Investigating the Role of Environmental Criteria in the selection of Steel Suppliers using the Vicor Technique in the Context of Fuzzy Data

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Abstract

Considering the various pollutions caused by human activity, especially in the industry, which has led to the destruction of the environment and the reduction of the quality of human life, it has prompted human societies and governments to consider the issue of the environment as a concern and The important challenge in today's post-industrial age should be given more attention. Manufacturing companies and industries such as steel should also design and implement their production approach based on environmental standards to reduce this concern. One of the environmental factors in the steel industry is the choice of a green supplier, the present study is carried out using fuzzy Vicor multi-criteria decision-making processes in order to evaluate the environmental performance of suppliers. A supplier with the highest score is ranked number one. This means that the supplier has the highest environmental performance. Vicor technique selects and ranks the best supplier from among the options available in the supply chain. The total size of the statistical population is 30 people from the West Asia Steel Company, all of whom were given their opinion by completing the questionnaire. are According to the findings of the research, the ranking Finally, according to the collected data, the ranking of suppliers based on the fuzzy score is $S^3>S^2>S^1$.

Keywords: Fuzzy Vikor Method, Supply Chain, Environmental, Industry Folad Garb Asia.

1. Introduction

In today's global business, the competition among organizations is very intense, and to impress customers, organizations need to position themselves in a superior position compared to their competitors.being environmentally friendly and adapting to environmental requirements is a way to differentiate from competitors. If competitors have benefited from green supply chain management (gscm), the company will be more pressured to implement green supply chain management. On the other hand, customers also play an essential role in deploying the gscm system. Therefore, the strategic management of the green supply chain is one of the requirements for success in today's competitive market and should be seriously considered [1]. The supply chain has become an essential factor in global markets. This is so that in the global arena, the main competition takes place among the main competition among the supply chains. Stadler sees the supply chain as a network of organizations that participate in processes and activities with upstream-to-downstream communication and create value through products and services provided to the end customer. One of the ways to improve the performance of organizations in the field of production service and achieve a competitive advantage is the efficient management of the supply chain [2]. In today's era, due to the many sensitivities that have been raised in the issue of the environment, choosing the most appropriate green supplier has become very important because various government laws and policies regarding consumers of the environment and compatibility with the environment have increased and have been proposed with a more specialized approach. According to the traditional characteristics and based on quantitative criteria such as price, demand, etc., selecting the most suitable supplier is done efficiently. However,

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due to qualitative variables, fluctuations of subjective inputs, excessive criteria, and multi-level uncertainties, it is necessary to use multi-criteria decision-making methods with fuzzy set theory to select a green supplier. Quality measures involve subjective assessments such as environmental performance, process planning, and pollution control initiatives. Because in a company, managers of different departments have different views. Therefore, evaluating supplier selection based on performance and order allocation based on that is difficult. Therefore, this study uses fuzzy vikor models to select the best-qualified and green supplier. The fuzzy vikor method selects and ranks the best supplier among the options available in the supply chain. The importance of this research is determined in determining the suitable alternative for green suppliers. Therefore, purchasing decisions are vital to a company's overall efficiency and effectiveness. One of the most important decisions related to purchasing operations is evaluating and selecting suppliers. Therefore, the purpose of this research study is to use fuzzy-based multi-criteria decision-making processes to evaluate suppliers' environmental performance. The purpose of this research is to use fuzzy-based multi-criteria decision-making processes to evaluate suppliers' environmental performance and select green suppliers in the steel supply chain.

