

# Chapter 12

## Investigation of Green Criteria With Clustering Analysis in Green Supplier Selection

**Mehmet Ali Taş**

*Turkish-German University, Turkey*

**Serap Akcan**

*Tarsus University, Turkey*

### **ABSTRACT**

*Green supplier selection has a crucial importance for businesses. In the past, the selection of suppliers was solely based on conventional criteria such as cost, quality, and flexibility whereas expectations of businesses transformed in today's world on grounds of raised environmental awareness, public pressure, and regulations. Alternatives called green suppliers sensitive to the environment, preserving the ecological balance, managing wastes, and preventing pollution increased in value. This study analyzes practices on the selection of green suppliers. The articles between 2014 and 2021 were analyzed from the perspective of green criteria. The green criteria in the 50 articles determined are divided into 28 groups. With the k-means algorithm, these criteria groups are divided into four clusters, which was aimed to analyze the usage frequency of green criteria. This study is intended to contribute to green supplier selection practices in academia and industry in the future.*

### **INTRODUCTION**

Businesses establish supply chains for products and services they provide. One of the most important steps in any supply chain is the selection of a supplier that fits for demands and expectations of the business. Suppliers that are part of a green supply chain are expected to be green suppliers. Suppliers that adopt green practices, manage their waste, comply with societal and legal norms about the environment and run environmental management systems are preferable for green supply chains (Büyüközkan &

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Vardaloğlu, 2008). Multi-criteria decision-making (MCDM) methods are adopted often for the selection of a green supplier.

These methods are based on comparison and grading of alternatives, which provides selection of the best one or ranking the alternatives. It enables to offer rational solutions for complicated problems in the light of considerations that contradict one another (Triantaphyllou, 2000). There are a variety of MCDM methods in the literature. Among the most popular ones are Analytic Hierarchy Process (AHP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), Elimination and Choice Translating Reality English (ELECTRE), and Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE). Freeman and Chen (2015) implemented Entropy and TOPSIS along with integrated AHP. Espinilla et al. (2015) adopted ELECTRE, Gupta and Barua (2017) used BWM (Best-Worst Method) and fuzzy TOPSIS, and Kumar et al. (2017) implemented fuzzy ELECTRE. Similarly, literature also offers studies over the selection of green suppliers through goal programming and optimization. A thorough literature review was performed in this study. It was intended that observing current trends by choosing a time period covering recent dates produces more accurate and consistent results. Thus, it was deemed appropriate to include the studies between 2014-2021. The Web of Science Core Collection database was selected for literature review. The reason for choosing this database is to access articles published in quality journals with well-known indexes. An online search was performed on this database using these keywords: “green supplier” or “green supplier selection” or “green supplier evaluation” or “green supplier multi-criteria decision making” in the topic section. Only articles were chosen and books, book chapters, conference papers, theses, and other academic publications were excluded from the search. In addition, the timespan was set from 2014 to 2021, and only articles written in English were considered. It was desired to select green supplier selection articles that included at least one MCDM method, one case study, and considered appropriate for the scope of the study. All of the articles reached from the database were first subjected to abstract scanning and those that were not suitable for the study were excluded. 50 articles that were eligible after full-text scanning were included in the study.

## **BACKGROUND**

Recently, many literature reviews of green supplier selection and green supply chain have been applied. Srivastava (2007) divided studies over green supply chain management into three categories: Importance of a green supply chain, green design and green operations. As a part of the study where the focus was on reverse logistics, criteria were tabulated using multi-criteria decision-making and other methods that were previously adopted. Genovese et al. (2010) compiled a review on the selection of environmental suppliers and presented a list of criteria employed. Sarkis et al. (2011) classified the studies over green supply chain management within the framework of organizational theories. Igarashi et al. (2013) carried out a compilation study that includes 60 articles over the selection of green suppliers from 1991 to 2011. The articles were reviewed and analyzed from the normative, empirical, and conceptual perspectives. Govindan et al. (2015) reviewed the evaluation and selection of green suppliers between 1997 and 2011. The study, which analyzed the selection perspectives and common criteria for selection, suggested that the most common criterion is environmental management systems. Fahimnia et al. (2015) performed a wide-ranging literature review about green supply chain management, and divided the articles into clusters by journal, country, year and citations. My Dung et al. (2016) reviewed the studies where AHP and Analytical Network Analysis (ANP) were adopted for the selection of green suppliers. Soda et al.

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