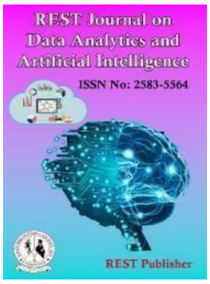
REST Journal on Data Analytics and Artificial Intelligence

Vol: 4(4), December 2025

REST Publisher; ISSN: 2583-5564

Website: http://restpublisher.com/journals/jdaai/

DOI: https://doi.org/10.46632/jdaai/4/4/4



Performance Metrics and VIKOR Method Integration for Supply Chain Management Assessment

***[1]Bandna Khare, [2]Vijay Kumar**

[1]JNCT Professional University, Bhopal, Madhya Pradesh, India.
[2]Oriental College of Technology, Bhopal, Madhya Pradesh, India.
*Corresponding Author Email: *khare50bandna@gmail.com*

Abstract: *This research involves the development and validation of metrics to evaluate supply chain management (SCM) process capabilities across various industries. Utilizing the VIKOR multi-criteria decision-making approach, it assesses and ranks industry sectors based on four key performance indicators. The results reveal notable performance disparities among the automotive, engineering construction, high-tech, life sciences, and telecommunications sectors. The telecommunications sector demonstrates the most balanced performance, reflected in a low VIKOR score and high ranking, while the life sciences sector ranks lowest due to consistently weak performance across multiple metrics. This in-depth evaluation offers valuable insights for industry benchmarking and pinpoints areas for potential improvement in supply chain operations. By offering a systematic framework for comparative analysis, the study supports organizations in refining their strategies to enhance efficiency and competitiveness in alignment with industry best practices.*

Keywords: *supply chain management, VIKOR method, multi-criteria decision-making, industry benchmarking, performance metrics, process capabilities, inventory management, forecast accuracy, on-time delivery, and warehouse management costs.*

1. INTRODUCTION

This paper bridges a significant gap by theoretically developing and empirically validating new metrics for measuring. From a competency-based perspective, where competency is viewed as a set of skills, abilities, and technologies that enable a firm to outperform its competitors, the SSCM process aims to convert diverse resources into competitive service offerings.[1] Supply chain management enhances reliability, responsiveness, sustainability, flexibility, cost reduction, and process efficiency. Both academically and practically, the focus in supply chain and operations management remains heavily on the manufacturing sector. [2] Supply chain management (SCM) is widely recognized for its role in improving organizational performance and creating value. There has been a significant increase in academic research focused on this integration. This study provides a comprehensive and up-to-date examination of the business processes that form the foundation of SCM, identifying and analyzing the key components, while highlighting their relative benefits. [3] Supply chain management (SCM) is a process that coordinates operations and activities throughout the order fulfilment cycle. Its main objective is to minimize total costs across all organizations in the supply chain while ensuring that the correct product is delivered to the end customer on time and with accuracy. [4] The supply chain management process was examined to evaluate the strength of its relationships. The study considered dependent variables such as on-time delivery, forecast accuracy, days in inventory, warehouse management costs as a percentage of revenue, and transportation costs as a percentage of revenue. The choice of both dependent and independent variables was guided by the integration of two primary sources. [5] (SCM) practices are undergoing disruption due to technological innovations that are reshaping the current processes. Business operations are becoming more data-driven, with insights derived from data being viewed as essential tools for enhancing supply chain performance. In this context, big data and business analytics are increasingly recognized for improving decision-making practices, both at the organizational and process levels. Big data, considered a new management paradigm, is founded on the idea that decision-making is more effective when supported by logic, facts, and evidence rather than relying solely on intuition and deliberative reasoning. [6] In recent years, the supply chain management process, along with related concepts like network sourcing, value chain management, and value stream management, has gained growing interest from academics, consultants, and industry experts. [7] Supply chain management consists of business processes where a network of trading partners collaborates to meet the needs of the end customer. This process spans from the supplier's supplier to the customer's customer, overseeing the movement of products, services, and information across the organization to maximize value delivery to the end customer. [8] Supply chain management (SCM) involves the coordination and integration of activities both within and across organizations to increase customer value and strengthen competitiveness in a global market. This approach is also relevant in the education sector, a non-profit domain, where it promotes stakeholder collaboration to enhance processes and results. [9] The supply chain management (SCM) process is increasingly recognized and widely adopted, with growing interest in supply chain integration among both professionals and researchers. The planning and coordination within and across organizations to establish a unified, high-performing business model. [10] Supply chain management (SCM) consists of organized and measurable processes aimed at achieving a specific outcome. It includes managing the flow of relationships, information, and materials across organizational boundaries, with the goal of enhancing supply chain efficiency by coordinating the management of physical products and associated information in an integrated manner. [11] By analyzing the existing challenges in remanufacturing, this study proposes several strategies for its effective implementation. It highlights the critical role of reverse logistics management, which is grounded in fundamental supply chain management processes. [12] Various studies have explored the integration of supply chains, while other research has focused on how web-based internal and inter-organizational processes enhance supply chain management. Supplier selection remains a key challenge in contemporary supply chains, with integration strategies and supplier selection processes dependent on multiple criteria and technology-driven decision-making methods. [13] Traditionally, supply chain management (SCM) has concentrated on overseeing process operations and material flows. However, recent definitions have evolved to view an organization as a distinct entity, highlighting the importance of managing supply chain participants to achieve shared benefits. This shift encourages a supply chain-centric approach, moving away from a focus on individual organizational goals. [14] The Supply Chain Management Process (SCMP) enhances the efficiency of supply chain operations by incorporating risk control and monitoring through data management systems. It also outlines recommended techniques for effectively implementing each phase of the process. [15]