Globalization, increasing regulations of governmental and non-governmental organizations, and the pressure and demand of customers regarding compliance with supply chain management and environmental issues, have caused organizations to examine the necessary measures to be implemented in order to improve environmental and economic performance. The acceleration of government regulations to obtain "green environmental" standards and the growing demand of consumers for the supply of products has led to the emergence of a new concept of green supply chain management, which includes the stages of the product life cycle from design to recycling. Green supply chain management is one of the activities that it is subject to the processes of substitution, reuse, recycling and reducing material risks. In other words, green supply chain management includes green purchasing, green production, green distribution, green marketing and reverse logistics [3]. The concept of green supply chain was first proposed by kele and silver in 1989. Srivastava has defined the green supply chain as follows: "considering environmental issues in supply chain management including product design, selection and sourcing of materials, manufacturing and production process, transformation of the final product to the customer and product management after consumption and passing through its useful life. Although in supply chain literature, the concepts of sustainable supply chain management and green supply chain management are usually used interchangeably, these two concepts are slightly different from each other. Sustainable supply chain management includes economic dimensions and social and environmental sustainability. Therefore, the concept of sustainable supply chain management is broader than green supply chain management, and green supply chain management is a part of sustainable supply chain management [4]. after the oil and gas industries, the steel industry is the most important industry in the world and has a large volume of business. In our country, steel industry is considered as one of the most important industries of the country, which plays a significant role in the gross domestic product and plays a vital role in the development and growth of the country. In iran, the steel industry has a special place; in a way, the steel industry can be considered as the leading industry of iran.the 20% share of steel products export from non-oil exports of the country shows this claim. The progress made in the steel industry has turned this industry into one of the infrastructure industries in such a way that this industry forms one of the main pillars of the country's development. In fact, the development of the steel industry, considering the economic, social and geographical features of the country, is not only of great economic importance, but it will also lead to the realization of non-oil exports and foreign exchange earnings. An important point about the steel industry is that in all its processes along the steel supply chain, from the supply of raw materials and the exploitation of natural resources to manufacturing, production and use, and after the use of its waste after consumption by the final consumer is connected with the environment. Also, due to the export of steel products to international markets, its need to comply with international environmental laws is also inevitable. A look at the current supply chain management in the steel industry in the country clearly shows that there is not much attention paid to green approaches and it can be said that the supply chain in the steel industry in our country remains largely traditional. Despite the significant contribution that isfahan steel industry plays in the country's economy, the establishment of numerous industrial units as well as the transportation of manufactured products throughout the country has caused the supply chain of steel industry in this province to cause a lot of environmental pollution. Despite this and due to the large scale of activities of the steel industry in isfahan province as the hub of iran's steel industry, so far little research has been done in the field of green supply chain management in isfahan province in the field of steel, and subsequently, the obstacles to the implementation of these practices are less common. Checked. Therefore, there is a need for detailed and comprehensive investigations to understand the factors and obstacles to the non-implementation of green supply chain management practices in this industry according to various conditions and factors, so that these obstacles can be removed as quickly as possible. It is clear that the complete removal of all these obstacles is not possible in any way due to their extent and variety, and due to the high variety of factors involved in it, it is considered a

