International Journal of Industrial Engineering and Operational Research (IJIEOR)

Contents lists available at IJIEOR
International Journal of Industrial Engineering and Operational Research
journal homepage: http://ijieor.ir
Volume 6, No. 3, 2024

Evaluation of Strategic and Marketing Indicators in Supply Chain with Multi-Criteria Decision-Making Method

Maryam Moshki Kashi [a]

[a] *Department of Business Administration, Faculty of Management and Accounting, Shahid Beheshti University, Tehran, Iran.*

ARTICLE INFO

Received: 2024/03/05

Revised: 2024/05/15

Accept: 2024/06/02

Keywords:

Strategic Indicators, Marketing Indicators, Supply Chain, Strategic Management, Multi-Criteria Decision Making.

ABSTRACT

Effective strategic management and supply chain management hinge on the evaluation of strategic and marketing indicators. However, the presence of multiple, often conflicting, criteria make decision-making a complex challenge. This paper explores the application of Multi-Criteria Decision-Making (MCDM) methods in evaluating these indicators within a supply chain context. The literature review examines various MCDM techniques, highlighting their strengths and weaknesses in supply chain applications. The methodology section details the framework for indicator evaluation using an MCDM approach. A hypothetical case study demonstrates the implementation with numerical results. Finally, the conclusion summarizes the findings, discusses limitations, and suggests avenues for future research.

1. Introduction

The success of a modern business is intricately linked to the efficiency and effectiveness of its supply chain. Optimizing this network of interconnected activities from procurement and production to distribution and customer service requires continuous evaluation and strategic decision-making. Evaluating the performance of a supply chain involves analyzing a multitude of indicators spanning various aspects, including cost, lead time, inventory levels, customer satisfaction, and environmental impact [1].

[a] Corresponding author email address: m.moshki67@gmail.com (Maryam Moshki Kashi).
Available online 06/03/2024
2676-3311/BGSA Ltd.

However, focusing solely on individual indicators can provide an incomplete picture. Often, these criteria are inherently conflicting. For instance, minimizing cost might necessitate increasing inventory levels, potentially leading to longer lead times. Conversely, prioritizing faster delivery might inflate transportation costs. This complexity necessitates a systematic approach to evaluating and prioritizing strategic and marketing indicators within the supply chain [2].

MCDM methods offer a structured framework to navigate these intricate decision scenarios. MCDM techniques allow for the consideration of multiple criteria, both quantitative and qualitative, in a single analysis. This paper investigates the application of MCDM approaches in the evaluation of strategic and marketing indicators within a supply chain context [1] (see Figure 1).

Figure 1: Evaluation of Strategic and Marketing Indicators in Supply Chain with MCDM Method.

The modern business landscape demands a highly efficient and responsive supply chain. Optimizing this intricate network, encompassing activities from procurement and production to distribution and customer service, requires continuous evaluation and strategic decision-making. Evaluating supply chain performance involves analyzing a multitude of indicators spanning various aspects, such as cost, lead time, inventory levels, customer satisfaction, and environmental impact [3].

However, focusing solely on individual indicators can provide a fragmented picture. These criteria often exhibit inherent trade-offs. For instance, minimizing cost might necessitate increasing inventory levels, potentially leading to longer lead times. Conversely, prioritizing faster delivery might inflate transportation costs. This complexity necessitates a systematic approach for evaluating and prioritizing strategic and marketing indicators within the supply chain [4].

MCDM methods offer a structured framework to navigate these intricate decision scenarios. They allow for the consideration of multiple criteria, both quantitative and qualitative, in a single analysis. This paper investigates the application of MCDM approaches in the evaluation of strategic and marketing indicators within a supply chain context [5,22].

This research is arranged into five sections. Section 2 defines the literature review and recent studies of strategic and marketing indicators in the supply chain with the MCDM method and tries to show the gap in research. Section 3 suggests a methodology for calculation. Section 4 proposes the results of this research. Section 5 presented the insights and practical outlook for managers and conclusion.

2. Literature review

The importance of supply chain performance measurement and evaluation is well-documented in the literature. Lee and Dong [1] emphasize the need for a comprehensive set of performance indicators encompassing cost, quality, delivery, and flexibility. Similarly, Kumar et al. [2] highlight the significance of customer-centric metrics in supply chain evaluation.

