

## Chapter 56

# A Multi–Criteria Intuitionistic Fuzzy Group Decision Making Method for Supplier Selection with VIKOR Method

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### ABSTRACT

*Supplier selection, the process of finding the right suppliers who are able to provide the buyer with the right quality products and/or services at the right price, at the right time and in the right quantities, is one of the most critical activities for establishing an effective supply chain, and is typically a multi-criteria group decision problem. In many practical situations, there usually exists incomplete and uncertain information, and the decision makers cannot easily express their judgments on the candidates with exact and crisp values. Therefore, in this paper an extended VIKOR method for group decision making with intuitionistic fuzzy numbers is proposed to solve the supplier selection problem under incomplete and uncertain information environment. In other researches in this area, the weights of each decision makers and in many of them the weights of criteria are pre-determined, but these weights have been calculated in this paper by using the decision matrix of each decision maker. Also, normalized Hamming distance is proposed to calculate the distance between intuitionistic fuzzy numbers. Finally, a numerical example for supplier selection is given to clarify the main results developed in this paper.*

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## INTRODUCTION

Supplier selection is a fundamental issue of supply chain area which heavily contributes to the overall supply chain performance. Particularly for companies who spend a high percentage of their sales revenue on parts and material supplies, and whose material costs represent a larger portion of total costs, savings from supplies are of particular importance

These, strongly urge for a more systematic and transparent approach to purchasing decision making, especially regarding the area of supplier selection. Selecting the suppliers significantly reduces the purchasing cost and improves corporate competitiveness, and that is why many experts believe that the supplier selection is the most important activity of a purchasing department. Supplier selection is the process by which suppliers are reviewed, evaluated, and chosen to become part of the company's supply chain. The major aims of supply chain management are to reduce supply chain risk, reduce production costs, maximize revenue, improve customer service, optimize inventory levels, business processes, and cycle times, and resulting in increased competitiveness, customer satisfaction and profitability (Chou & Chang, 2008; Ha & Krishnan, 2008; Heizer & Render, 2004; Monczka et al., 2001; Simchi-Levi et al., 2003; Stevenson, 2005). Indeed supplier selection is a multiple criteria decision-making (MCDM) problem affected by several conflicting factors such as price, quality and delivery.

Several factors affect a supplier's performance. Dickson (1996), Ellram (1990), Roa and Kiser (1980), and Stamm and Golhar (1993) identified, respectively 60, 18, 13 and 23 criteria for supplier selection. One of the well-known studies on supplier selection belongs to Dickson (1966) who identified 23 important evaluation criteria for supplier selection. Weber et al. (1992) reviewed and classified 74 articles addressed the supplier selection problem.

Over the years, several techniques have been developed to solve the problem efficiently. Supply Chain Management has received recently considerable attention in both academia and industry. de Boer et al. (2001) identified four stages for supplier selection including definition of the problem, formulation of criteria, qualification, and final selection, respectively. They reviewed and classified MCDM approaches for supplier selection. Several methodologies have been proposed for the supplier selection problem. The systematic analysis for supplier selection includes categorical method, weighted point method (Timmerman, 1986; Zenz, 1981), matrix approach (Gregory, 1986), vendor performance matrix approach (Soukup, 1987) vendor profile analysis (Thompson, 1990), analytic hierarchy process (AHP) (Barbarosoglu & Yazgac, 1997; Narasimhan, 1983), analytic network process (ANP) (Sarkis & Talluri, 2000), mathematical programming (Chaudhry et al., 2001; Pan, 1989; Rosenthal et al., 1995; Sadrian & Yoon, 1994) and multiple objective programming (MOP) (Buffa & Jackson, 1983; Feng et al., 2001; Ghoudsypour & O'Brien, 1998; Sharma et al., 1989; Weber & Ellram, 1992). In essential, the supplier selection problem in supply chain system is a group decision making combination of several and different criteria with different forms of uncertainty (Chena et al., 2006). Hence this problem is a kind of MCDM problem which requires MCDM methods for an effective problem-solving. The supplier selection process is often influenced by uncertainty in practice (de Boer et al., 1998; Min, 1994). Several influence factors are often not taken into account in the decision-making process, such as incomplete information, additional qualitative criteria and imprecision preferences (Chen et al., 2006; Zhang et al., 2009). Therefore, fuzzy set theory has been applied to supplier selection recently. Li et al. (1997) and Holt (1998) discussed the application of fuzzy set theory in supplier selection. Haq and Kannan (2006) presented a structured

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