2. MATERIAL AND METHOD

Alternative:
Automotive: This pertains to the production, sale, or repair of cars and other vehicles. The automotive sector is focusing on developing stronger, lighter materials to enhance fuel efficiency, benefiting industries such as aerospace and automotive.

Engineering Construction: Construction engineering involves the planning, design, and management of construction projects. It applies engineering principles to ensure safe, efficient, and sustainable construction of structures.

High-tech: Referring to the most advanced or complex technologies available, high-tech contrasts with low-tech, which involves simpler, often traditional technologies. For instance, a slide rule is considered low-tech compared to modern computing devices.

Life Sciences: A field of science that focuses on the study of organisms and their life processes. Life sciences encompass fields like biology, botany, zoology, microbiology, and ecology. It aims to understand the structure, function, behaviour, and evolution of living entities, from cells to ecosystems.

Telecommunications: Telecommunications refers to the electronic transmission of information over long distances. It includes all types of voice, data, and video communication and serves as an umbrella term for a wide range of technologies and infrastructures that facilitate information exchange and connectivity.

Evolution Parameters:

On-time Delivery (in %): On-time delivery (OTD) is a metric that gauges a company's ability to meet its delivery commitments. It is calculated as the percentage of orders delivered on or before the promised date and time. A higher OTD rate reflects a more efficient and dependable supply chain.

Forecast Accuracy (in %): Forecast accuracy percentage (often referred to as "Forecast Accuracy %") measures how closely a forecast matches the actual result. It is computed by dividing the absolute difference between the forecasted and actual values by the actual value, and multiplying by 100 to get the percentage. A higher percentage indicates better accuracy.

Days in Inventory (in days): Days in inventory measures the average number of days a business keeps its inventory before it is sold. This metric is crucial for evaluating inventory efficiency and cash flow, as well as understanding how long capital is tied up in inventory.

Warehouse Management Costs (as a % of revenue): Warehouse management typically 3-10% of revenue, though this can vary based on industry, company size, and operational complexity. Some reports suggest costs may rise to 5-15% of revenue, particularly for retailers. Research by APQC highlights significant cost efficiency differences, with top performers spending about $11.80 per $1,000 in revenue, while less efficient companies spend considerably more.

