Chapter 12  
Evaluation and Selection of Green Suppliers Using Fuzzy VIKOR and Fuzzy TOPSIS  

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ABSTRACT  
Green supplier selection is considered to be one of the prominent strategic ways to determine the success of whole supply chain in recent times. In this chapter, fuzzy VIKOR and fuzzy TOPSIS methods are used to select the suitable green supplier under fuzzy environment. The green supplier evaluation approach is demonstrated with a real-world case study involving textile manufacturing industry in southern part of India concerning 11 foremost evaluation criteria that the company has determined to select the most suitable supplier. The compromising solution for the four decision makers in Fuzzy VIKOR corroborate with the compromising solution of Fuzzy TOPSIS method. The application of proposed method in the case organization helps to identify the appropriate supplier systematically. The result offer useful insight for the managers to select the suitable supplier to improve the environmental image of the organization.  

INTRODUCTION  
Since 1980s, supply base sourcing and practices have emerged significantly in the manufacturing sector. Consequently, purchasing function is considered as one of the prevailing factors and suppliers are accountable for the competitive success of the firm (Handfield, & Pannesi, 1995). However, the complexity of purchasing process has considerably increased due to several developments. For instance, the concepts of ecological sustainability and green purchasing have exposed the inherent complexities encountered when trying to merge environmental concerns with purchasing practices and systems. Changes in environmental requirements and public pressure on organizations have become a new trend in the business world.

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Globalization, intense competition, customer awareness and rapid pace of technological changes seem to be the driving forces of business today lead to the development of supply chains. Consequently, environmentally conscious manufacturing has become an obligation of manufacturers in supply chain management (SCM) and has been extended to the policy as well as strategy for the business to produce environment friendly products. To achieve this, manufacturers need to work with their suppliers of raw material and component which results in the greening of supply chain. The integration of environmental, economical and social aspects to achieve sustainable development is a major business challenge for the new century. In order to survive in the global market, it is mandatory for the firms to follow green procurement approach.

Supplier selection is a fundamental issue of supply chain area contributing to overall supply chain performance improvement. Supplier selection problem has been addressed and experimented for a quite long time through lot of studies by the academic as well as industrial researchers using different criteria and methodologies. GSCM mainly focuses on how the industries make use of their suppliers’ technologies, capabilities and processes to integrate environmental issues and thereby improve their competitive advantage (Vachon & Klassen, 2008). The supplier selection process is often influenced by uncertainty in practice (De Boer, van der Wegen, & Telgen, 1998; Min, 1994). Academicians and researchers are viewing supplier selection problem as multi-dimensional and multi-functional due to its increased complexity. Therefore, choosing the right method for supplier selection has become very important to reduce the associated purchase risk.

It has been found from the literature of published articles in the context of green supplier selection, various methodologies and procedures have been presented, among which most of them are multi-criteria decision making methods (MCDM). Few examples of such methodologies are Analytic Hierarchy Process (AHP), Analytic Network Process (ANP), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), VIKOR, DEMATEL, fuzzy VIKOR and fuzzy TOPSIS, fuzzy AHP and so on. By considering the multi-criteria decision making structure of the green supplier selection problem and also the vagueness in the real time environment, fuzzy TOPSIS and fuzzy VIKOR were considered as the appropriate techniques for selecting the best supplier. The proposed methodologies were applied individually for a textile industry located in southern part of India for choosing the best supplier among the alternatives. Results of both methodologies were compared to justify the final selection of the supplier.

The main objective of this study is to develop a comprehensive framework model for the implementation of green supply chain practices in industries by evaluating the suppliers’ capabilities regarding cost, quality, technology capability, service, pollution control, environmental management system and so on to select the most appropriate green supplier among the alternatives.

LITERATURE REVIEW

Environmental concern is a reality all over the world and that is the reason why green production has become more popular in almost every industry. The study and management of Industrial pollution has been a critical issue to the society for ever. Greening of suppliers is an important aspect in an external environmental supply chain and a green supplier evaluation system is necessary for a firm in determining the suitability of a supplier as a partner in the green supply chain.

Noci (1997) suggested three steps in the selection process of green suppliers: First to determine the applicable green strategies of the company, secondly to define the operational measuring method to as-