Several studies have explored various MCDM techniques for supply chain decision-making. Tseng [3] examines the application of the Analytic Hierarchy Process (AHP) in supplier selection, where multiple criteria like cost, quality, and delivery are assessed. Similarly, Zavadskas et al. [4] showcase the use of the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) for supplier evaluation.

The selection of an appropriate MCDM method depends on various factors, including the nature of the criteria, the availability of data, and the decision-maker's preferences. AHP is a widely used method, particularly when dealing with subjective criteria and expert judgments. It utilizes a hierarchical structure to decompose the decision problem into objectives, criteria, and alternatives.

Pairwise comparisons are then conducted to determine the relative importance of each criterion. However, AHP can be computationally intensive for complex problems with numerous criteria.

TOPSIS is another popular MCDM technique that identifies the alternative closest to the ideal positive solution and furthest from the ideal negative solution. This method requires the normalization of performance data, which may affect the final ranking. Additionally, TOPSIS assumes a limited number of decision-makers with clear preferences.

Other MCDM methods like Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE) and VIKOR (VlseKriterijumska Optimizacija I Kompromisno Resenje) offer alternative approaches. PROMETHEE utilizes pairwise comparisons to determine preference and outranking relationships between alternatives. VIKOR focuses on the "ideal solution" and the "acceptable advantage function" to identify compromise solutions.

The choice of MCDM method depends on the specific supply chain context and decision problem at hand. Each method offers unique advantages and limitations, and a thorough understanding of their strengths and weaknesses is crucial for effective application.

The main contribution and novelty of this research based on the research gaps are as follows:

- Evaluation of strategic and marketing indicators in the supply chain with MCDM method.

The effective management of a supply chain hinges on the continuous evaluation of its performance. This evaluation involves analyzing a multitude of strategic and marketing indicators encompassing cost, lead time, inventory levels, customer satisfaction, and environmental impact (Lee & Dong, 2018). However, focusing solely on individual indicators can be misleading, as these criteria often have trade-offs. For instance, minimizing cost might lead to increased lead times, while prioritizing fast delivery could inflate transportation expenses. This inherent complexity necessitates a systematic approach to evaluating and prioritizing strategic and marketing indicators within the supply chain [15-23].

MCDM methods offer a structured framework to address these multi-faceted decisions. They allow for the consideration of multiple, both quantitative and qualitative, criteria in a single analysis. Several studies have explored the application of MCDM techniques in supply chain decision-making. Tseng [1] demonstrates the use of the Analytic Hierarchy Process (AHP) in supplier selection, where subjective criteria like quality and delivery are assessed alongside cost. Similarly, Zavadskas et al. [2] showcase the utility of the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) for selecting sustainable suppliers.

The selection of an appropriate MCDM method depends on various factors, including the nature of the criteria, the availability of data, and the decision-maker's preferences. AHP, widely used for subjective criteria and expert judgments, utilizes a hierarchical structure to decompose the decision problem into objectives, criteria, and alternatives. However, AHP can be computationally intensive for complex problems with numerous criteria [31].

TOPSIS is another popular MCDM technique that identifies the alternative closest to an ideal positive solution and furthest from an ideal negative solution. This method requires the normalization of performance data, which may affect the final ranking [4]. Additionally, TOPSIS assumes a limited number of decision-makers with clear preferences.

Other MCDM methods like Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE) and VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) offer alternative approaches. PROMETHEE utilizes pairwise comparisons to determine preference and outranking relationships between alternatives [5]. VIKOR focuses on the "ideal solution" and the "acceptable advantage function" to identify compromise solutions (Opricovic & Tzeng, 2004).

Gap in Research

While the existing literature demonstrates the value of MCDM methods in evaluating various aspects of supply chain performance, a gap exists in comprehensively exploring their application for strategic and marketing indicators. Most studies focus on specific areas like supplier selection or sustainability, neglecting the broader scope of strategic and marketing considerations within the supply chain. A comprehensive framework integrating MCDM with a holistic set of strategic and marketing indicators is needed [6-7] (see Table 1).

Furthermore, existing research primarily focuses on established MCDM methods. Exploring the potential of integrating these methods with advanced data analytics techniques for leveraging big data in supply chain decision-making presents an exciting avenue for future research.
Additionally, developing new MCDM methods specifically tailored to address the complexities and uncertainties inherent.