VIKOR method: The VIKOR method is a multi-criteria decision-making technique developed to address challenges involving conflicting and incompatible factors. It focuses on ranking and choosing among diverse alternatives, while identifying compromise solutions to resolve conflicting criteria, thereby supporting decision-makers in reaching a final choice. [16] This paper offers a chance to compare the ranking performance of two illustrative examples. Additionally, it seeks to identify the most effective VIKOR method by analyzing the values of Spearman's rank correlation coefficient. [17] VIKOR method is a decision-making approach used to solve multi-criteria problems, especially when dealing with conflicting or incompatible factors. It focuses on ranking alternatives and identifying compromise solutions that balance competing criteria, helping decision makers select the most optimal option. [18] The VIKOR method aims to determine the optimal alternative by balancing ideal and anti-ideal solutions across multiple criteria. Its key advantage is its capacity to handle both quantitative and qualitative factors, even in cases of incomplete or contradictory data. However, a key limitation is its sensitivity to changes in criterion weights, which can influence the final ranking outcomes. [19] The VIKOR method is crucial in assessing However; human judgment can sometimes be ambiguous in various situations, making it challenging to obtain accurate data. Despite this, the method remains a valuable tool for managing uncertainties within the data. [20] In situations with conflicting criteria, a compromise solution can help decision makers determine the most appropriate option. This study used the VIKOR method, designed for multi-criteria optimization in complex systems, to establish a priority ranking of alternatives based on a balanced assessment of the selected criteria. [21] Developed to gather and analyze data across various attributes and criteria. It was selected for its ability to identify the most significant and efficient criteria in multi-attribute, multi-criteria decision-making scenarios. VIKOR is an effective tool for addressing complex decision problems within a constrained solution space. [22] Initially developed to optimize complex multi-criteria systems, the VIKOR method produces a set of compromise rankings and solutions, along with stability intervals, to assess the robustness of the results against variations in initial weights. The method follows a series of structured steps to achieve these outcomes. [23] VIKOR is a valuable approach when decision makers face uncertainty or lack clear specifications at the start of system design. The method focuses on maximizing overall team utility, making it more agreeable to stakeholders. These compromise solutions can also form a foundation for negotiations, as they reflect the decision makers' preferences through the assignment of criterion weights. [24] The VIKOR method creates a compromise ranking list and calculates weight stability intervals to maintain the consistency of the initial weighting scheme. It is particularly suited for situations with conflicting criteria, utilizing a multi-criteria ranking index to assess how close each option is to the ideal solution. [25] A person who is both assertive and cooperative typically strives to find a solution that is mutually beneficial, where all parties involved gain something of value. Compromise entails reaching an agreement through mutual concessions, often leading to a stable result. The VIKOR method is effective in identifying such compromise solutions. Compromise is usually seen as acceptable when all decision-makers hold equal influence and are willing to make concessions under the current conditions. [26] The compromise ranking approach, referred to as the VIKOR method, evaluates and ranks alternatives to identify the one that most closely aligns with the ideal solution. Although this study applies the method to a limited set of alternatives for clarity, the model is scalable and suitable for assessing a larger pool. Its primary objective is to compare the characteristics of each option and determine the most favourable choice among them. [27] The study demonstrates that the entropy-VIKOR method can effectively identify the optimal piston material composition without the need for extensive and costly experimental procedures. Additionally, sensitivity analysis confirms that the resulting rankings remain stable even when criterion weights are altered. [28] To address this problem, Pareto optimality was adopted as the solution approach. Among various multi-criteria analysis methods, the VIKOR technique stands out in scientific research for its foundational nature and its ability to deliver compromise solutions when dealing with conflicting data. [29] Therefore, building on previous research, an enhanced VIKOR method is employed to create a model for selecting lean management tools. To illustrate its practicality, the model is applied to a yogurt flavour production line in a dairy company. Its effectiveness is then assessed through sensitivity analysis and real-world application. [30].

3. ANALYSIS AND DISCUSSION

TABLE 1. Determination of best and worst value Supply chain management process VIKOR method

	Delivery On-time (in %)	Forecast Accuracy (in %)	Days in Inventory (in days)	Warehouse Management Costs (in % of revenue)
Automotive	180	178	127	135
Engineering Construction	145	167	165	155
High Tech	167	190	267	234
Life Sciences	157	159	197	285
Telecommunications	145	178	290	177
Best	145	190	290	135
Worst	180	159	127	285

Table 1 evaluates supply chain performance across various industries using the VIKOR method, analyzing delivery timeliness, forecast accuracy, inventory duration, and warehousing costs to determine best and worst-performing benchmarks.

