

## Chapter 20

# An Integrated Grey Relations Analysis and VIKOR Method for Multi Criteria Decision Making Under Fuzzy Environment: Supplier Selection Case

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### ABSTRACT

*Today, suppliers of companies are no longer local. Companies have to offer their products to the market just in time and as fast as possible in order to compete. This situation is possible by establishing an effective supply chain for the goods and services they need in the manufacturing system. Finding the right suppliers who are able to provide the companies with the high quality products and services at the reasonable price, at just on time and in the right quantities is an important issue concerned in the process of supply chains concept. There are certain techniques developed in this respect. Some of such methods are approaches developed for situations unmindful of fuzziness and vagueness. Nonetheless, the process of supplier selection contains both vagueness and fuzziness. This study improves the Grey Relational Analysis and VIKOR methods, to fuzzy and ambiguous environments. Then, these approaches are applied to a supplier selection problem, which is previously solved through fuzzy logic and AHP method in literature, and the comparative results of both techniques are given.*

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## **1. BACKGROUND AND MOTIVATION**

Supplier selection and management is today a means for outclassing opponents, and it is of strategic importance, particularly for production companies. Nowadays, companies tend to establish sound and long-term relationships with their suppliers in the global market. A successful method of supply chain management is directly related to an effective supplier selection method/process. Therefore, for manufacturers, it is really a difficult task to install an effective supplier selection process and to choose the right supplier. Rapid changes of demand in the market urge companies to decrease their production and storage costs, improve quality, enhance customer satisfaction, and leave them face to face with other difficulties such as decreasing product life cycle. In the case where companies can operate their own resources, as well as the outsourced ones, in an integrated way, they can remain competitive and continue their progress. Firms wish to refrain from spending their money, time and energy on unfamiliar goods and services, whereas they want to focus on fundamental production issues. In order to decrease the costs in the supply chain and to minimize related risks, companies have to decide on which supplier to collaborate with. At this stage, the ability to choose the right supplier brings certain advantages for enterprises, such as competitive edge, decrease in costs, and improvement in end product quality. Supplier selection and management also includes issues like commercial experiences of suppliers, their prestige, product prices, quality, and delivery time. In addition, supplier selection is often a difficult period for decision-makers since it contains an ambiguous and varying environment. One has to be careful while making decisions in such an ambiguous and complex environment, and in practice, there is a need for a systematic method. Supplier selection can be described as a multi-criteria decision-making problem owing to the various tangible and intangible criteria it includes by nature. Alternatives, which are determined according to attributes considered within multi-criteria problems, are compared with each other and ranked. Since decision-makers apply their personal attitudes with regard to intangible criteria, a vague and uncertain condition arises. There is not a single appropriate solution for problems involving such circumstances; therefore, the optimal solution may change due to applied methods and chosen criteria. That is, none of the alternatives may be the best solution for the chosen or determined criteria. Nonetheless, it is necessary to obtain the appropriate solution pursuant to selection problems and prescribed criteria. In this respect, various decision support approaches are used in order to determine the most convenient alternative.

Most models used in supplier selection focus firstly on determination of criteria, and then assessment of alternatives depending on these criteria. The common feature of such models consists of how the sequence of these alternatives will be determined. The first study on criteria assessment was realised by Dickson in 1966 (Yucel & Guneri, 2011). He examined a total of 273 companies in the USA and Canada, and determined 23 main criteria. Among these 23, according to him, the most important three criteria were quality, on-time delivery and past performance. Weber et al. (1991) analysed 74 articles on supplier selection issued between 1966 and 1991. According to results of this analysis, quality, on-time delivery and price criteria bore the highest importance; of secondary importance were geographical position, financial situation, capacity, and production facility. In terms of supplier selection, Nydick and Hill (1992) examined quality, price, delivery, and service in 1992, Karpak et al. (2001) and analysed cost, quality and delivery, while Bhutta and Huq (2002) handled costs, quality, technology, and service. Liao and Kao (2011) summarised criteria used in literature since 1966, and expressed that quality, cost, and on-time delivery are proposed as supplier selection criteria in many articles.

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