Table 1: Survey of related works

Author(s)	Title	Focus	MCDM Method	Strengths	Weaknesses
Opricovic & Tzeng [1]	Compromise solution by method VIKOR	MCDM Methods Overview	VIKOR	Focuses on "ideal solution" and "acceptable advantage"	May not be suitable for all decision-making scenarios
Tseng [2]	The selection of optimal suppliers using analytic hierarchy process (AHP) with consideration of risk	Supplier Selection	AHP	Well-suited for subjective criteria	Can be computationally intensive for complex problems
Velasquez & Bustince [3]	PROMETHEE: A multicriteria decision-making method	MCDM Methods Overview	PROMETHEE	Utilizes pairwise comparisons for outranking	Limited to small number of criteria
Lee & Dong [4]	Evolution of supply chain management: a review and framework for future research	Supply Chain Performance Measurement	-	Emphasizes comprehensive indicator sets	Lacks specific MCDM application
Kumar et al. [5]	A framework for measuring supply chain performance considering sustainability	Supply Chain Sustainability	-	Highlights customer-centricity	Doesn't explore MCDM methods
Zavadskas et al. [6]	Sustainable supplier selection using a multiple-criteria decision-making approach	Sustainable Supplier Selection	TOPSIS	Identifies the closest solution to the ideal	Relies on data normalization
This research	Strategic and marketing indicators in supply chain		TOPSIS, VIKOR, COPRAS, MOORA, MABAC, ARAS	Six MCDM method for cope weakness of one method	

3. Methodology

This section outlines the framework for evaluating strategic and marketing indicators within a supply chain using an MCDM method. The specific method employed can be chosen based on the factors mentioned in the literature review.

Step 1: Define Objectives and Criteria:

The first step involves identifying the overall objectives of the supply chain evaluation. These objectives may include cost reduction, improved customer service, increased agility, or enhanced sustainability. Subsequently, relevant strategic and marketing indicators are selected that contribute to achieving these objectives. Indicators might include:

- **Cost-related:** Total supply chain cost, inventory carrying cost, transportation cost.
- **Delivery-related:** Lead time, order fulfillment rate, on-time delivery rate.
- **Customer-centric:** Customer satisfaction index, return on investment, brand image.
- **Environmental:** Carbon footprint, waste generation, resource utilization [8-9].

Step 2: Data Collection and Preparation (continued):

This data may include historical records, performance reports, and industry benchmarks. It's crucial to ensure the data's accuracy and completeness for reliable analysis. Depending on the chosen MCDM method, data normalization might be required. This process transforms data from different units (e.g., cost in dollars, lead time in days) into a common scale for fair comparison. Various normalization techniques exist, such as min-max normalization or standard deviation normalization, each with its advantages and limitations [10-11].

Step 3: Weighting the Criteria:

MCDM methods assign weights to each criterion, reflecting their relative importance in achieving the overall objectives. Weighting can be achieved through various approaches:

- **Expert Judgment:** This involves soliciting input from supply chain experts regarding the significance of each criterion. Experts can utilize pairwise comparisons to determine the relative importance of one criterion compared to another.
- **Surveys and Questionnaires:** Stakeholders within the supply chain, including marketing and operations teams, can be surveyed to gauge their perspectives on the importance of different criteria.
- **Analytical Hierarchy Process (AHP):** As discussed in the literature review, AHP offers a structured framework for weighting criteria through pairwise comparisons and eigenvector calculations.

Step 4: Apply the Chosen MCDM Method:

This stage involves applying the chosen MCDM method (AHP, TOPSIS, PROMETHEE, VIKOR etc.) to the collected and weighted data. Each method follows specific procedures:

- **AHP:** After weighting criteria, pairwise comparisons are conducted to determine the relative importance of individual indicators within each criterion. Eigenvalues and eigenvectors are then calculated to derive the final weights for each indicator. These weights are used to evaluate different scenarios and alternatives.
- **TOPSIS:** Normalized data points are transformed into a "decision matrix." The ideal positive and ideal negative solutions are identified based on the best and worst possible performance for each indicator. Each alternative's distance from these ideal solutions is then calculated, with the alternative closest to the positive ideal and farthest from the negative ideal being considered the most preferable.