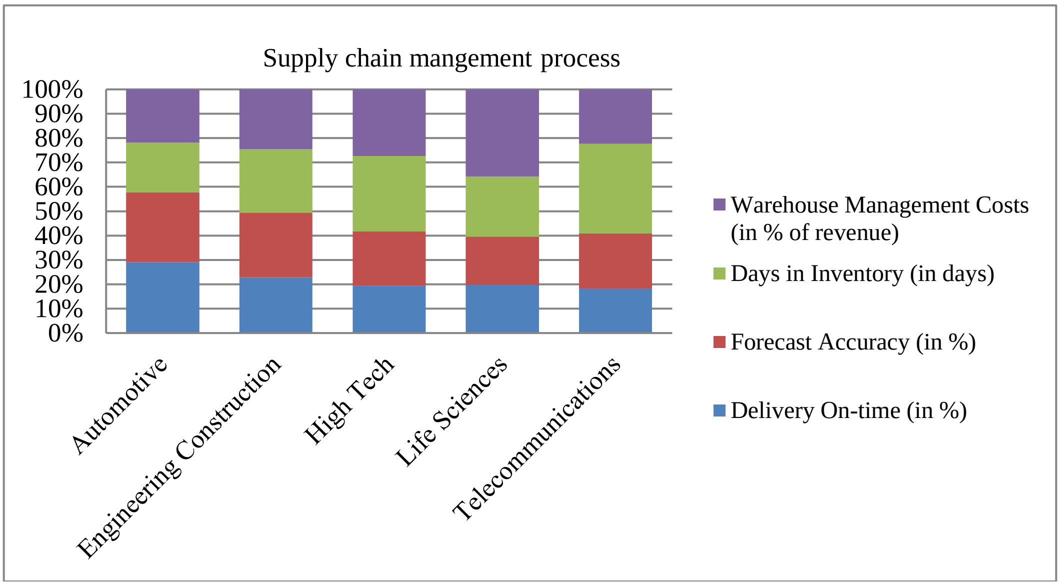


FIGURE 1. Determination of best and worst value Supply chain management process VIKOR method

Figure 1 illustrates the supply chain performance of five industries using the VIKOR method, highlighting variations in delivery, forecast accuracy, inventory duration, and warehousing costs to assess overall performance.

TABLE 2. Calculation Sj and RJ

	Delivery On-time (in %)	Forecast Accuracy (in %)	Days in Inventory (in days)	Warehouse Management Costs (in % of revenue)	Sj	Rj
Automotive	0.25	0.096774	0.25	0	0.596774	0.25
Engineering Construction	0	0.185484	0.191718	0.033333	0.410535	0.191718
High Tech	0.157143	0	0.035276	0.165	0.357419	0.165
Life Sciences	0.085714	0.25	0.142638	0.25	0.728352	0.25
Telecommunications	0	0.096774	0	0.07	0.166774	0.096774

Table 2 displays the SjS_j and RjR_j values computed for each industry using the VIKOR method, derived from normalized data on delivery performance, forecast accuracy, inventory duration, and warehousing costs. These metrics are used to identify compromise solutions, where lower SjS_j and RjR_j values reflect stronger overall performance. Among the sectors, Telecommunications records the lowest scores, suggesting a more balanced performance, while Life Sciences has the highest values, indicating weaker results across the evaluated criteria.

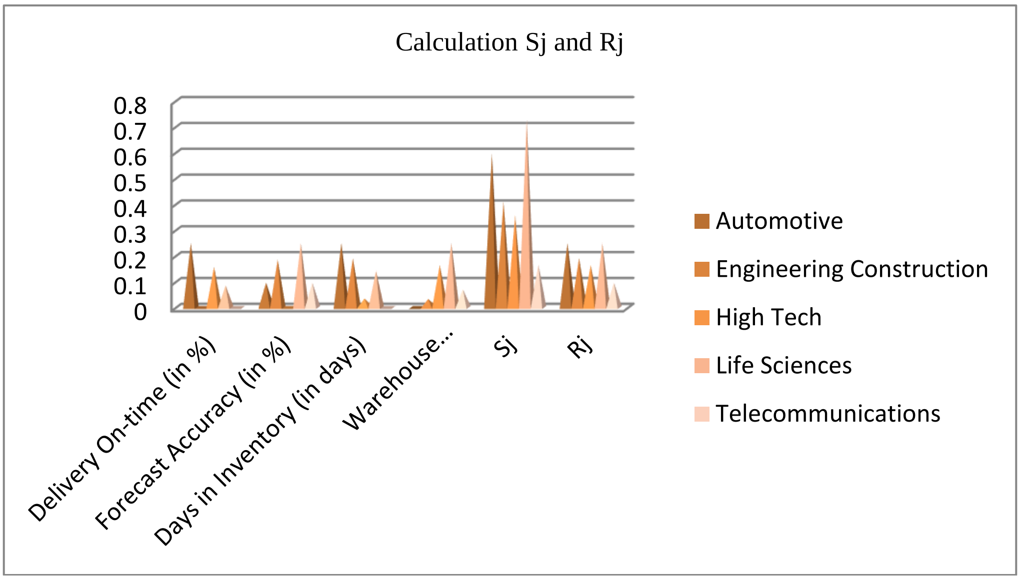


FIGURE 2. Calculation Sj, Rj

Figure 2 shows the Sj and Rj values obtained using the VIKOR method. VIKOR method, indicating that the telecommunications sector achieved the lowest scores, representing the best overall balance, whereas the life sciences sector demonstrated the weakest performance.