multi-criteria issue. According to the above, prioritizing the most important obstacles to the implementation of supply chain management can cause the most important obstacles to be identified in the first step and lead the current inefficient supply chain to adopt greener practices and procedures [5]. Today, companies and industries are under increasing pressure from society and governments to adapt to the environment. Modern companies focus on their key capabilities in order to succeed in the intense market competition [6]. For this purpose, they assign a large share of the value creation process to supply chains [7]. Almost 70% of product production costs are related to raw materials and supply chains [8]. Recently in the issue of selecting suppliers, identifying and the selection of the appropriate support has been taken into consideration [9]. suppliers are one of the most essential parts of the supply chain, whose performance indirectly has a significant impact on customer satisfaction. Since the demands of customers are different from organizations, organizations have to consider various criteria to choose their suppliers [10]. Supplier selection is an important issue in supply chain management and a multi-criteria decision making issue. In addition, the sustainability of the supply chain means paying attention to the three environmental, economic and social aspects of the supply chain as a new and influential discussion that has attracted the attention of researchers in the field of supply chain management. Suppliers, as essential components of the supply chain, can play a significant role in creating a sustainable supply chain [11]. Researchers such as voghter and bassiouni et al paid attention to forecasting methods in the supply chain network [12,13]. supply chain network in companies, downstream, intermediate and upstream of the network [14]. Based on the research of marchi et al., larger and faster volume in systems transportation can reduce supply chain costs by about 80% [15]. Supply chain stable and reliable can guarantee the survival and life of the company [16]. The basis and foundation of supply chain optimization is the selection of the right supplier [17]. Supply chain is a network of departments and institutions through which materials, facilities and information flow [18]. also, supply chain network management is considered one of the competitive strategies of commercial and manufacturing companies and enterprises to increase profitability and productivity [19]. Redesigning or re-designing the supplier network for, considering global threats such as war and insecurity and infectious diseases in order to support and reduce costs and reduce supply risk, a it is a necessity in today's industrial society [20]. One of the important components in the strategic decision of companies and commercial and production enterprises is the design of the supply chain network [21,22]. in the research of fuzzy modeling of closed loop management structures, a set of green relationship designs between the main products of the model and the pattern of causal relationships between qualities have been identified with the fuzzy dimatel technique. The matrix is obtained from dimatel's technique (matrix of internal communication), the causal correlation and the factors between the factors that show both influence and influence. On the other hand, it has an impact assessment. It shows the degree of influence and impression of the desired factor in the system, that factor has more with other factors of the system. To support the top management are the most important features with other features. Programs on customers are in the second place, controls and solutions are ranked with other suppliers [23]. Based on multiple criteria For this purpose, in the first stage, by forming a group of experts, the criteria for selecting suppliers were identified, and in the second stage, a questionnaire based on the approved criteria was prepared for the evaluation of suppliers and given to the senior managers The results obtained using they were ranked using topsis and electre iii techniques in fuzzy environment. Finally, four indicators were selected as follows. It should be noted that the weights of all indicators are considered the same according to the opinion of experts.1-Price 2- having environmental certificates 3- use of green technology in extraction, production and distribution 4- the amount of greenhouse gas emissions [24]. This study titled green supplier selection for steel industry using bwm and fuzzy topsis (case study of khuzestan steel company) helps to find the key factors for selecting green suppliers for ksc. The analysis of the key factors of ksc supplier selection shows that green innovation criteria should be given more attention by ksc in selecting a green supplier [25]. in this research titled green supplier selection using multi-criteria decision-making under ambiguous environment (a case study in the automotive industry), the evaluation of a set of suppliers is primarily based on conventional and environmental criteria. This work proposes a multi-criteria decision-making (mcdm) based framework to evaluate green supplier selection using an integrated fuzzy analysis hierarchy process (ahp) with three other techniques namely mabac (multi-attribute boundary approximation area comparison) & waspas ("weighted aggregate product-assessment") and topsis ("technique for order priority based on similarity to ideal solution"). At first, six green supplier selection environmental criteria (environmental management system, green image, employee environment training, environmental design, pollution control and resource consumption) and three conventional criteria (price, quality and service level) were identified and identified through literature review. From the findings of ahp, "environmental management system", "pollution control ", "quality" and "green image" are ranked as four green supplier selection criteria [26,27]. proposed the vikor method for conflicting criteria with some distance and can arrange suppliers based on performance. Yousefi et al [28]. presented a two-stage hybrid model for efficient supplier selection, order allocation, and price determination in or-

der to coordinate among members in the supply chain. anvari et al [29]. studied a modified vikor model for multi-criteria decision making process to study the case of conflicting criteria in lean utility selection problem. It has focused on many cases and analyzed them using vikor's method. Rostamzadeh et al [30]. to evaluate green supply chain management for the use of sustainable environmental activities based on some unknown criteria such as green production, green recycling, green transportation, green purchasing, environmental design and green warehouse in a manufacturing company. A laptop manufacturer in malaysia was studied. Finally, a comparative analysis is performed with vikor's results to improve environmental performance.entezami et al [31] presented a multi-objective model for considering green supply chain planning problems for multi-product, multi-period, and multi-site production.sarkar et al [32] proposed an integrated model combining dematel and process network analysis for green supplier selection in a welding company, namely fuzzy dematel and a multi-sectoral planning approach. The dematel method and fuzzy vikor support the results, determining the best supplier. Dey and saha [33] studied the desirable retail price, wholesale price, decision-making at the level of product greenness, and purchasing decisions in two supply chain schemes. Retailers decide on an appropriate inventory strategy for supply chain members to gain more profit, and manufacturers improve the product's greenness to attract more investment. In the study by chen et al [34] Which focused on selecting the optimal green supply chain management strategy in the electronics industry, they identified four green product life cycle management functions, including design, purchasing, production, and marketing and services, and their relationship with green management. Then, based on these identified functions, they selected the optimal green supply chain management strategy.

Simpon and Samson [35] proposed four strategies for green supply chain management, which are as follows: 1) risk-based strategy, 2) efficiency-based strategy, 3) innovation-based strategy, and 4) closed-loop strategy. Botkhom et al [36] presented a new measurement model for measuring university and industrial performance indicators related to green supply chain management practices to overcome these barriers (university and industrial). Shatokha[37] analyzed various transition issues in central eastern european countries' iron and steel industry. The experience gained helps understand new challenges related to modernization, adoption of new technologies, optimization of resources and installed capacities, and energy consumption towards a low-carbon and sustainable economy.