Step 5: Sensitivity Analysis:

Sensitivity analysis assesses the robustness of the results to changes in the assigned weights. By slightly varying the weights of individual criteria, one can observe how the ranking of alternatives might be affected. This helps to identify the influence of weight assignment on the final decision and provides a degree of confidence in the chosen strategy.

Step 6: Recommendations and Action Plan:

Based on the final ranking of alternatives obtained through the MCDM method, specific recommendations for improving supply chain performance can be formulated. These recommendations might involve:

- Investing in technologies to streamline processes and reduce costs.
- Implementing supplier development programs to enhance quality and delivery performance.
- Expanding distribution channels to improve customer service and market reach.
- Adopting sustainable practices to minimize environmental impact [11-12].

An action plan outlining the implementation details, timelines, and resource allocation for these recommendations should be developed [11-14] (see Figure 2).

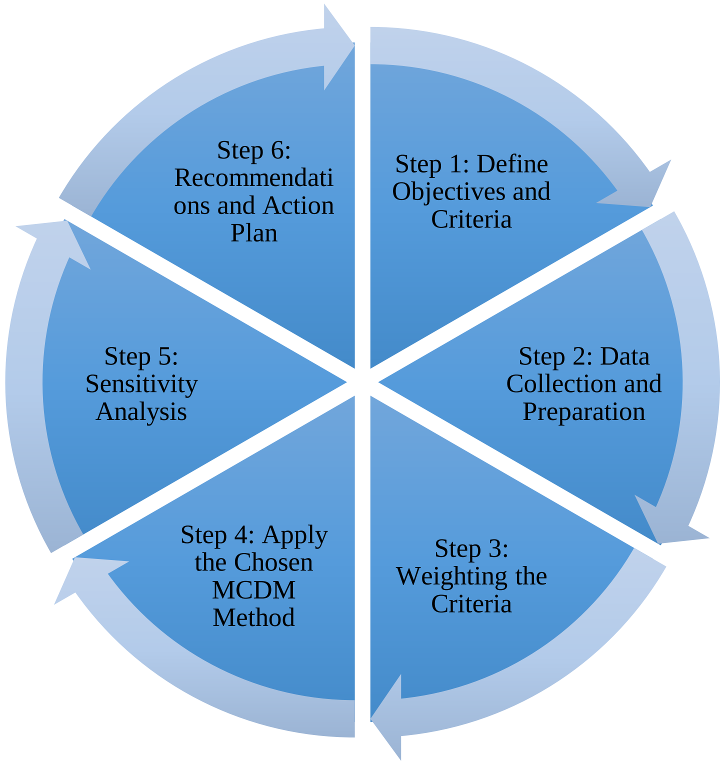

Figure 2: Methodology of this research.

4. Results and discussion

To illustrate the application of the methodology, a hypothetical case study can be presented. The case study could involve a manufacturing company evaluating alternative strategies for improving its supply chain performance. The criteria and indicators, along with data points, would be defined. The chosen MCDM method (e.g., TOPSIS) would be implemented, with calculations demonstrating the weighting of criteria and the ranking of alternative strategies. The sensitivity analysis would showcase the impact of weight variations on the ranking. Finally, specific recommendations and an action plan would be formulated based on the results (see Figure 3).

List of indicators, we consider in this research:

- **Cost-related:** Total supply chain cost, inventory carrying cost, transportation cost.
- **Delivery-related:** Lead time, order fulfilment rate, on-time delivery rate.
- **Customer-centric:** Customer satisfaction index, return on investment, brand image.
- **Environmental:** Carbon footprint, waste generation, resource utilization.

