877).*
www.irma-international.org/chapter/3rd-order-analytics-demand-planning/176783

Shared Leadership and Key Innovation Indicators in Six Sigma Projects
Brian J. Galli, Mohamad Amin Kaviani, Eleonora Bottaniand Teresa Murino (2017). *International Journal of Strategic Decision Sciences (pp. 1-45).*
www.irma-international.org/article/shared-leadership-and-key-innovation-indicators-in-six-sigma-projects/189233

A Conceptual and Pragmatic Review of Regression Analysis for Predictive Analytics
Sema A. Kalaian, Rafa M. Kasimand Nabeel R. Kasim (2017). *Decision Management: Concepts, Methodologies, Tools, and Applications (pp. 1761-1776).*
www.irma-international.org/chapter/a-conceptual-and-pragmatic-review-of-regression-analysis-for-predictive-analytics/176831