2. Materials and Research Methods

The present study is of a mixed method type, using both qualitative and quantitative methods. In the qualitative part of the research, interviews with industry experts will be conducted to determine essential and influential criteria, and in the quantitative part, matrices will be created, and conceptual ideas will be transformed into numbers to weigh the criteria. In terms of research objective, the study will be of an applied research type. The target population is 30 individuals from the West Asia Steel Company. In this research, data will be collected through library and internet research (including books, theses, project reports, journals, conference papers, and online sources) and field research (interviews and questionnaires), using questionnaires and interviews as tools for data collection. A matrix questionnaire was designed to evaluate three suppliers based on seven main criteria. Three experts from the West Asia Steel Company reviewed and approved the matrix questionnaire. To examine the validity of the questionnaires used in this research, expert individuals and professors reviewed and confirmed content validity. The fuzzy VIKOR technique was used for data analysis in this research. The most important indicators of this study for decision-making were extracted, and ultimately, a meta-analysis or summary of the research background was presented. Furthermore, library resources and a detailed review of the research background were consulted for the operationalization and indexing of this research. Operational research techniques usually do not have subject reliability.

Fuzzy VIKOR

Opricovic and Tzeng introduced the VIKOR method for multi-criteria optimization problems with conflicting and non-comparable criteria to compromise ranking order. It mainly focuses on providing rankings, selecting the best supplier from a set of options, and then identifying the best compromise solution for the problem of conflicting or non-comparable criteria. The compromise solution is the closest feasible solution to the ideal and creates an agreement with the ranking order. After obtaining the compromise solution, the VIKOR ranking index is calculated based on the individual criterion "closeness" to the ideal solution. The PLp metric is a multi-criteria ranking used as a sum function in the VIKOR planning method. This method has been followed using the PLp metric to aggregate the pursued function [29].

Table 1. Demographic information of experts.

number of people	Experience	Field of Study	Level of Education
1	13 years	mechanical	B.A
1	15 years	mechanical	M.A
1	15 years	metallurgy	M.A

3. Results and Discussion

Fuzzy VIKOR deals with the current assessment of supplier selection for green supply chains.

Experts give their opinion on seven green criteria for suppliers, which are given below:

1. Environmentally friendly technology C1
2. Environmentally friendly materials C2
3. Management commitment C3
4. Lean process planning C4
5. Staff training C5
6. Partnership with green organizations C6
7. pollution control initiatives C7

Fuzzy Vikor Method

The fuzzy VIKOR method evaluates green supply chain initiatives.

The proposed model focuses on ranking and selecting options and determining compromise solutions for problems with conflicting criteria. Alternatives are ranked by decision-makers using a non-scored ranking scale based on their individual preferences. Similarly, the total weight of criteria and the fuzzy decision matrix for alternatives are calculated using equations:

1. Calculate the best and worst values using the equations. The maximum value of the total fuzzy value is a positive result, and the minimum value of the total fuzzy value is.
2. Calculate the normalized matrix ri j using the equation.
3. Next, calculate the group preference values (Si) and non-divisible regret values (Ri) using the equation.
4. the VIKOR index value is calculated using the equation after calculating the group preference and non-divisible regret. The maximum group preference value (v) was summarized with a value of V, taken as 0.5.

The final ranking of options is re-evaluated in descending order by Si, Ri, and Qi.

The final ranking of options by Si, Ri, and Qi in descending order is re-evaluated.

The ranking of the best options is S3 > S2 > S1, as shown in the final table.

Condition 1: $Q(A) - Q(A) \geq DQ(.21.2492) - (.0.1813) \geq 1/(4 - 1)$, $1.4305 \geq 0.33$. This means that condition one is met, and S3 is the best supplier.

Table 2. Some criteria for green supply chain management.

Description	Symbol
Decision-maker	D1
Decision-maker	D2
Decision-maker	D3
supplier	A1
supplier	A2
supplier	A3

Table 3. Fuzzy numbers and importance.

Left	Score	Right	Fuzzy number	Symbol
1	1	3	(1,1,3)	**P**
1	3	5	(1,3,5)	**F**
3	5	7	(3,5,7)	**G**
5	7	9	(5,7,9)	**VG**
7	9	9	(7,9,9)	**E**

Table 4. Fuzzy decision matrix.