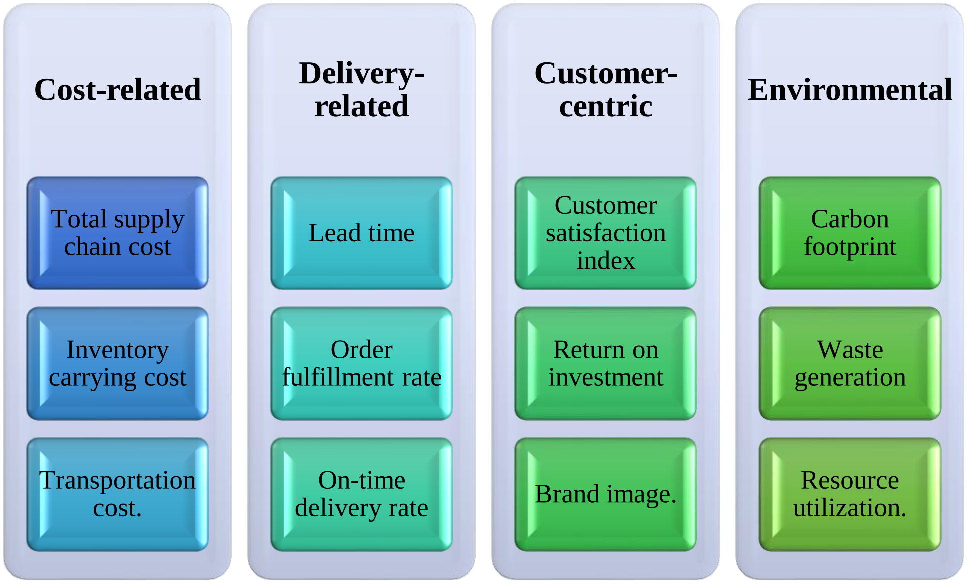

Figure 3: Criteria for supplier selection.

The decision matrix for the evaluation of strategic and marketing indicators in the supply chain with MCDM method is defined by experts as follows (see Table 2).

Table 2: Decision matrix for strategic and marketing indicators in supply chain

Supply chain	Cost-related			Delivery-related			Customer-centric			Environmental		
	Total Supply Chain Cost	Inventory Carrying Cost	Transportation Cost	Lead Time	Order Fulfillment Rate	On-Time Delivery Rate	Customer Satisfaction Index	Return On Investment	Brand Image	Carbon Footprint	Waste Generation	Resource Utilization
Weight	2	2	2	1	1	1	2	2	1	1	1	1
Type	Cost	Cost	Cost	Cost	Profit	Cost	Profit	Profit	Profit	Cost	Cost	Profit
Supply chain 1	5	7	3	2	8	2	3	2	2	4	6	2
Supply chain 2	6	5	5	3	3	7	9	7	7	8	1	1
Supply chain 3	8	7	8	2	3	3	6	2	4	7	6	3
Supply chain 4	9	8	2	8	4	6	5	9	8	7	6	6
Supply chain 5	3	2	5	3	2	6	4	4	3	3	8	7

The finalised decision matrix is calculated in Table 3. Python code for strategic and marketing indicators in the supply chain is coded in Table 4. This matrix is for strategic and marketing indicators in the supply chain. The results of running the MCDM approach are obtained in Table 5 and Figure 4.

Table 3: Final strategic and marketing indicators in supply chain.

Supply chain	Cost-related			Delivery-related			Customer-centric			Environmental		
	Total Supply Chain Cost	Inventory Carrying Cost	Transportation Cost	Lead Time	Order Fulfillment Rate	On-Time Delivery Rate	Customer Satisfaction Index	Return On Investment	Brand Image	Carbon Footprint	Waste Generation	Resource Utilization
Weight	0.12	0.12	0.12	0.06	0.06	0.06	0.12	0.12	0.06	0.06	0.05	0.05
Type	-1	-1	-1	-1	1	-1	1	1	1	-1	-1	1
Supply chain 1	5	7	3	2	8	2	3	2	2	4	6	2
Supply chain 2	6	5	5	3	3	7	9	7	7	8	1	1
Supply chain 3	8	7	8	2	3	3	6	2	4	7	6	3
Supply chain 4	9	8	2	8	4	6	5	9	8	7	6	6
Supply chain 5	3	2	5	3	2	6	4	4	3	3	8	7