TABLE 3. Final Result of Calculation Sj Rj Qj Rank

	Sj	Rj	Qj	Rank
Automotive	0.846774	0.596774	0.669631	2
Engineering Construction	0.635586	0.410535	0.385805	3
High Tech	0.687419	0.357419	0.367477	4
Life Sciences	1.228352	0.728352	1	1
Telecommunications	0.333548	0.166774	0	5

Table 3 shows the resulting Qj values derived from the VIKOR method, indicating that the telecommunications sector performed the best with the lowest score, whereas life sciences ranked last due to having the highest Qj value.

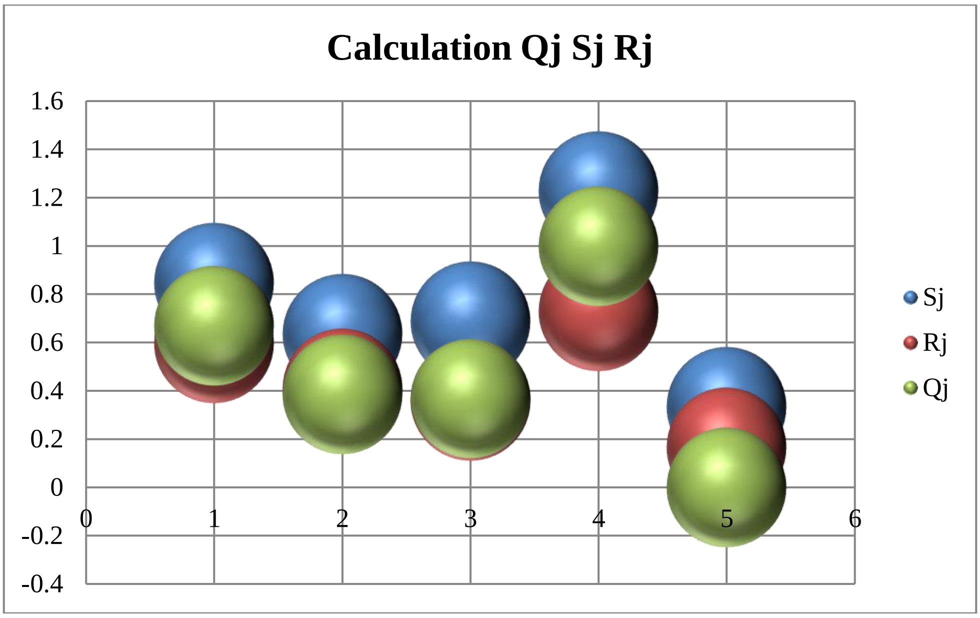


FIGURE 3. Calculation Sj, Rj and Qj

Figure 3 presents the computed values of Sj, Rj, and Qj. using the VIKOR method, showing telecommunications as the top-ranked sector due to its notably low Qj value, while life sciences ranked at the bottom.