Fuzzy matrix																					
	c1			c2			c3			c4			c5			c6			c7		
A1	1.0	3.0	7.0	3.0	5.0	7.0	1.0	1.7	5.0	1.0	1.7	5.0	1.0	1.0	5.0	1.0	2.3	5.0	1.0	4.3	9.0
A2	1.0	3.7	7.0	3.0	5.7	9.0	3.0	5.0	5.0	3.0	5.0	7.0	1.0	4.3	7.0	3.0	5.0	7.0	3.0	6.3	9.0
A3	1.0	3.7	7.0	3.0	5.7	9.0	3.0	5.0	9.0	3.0	5.0	7.0	3.0	5.0	7.0	3.0	5.7	9.0	3.0	6.3	9.0

Table 5. Positive ideal and negative ideal matrix.

Positive ideal and negative ideal matrix																					
f*	1.0	3.0	7.0	3.0	5.7	9.0	1.0	1.7	5.0	1.0	1.7	5.0	1.0	1.0	5.0	1.0	2.3	5.0	1.0	4.3	9.0
fo	1.0	3.7	7.0	3.0	5.0	7.0	3.0	5.0	9.0	3.0	5.0	7.0	3.0	5.0	7.0	3.0	5.7	9.0	3.0	6.3	9.0
	c1			c2			c3			c4			c5			c6			c7		
A1	-6.0	0.0	6.0	-4.0	0.7	6.0	-4.0	0.0	4.0	-4.0	0.0	4.0	-4.0	0.0	4.0	-4.0	0.0	4.0	-8.0	0.0	8.0
A2	-6.0	0.7	6.0	-6.0	0.0	6.0	-4.0	-3.3	2.0	-6.0	-3.3	2.0	-4.0	3.3	6.0	-6.0	-2.7	2.0	-6.0	2.0	8.0
A3	-6.0	0.7	6.0	-6.0	0.0	6.0	-8.0	-3.3	2.0	-6.0	-3.3	2.0	-2.0	4.0	6.0	-8.0	-3.3	2.0	-6.0	2.0	8.0
	6.0	8.0	8.0	6.0	8.0	8.0	8.0	8.0	8.0	6.0	8.0	8.0	6.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0

Table 6. Fuzzy normalized matrix.

Fuzzy normalized matrix																					
	c1			c2			c3			c4			c5			c6			c7		
A1	-1.0	0.0	0.8	-0.7	0.1	0.8	-0.5	0.0	0.5	-0.7	0.0	0.5	-0.7	0.0	0.5	-0.5	0.0	0.5	-1.0	0.0	1.0
A2	-1.0	0.1	0.8	-1.0	0.0	0.8	-0.5	-0.4	0.3	-1.0	-0.4	0.3	-0.7	0.4	0.8	-0.8	-0.3	0.3	-0.8	0.3	1.0
A3	-1.0	0.1	0.8	-1.0	0.0	0.8	-1.0	-0.4	0.3	-1.0	-0.4	0.3	-0.3	0.5	0.8	-1.0	-0.4	0.3	-0.8	0.3	1.0

Table 7. Weighted fuzzy normalized matrix.

Weighted fuzzy normalized matrix																					
	c1			c2			c3			c4			c5			c6			c7		
A1	-3.0	0.0	6.8	-0.7	0.1	5.3	-2.5	0.0	4.5	-3.3	0.0	4.5	-3.3	0.0	4.5	-1.5	0.0	4.5	-1.0	0.0	9.0
A2	-3.0	0.5	6.8	-1.0	0.0	5.3	-2.5	-3.2	2.3	-5.0	-2.9	2.3	-3.3	2.3	6.8	-2.3	-2.5	2.3	-0.8	1.4	9.0
A3	-3.0	0.5	6.8	-1.0	0.0	5.3	-5.0	-3.2	2.3	-5.0	-2.9	2.3	-1.7	2.8	6.8	-3.0	-3.2	2.3	-0.8	1.4	9.0

							Qi			Q-crisp	Rating
0.0	0.2	0.5	-0.5	0.0	0.5		-0.5	0.2	1.0	0.2185	3.0
0.0	0.1	0.5	-0.5	0.1	0.5		-0.5	0.2	1.0	0.2157	2.0
0.0	0.1	0.5	-0.5	0.1	0.5		-0.5	0.2	1.0	0.2116	1.0

	Si			S-crisp	Rating
-15.3	0.1	39.0		6.0	3.0
-17.8	-4.4	34.5		2.0	2.0
-19.4	-4.5	34.5		1.5	1.0

	Ri			R-crisp	Rating
-0.7	0.1	9.0		2.15	1.0
-0.8	1.4	9.0		2.76	2.0
-0.8	1.4	9.0		2.76	2.0

S*	-19.4	-4.5	34.5
So	39.0		

R*	-0.8	0.1	9.0
Ro	9.0		

Table 8. Ranking the best alternatives.