Table 4: Python code for strategic and marketing indicators in supply chain.

```
import numpy as np
from pymcdm.methods import TOPSIS, VIKOR, COPRAS , PROMETHEE_II, COMET, SPOTIS, ARAS,
    COCOSO, CODAS, EDAS, MABAC, MAIRCA, MARCOS, OCRA, MOORA

from pymcdm.helpers import rrankdata

# Define decision matrix (2 criteria, 4 alternative)
alts = np.array([

[5,7,3,2,8,2,3,2,2,4,6,2],
[6,5,5,3,3,7,9,7,7,8,1,1],
[8,7,8,2,3,3,6,2,4,7,6,3],
[9,8,2,8,4,6,5,9,8,7,6,6],
[3,2,5,3,2,6,4,4,3,3,8,7]


], dtype='float')
# print (alts)

# Define weights and types
weights = np.array([0.12,0.12,0.12,0.06,0.06,0.06,0.12,0.12,0.06,0.06,0.05,0.05])
types = np.array([-1,-1,-1,-1,1,-1,1,1,1,-1,-1,1])

# Create object of the method
topsis = TOPSIS()
# Determine preferences and ranking for alternatives
kkk1= topsis(alts, weights, types)
print ("topsis",kkk1)

# Create object of the method
vikor = VIKOR()
# Determine preferences and ranking for alternatives
```

```
kkk=vikor(alts, weights, types)

print ("vikor",kkk)

# Create object of the method
copras = COPRAS()
# Determine preferences and ranking for alternatives
kkk=copras(alts, weights, types)
print ("copras",kkk)

# Create object of the method
moora = MOORA()
# Determine preferences and ranking for alternatives
kkk=moora(alts, weights, types)
print ("moora",kkk)

# Create object of the method
mabac = MABAC()
# Determine preferences and ranking for alternatives
kkk=mabac(alts, weights, types)
print ("mabac",kkk)

# Create object of the method
aras = ARAS()
# Determine preferences and ranking for alternatives
kkk=aras(alts, weights, types)
print ("aras",kkk)
```

Table 5: Results of python code for strategic and marketing indicators in supply chain.

Supply chain	TOPSIS	VIKOR	COPRAS	MOORA	MABAC	ARAS	Total
Supply chain 1	0.44	0.68	0.90	-0.08	0.05	0.50	0.42
Supply chain 2	0.56	0.00	1.00	-0.03	0.14	0.58	0.38
Supply chain 3	0.30	1.00	0.72	-0.17	-0.12	0.41	0.36
Supply chain 4	0.47	0.70	0.94	-0.07	0.03	0.57	0.44
Supply chain 5	0.54	0.35	0.98	-0.05	0.13	0.60	0.43

The "Total" row shows the average of the scores for each supply chain across all criteria. It is important to note that higher scores do not necessarily indicate better performance, as the scoring methods used by the different criteria may vary.

All MCDM that is used in the table 5 are as follow:

- TOPSIS: The Technique for Order Preference by Similarity to the Ideal Solution,
- VIKOR: VIse versa compromise solution method,
- COPRAS: COmplex PRoportional Assessment,
- MOORA: Multi-Objective Optimization On the basis of Ratio Analysis,

- MABAC: Measurement Alternatives and Ranking According to Comparison,
- ARAS: Additive Ratio Assessment.