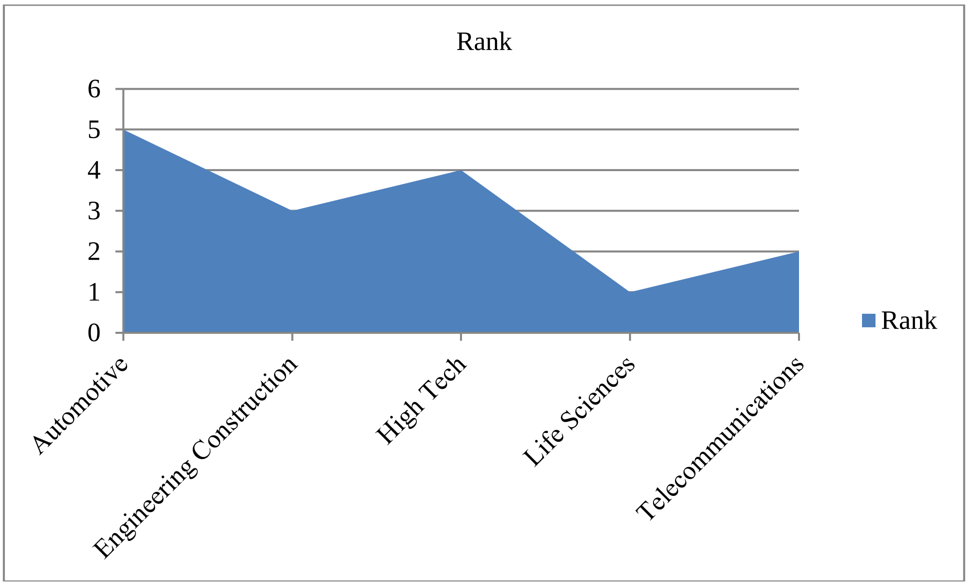


FIGURE 4. Rank

Figure 4 illustrates the SjS_j, RjR_j, and QjQ_j values calculated using the VIKOR method, with Telecommunications ranked highest due to its lowest score, while Life Sciences holds the lowest rank.

4. CONCLUSION

The analysis revealed significant differences in supply chain performance across sectors. The telecommunications sector ranked highest, achieving the lowest VIKOR score (Qj = 0), indicating well-balanced performance across all metrics. Specifically, it managed the highest inventory lead times (290 days), maintained moderate warehouse costs (177% of revenue), and achieved solid on-time delivery rates—highlighting the sector's efficient and strategically balanced supply chain operations. In contrast, the life sciences sector ranked at the bottom with the highest VIKOR score (Qj = 1), reflecting weak performance in several areas – particularly warehouse management costs (285% of revenue) and forecast accuracy (159%). These results indicate that the life sciences sector faces specific supply chain challenges that may require focused improvement strategies. The automotive sector came in second overall, followed by engineering construction and high-tech sectors, each of which shows unique strengths and weaknesses that are aligned with their operational realities. For example, while the automotive sector achieves excellent performance in managing warehouse costs, it lags behind in on-time delivery. These findings provide a solid basis for benchmarking supply chain performance across sectors and highlighting areas for targeted improvements. Companies can use this information to address specific weaknesses, such as life sciences companies focusing on improving forecasting and cost efficiency, or automotive companies aiming to improve delivery times. Additionally, this study underscores the utility of the VIKOR methodology in assessing complex supply chain systems involving conflicting objectives. Its ability to pinpoint compromise solutions makes it a practical tool for supply chain leaders striving for holistic performance optimization. Given the ongoing disruptions driven by technology and data-centric operations, this research provides a structured framework for comparative analysis that can guide strategic improvements in supply chain performance and competitiveness.

REFERENCES

[1]. Boon-Itt, Sakun, Chee Yew Wong, and Christina WY Wong. "Service supply chain management process capabilities: Measurement development." *International Journal of Production Economics* 193 (2017): 1-11.

[2]. Boon-itt, Sakun, and Chanida Pongpanarat. "Measuring service supply chain management processes: The application of the Q-sort technique." *International Journal of Innovation, Management and Technology* 2, no. 3 (2011): 217.

[3]. De Barros, Alexandre Pinheiro, Celia Satiko Ishikiriyama, Rafael Cordeiro Peres, and Carlos Francisco Simões Gomes. "Processes and benefits of the application of information technology in supply chain management: an analysis of the literature." *Procedia Computer Science* 55 (2015): 698-705.

[4]. Shaw, Nancy C., Mary J. Meixell, and Francis D. Tuggle. "A case study of integrating knowledge management into the supply chain management process." In *36th Annual Hawaii International Conference on System Sciences, 2003. Proceedings of the*, pp. 10-pp. IEEE, 2003.

[5]. Opricović, Serafim. "Compromise in cooperative game and the VIKOR method." *Yugoslav Journal of Operations Research* 19, no. 2 (2009): 225-238.

[6]. Govindan, Kannan, Susana G. Azevedo, Helena Carvalho, and Virgilio Cruz-Machado. "Impact of supply chain management practices on sustainability." *Journal of Cleaner production* 85 (2014): 212-225.

[7]. Brinch, Morten. "Understanding the value of big data in supply chain management and its business processes: Towards a conceptual framework." *International Journal of Operations & Production Management* 38, no. 7 (2018): 1589-1614.