S3	S2	S1	
1.5	2.0	6.0	S
2.8	2.8	2.2	R
0.2	0.2	0.2	Q

Based on data analysis and research findings, the ranking of suppliers has been determined as
S3 > S2 > S1.

Findings & Conclusion

Green factors have significant importance and involvement in suppliers' environmental performance. This research study uses a fuzzy-based multi-criteria decision-making process to evaluate suppliers' environmental performance. Firstly, criteria for evaluating the environmental performance of suppliers are identified. Secondly, ranking selected criteria and their alternatives (suppliers) based on expert opinions is determined by combining qualitative criteria through the fuzzy technique for preference ordering based on similarity to the ideal. The VIKOR method ranks and selects the best supplier from available options in the supply chain. This

study has identified various criteria for selecting sustainable suppliers based on environmental performance. As a result, this study provides a hierarchical model for selecting and evaluating sustainable suppliers, widely encompassing various fundamental features, including criteria weighting, decision-maker weighting, and evaluating existing alternatives with predetermined criteria. The fuzzy VIKOR method determines a compromise solution that decision-makers can accept as it provides maximum group preference for the majority and minimum regret for the adversary. The fuzzy VIKOR method has been used for supplier selection. Using linear normalization, the fuzzy VIKOR method calculates weights and the highest rankings for each option. This framework helps managers and analysts identify critical criteria of green factors, improve their understanding of greenness, and encourage sustainable product production. This study presents various challenges in selecting and evaluating sustainable supplier selection criteria from an organizational perspective. Apart from economic considerations, organizations are expected to compete in environmental sustainability and must be prepared to maintain competitiveness in the environmental field. Based on the collected data, the ranking of suppliers according to fuzzy VIKOR is determined as s2>s3>s1. Conclusion Green supply chain management is an approach to enhance product and process performance while complying with environmental regulations and requirements. Green supply chain management covers all product lifecycle stages from design, production, and distribution. This study provides a combination of fuzzy TOPSIS and fuzzy VIKOR models to solve the problem of selecting the best qualified and green supplier. This study has addressed two different methods, fuzzy TOPSIS, and fuzzy VIKOR, for evaluating the environmental performance of different suppliers. The proposed model considers linguistic variables for decision-makers ambiguity. In the first step, various problems arise while implementing green initiatives in the company. Secondly, implementing environmental functions in fuzzy conditions requires a specific logic and provides a better understanding of supplier selection. In fuzzy VIKOR, group preference values 'Si (5/9, 1/9, 1/5), VIKOR index' Qi ((0/0436, 0/0431, 0/0423), and non-divisible regret 'Ri (2/15, 2/76, 2/76) values have been found for all suppliers. The minimum value (lower is better) indicates the best supplier. Here, the minimum value in all analyses Si, Qi, and Ri, respectively, has been obtained for supplier S3, supplier S2, and supplier S1. Therefore, S3 will perform best per fuzzy VIKOR, while S1 will be the worst. Discussion and Comparison: The difference between this research and Avasti's research is that this researcher has used 12 environmental criteria with a fuzzy TOPSIS technique, while in the present study, seven environmental criteria have been used with a fuzzy VIKOR technique simultaneously for selecting a green supplier. The difference between this study and Sadeghi et al 's research is that these researchers have used the gray theory technique to determine the ranking of each option. However, in the present study, a fuzzy VIKOR technique has been used for selecting a green supplier, and both studies use environmental criteria. The difference between this study and Safaei et al.'s research is that the researchers have used ANP DEMATEL techniques to rank green criteria. However, the present study ranks based on green criteria. The difference between this study and Ramazani and Zarei's research is that they used an AHP-TOPSIS non-fuzzy technique for ranking green supply chain suppliers, while the present study uses a fuzzy VIKOR technique.

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