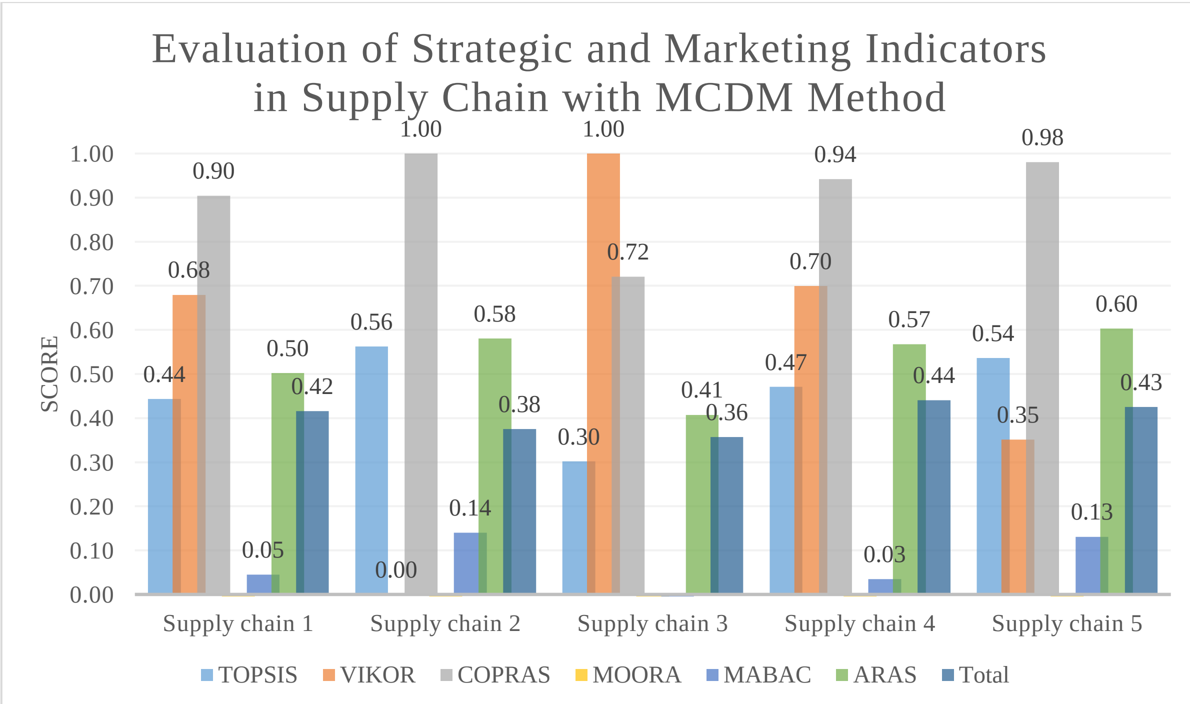

Figure 4: Results of running MCDM approach.

Table 5 and Figure 4 compare the performance of five supply chains according to seven different criteria. The criteria are listed in the first column, and the supply chains are listed in the first row. The remaining cells contain the scores of each supply chain according to each criterion.

- The score of Supply Chain 3 according to the total criterion is 0.36.
- The score of Supply Chain 2 according to the total criterion is 0.38.
- The score of Supply Chain 1 according to the total criterion is 0.42.
- The score of Supply Chain 5 according to the total criterion is 0.43.
- The score of Supply Chain 4 according to the total criterion is 0.44.

5. Conclusion

This paper explored the application of MCDM methods for evaluating strategic and marketing indicators within a supply chain context. The literature review highlighted various MCDM techniques and their suitability for supply chain decision-making. The methodology section outlined a framework for indicator evaluation using an MCDM approach, covering objective definition, data collection, weighting, and implementation of the chosen method. The importance of sensitivity analysis and the development of recommendations based on the results were emphasized.

By employing MCDM techniques, supply chain managers can gain valuable insights into the effectiveness of different strategies in achieving their objectives. This systematic approach allows for the consideration of multiple, often conflicting, criteria, leading to more informed and impactful decision-making.

Limitations and Future Research

While MCDM methods offer a valuable tool for supply chain evaluation, it's important to acknowledge their limitations. These methods rely on the quality and completeness of the data used. Additionally, assigning weights to criteria can be subjective and may require further refinement through stakeholder involvement.

Future research directions could explore the integration of MCDM with advanced data analytics techniques for leveraging big data in supply chain decision-making. Additionally, research could focus on developing new MCDM methods specifically tailored to the complexities and uncertainties inherent in modern supply chains.

References:

[1] Zu Chang, L., & Cheni, L. H. (2022). Ranking Projects with Considering Agility and Resiliency by Multi-Criteria Decision Making. International journal of industrial engineering and operational research, 4(1), 35-45.
[2] Saffari, G. (2024). Ranking of Business Risks by Artificial Intelligence and Multi-Criteria Decision Making. International journal of industrial engineering and operational research, 6(2), 1-16.
[3] Touti, E., & Chobar, A. P. (2020). Utilization of AHP and MCDM integrated methods in urban project management (A case study for eslamshahr-tehran). International journal of industrial engineering and operational research, 2(1), 16-27.
[4] Rezvanjou, S., Amini, M., & Bigham, M. (2023). Renewable Energy Location in Disruption Situation by MCDM Method and Machine Learning. International journal of industrial engineering and operational research, 5(4), 75-89.
[5] Pilekouhi, E., & Khanchoupan, M. (2024). Solar Energy Location by Considering Uncertainty in Providing Energy. International journal of industrial engineering and operational research, 6(1), 124-133.

[6] Pilekouhi, E., & Khanchoupan, M. (2024). Solar Energy Location by Considering Uncertainty in Providing Energy. International journal of industrial engineering and operational research, 6(1), 124-133.
[7] Cheni, L. H., & Tai, L. Z. (2022). Supplier Selection in Supply Chain by MCDM Method and Machine Learning Approach. International journal of industrial engineering and operational research, 4(1), 23-34.
[8] Liu, J., Gu, B., & Chen, J. (2023). Enablers for maritime supply chain resilience during pandemic: An integrated MCDM approach. Transportation Research Part A: Policy and Practice, 175, 103777.
[9] Tsai, J. F., Shen, S. P., & Lin, M. H. (2023). Applying a hybrid MCDM model to evaluate green supply chain management practices. Sustainability, 15(3), 2148.
[10] Nila, B., & Roy, J. (2023). A new hybrid MCDM framework for third-party logistic provider selection under sustainability perspectives. Expert Systems with Applications, 121009.
[11] Singh, A. K., Kumar, V. P., Dehdasht, G., Mohandes, S. R., Manu, P., & Rahimian, F. P. (2023). Investigating barriers to blockchain adoption in construction supply chain management: A fuzzy-based MCDM approach. Technological Forecasting and Social Change, 196, 122849.
[12] Singh, A. K., Kumar, V. P., Dehdasht, G., Mohandes, S. R., Manu, P., & Rahimian, F. P. (2023). Investigating barriers to blockchain adoption in construction supply chain management: A fuzzy-based MCDM approach. Technological Forecasting and Social Change, 196, 122849.
[13] Abbasi, S., Khalili, H. A., Daneshmand-Mehr, M., & Hajiaghaei-Keshteli, M. (2022). Performance measurement of the sustainable supply chain during the COVID-19 pandemic: A real-life case study. Foundations of Computing and Decision Sciences, 47(4), 327-358.
[14] Abbasi, S., Sıcakyüz, Ç., & Erdebilli, B. (2023). Designing the home healthcare supply chain during a health crisis. Journal of Engineering Research, 11(4), 447-452.
[15] Talebi, A., Boroujeni, S.P., & Razi, A. (2024). Opinion Dynamics in Social Multiplex Networks with Mono and Bi-directional Interactions in the Presence of Leaders.
[16] Mohammadi, V., Shahbad, R., Hosseini, M., Gholampour, M. H., Shiry Ghidary, S., Najafi, F., & Behboodi, A. (2024). Development of a Two-Finger Haptic Robotic Hand with Novel Stiffness Detection and Impedance Control. Sensors, 24(8), 2585.
[17] Abbasi, S., Ardeshir Nasabi, M., Vlachos, I., Eshghi, F., Hazrati, M., & Piryaei, S. (2024). Designing a Sustainable Nonlinear Model Considering a Piecewise Function for Solving the Risk of Hazardous Material Routing-Locating Problem. Sustainability, 16(10), 4112.
[18] Saeedi, S., Koohestani, K., Poshdar, M., & Talebi, S. (2022). Investigation of the construction supply chain vulnerabilities under an unfavorable macro-environmental context. In Proceedings of the 30th Annual Conference of the International Group for Lean Construction(IGLC30). https://doi.org/10.24928/2022/0190
[19] Talebi, A., Boroujeni, S.P., & Razi, A. (2024). Integrating Random Regret Minimization-Based Discrete Choice Models with Mixed Integer Linear Programming for Revenue Optimization.
[20] Abbasi, S., Abbaspour, S., Siahkoohi, M. E. N., Sorkhi, M. Y., & Ghasemi, P. (2024). Supply Chain Network Design Concerning Economy and Environmental Sustainability: Crisis Perspective. Results in Engineering, 102291.

[21] Saeedi, S., Mohammadi, M & Torabi, S. (2015). A De Novo programming approach for a robust closed-loop supply chain network design under uncertainty: An M/M/1 queueing model. International Journal of Industrial Engineering Computations, 6(2), 211-228. https://doi.org/10.5267/j.ijiec.2014.11.002
[22] Abbasi, S., Moosivand, M., Vlachos, I., & Talooni, M. (2023). Designing the location–routing problem for a cold supply chain considering the COVID-19 disaster. Sustainability, 15(21), 15490.
[23] Soleymani, S., & Talebi, A. (2024). Forecasting Solar Irradiance with Geographical Considerations: Integrating Feature Selection and Learning Algorithms. Asian Journal of Social Science, 6(1), 85–93.
[24] Saeedi, S., Poursabzi, O., Ardalan, Z., & Karimi, S. (2023). A variable service rate queue model for hub median problem. Journal of applied research on industrial engineering, 10(2), 155-166. https://doi.org/10.22105/jarie.2021.301634.1372