[8]. Croom, Simon, Pietro Romano, and Mihalis Giannakis. "Supply chain management: an analytical framework for critical literature review." *European journal of purchasing & supply management* 6, no. 1 (2000): 67-83.

[9]. Akdogan, A. Asuman, and Ozgur Demirtas. "Managerial role in strategic supply chain management." *Procedia-Social and Behavioral Sciences* 150 (2014): 1020-1029.

[10]. Habib, Mamun. "Supply chain management: theory and its future perspectives." *International Journal of Business, Management and social sciences* 1, no. 1 (2010): 79-87.

[11]. Mentzer, John T., William DeWitt, James S. Keebler, Soonhong Min, Nancy W. Nix, Carlo D. Smith, and Zach G. Zacharia. "Defining supply chain management." *Journal of Business logistics* 22, no. 2 (2001): 1-25.

[12]. Chen, Haozhe, Patricia J. Daugherty, and Timothy D. Landry. "Supply chain process integration: a theoretical framework." *Journal of business logistics* 30, no. 2 (2009): 27-46.

[13]. Tramarico, Claudemir Leif, Valério Antonio Pamplona Salomon, and Fernando Augusto Silva Marins. "Analytic hierarchy process and supply chain management: A bibliometric study." *Procedia Computer Science* 55 (2015): 441-450.

[14]. Pradabwong, Jiraporn, Christos Braziotis, Kulwant S. Pawar, and James Tannock. "Business process management and supply chain collaboration: a critical comparison." *Logistics Research* 8 (2015): 1-20.

[15]. Tummala, Rao, and Tobias Schoenherr. "Assessing and managing risks using the supply chain risk management process (SCRMP)." *Supply Chain Management: An International Journal* 16, no. 6 (2011): 474-483.

[16]. Opricovic, Serafim, and Gwo-Hshiung Tzeng. "Extended VIKOR method in comparison with outranking methods." *European journal of operational research* 178, no. 2 (2007): 514-529.

[17]. Chatterjee, Prasenjit, and Shankar Chakraborty. "A comparative analysis of VIKOR method and its variants." *Decision Science Letters* 5, no. 4 (2016): 469-486.

[18]. Tong, Lee-Ing, Chi-Chan Chen, and Chung-Ho Wang. "Optimization of multi-response processes using the VIKOR method." *The International Journal of Advanced Manufacturing Technology* 31 (2007): 1049-1057.
[19]. Taherdoost, Hamed, and Mitra Madanchian. "VIKOR method—an effective compromising ranking technique for decision making." *Macro Management & Public Policies* 5, no. 2 (2023).
[20]. Devi, Kavita. "Extension of VIKOR method in intuitionistic fuzzy environment for robot selection." *Expert Systems with Applications* 38, no. 11 (2011): 14163-14168.
[21]. Chang, Chia-Ling, and Chung-Hsin Hsu. "Multi-criteria analysis via the VIKOR method for prioritizing land-use restraint strategies in the Tseng-Wen reservoir watershed." *Journal of Environmental Management* 90, no. 11 (2009): 3226-3230.
[22]. Siregar, Dodi, Heri Nurdiyanto, S. Sriadhi, Diana Suita, Ummul Khair, Robbi Rahim, Darmawan Napitupulu et al. "Multi-attribute decision making with VIKOR method for any purpose decision." In *Journal of Physics: Conference Series*, vol. 1019, p. 012034. IOP Publishing, 2018.
[23]. Imandasari, Tia, Mhd Gading Sadewo, Agus Perdana Windarto, Anjar Wanto, Harma Oktafia Lingga Wijaya, and Rudi Kurniawan. "Analysis of the Selection Factor of Online Transportation in the VIKOR Method in Pematangsiantar city." In *Journal of Physics: Conference Series*, vol. 1255, no. 1, p. 012008. IOP Publishing, 2019.
[24]. Dag, Sundus, and Emrah Önder. "Decision-making for facility location using VIKOR method." *Journal of International Scientific Publications: Economy & Business* 7 (2013): 308-330.
[25]. Fallahpour, A. R., and A. R. Moghassem. "Evaluating applicability of VIKOR method of multi-criteria decision making for parameters selection problem in rotor spinning." *Fibers and polymers* 13 (2012): 802-808.
[26]. Opricović, Serafim. "Compromise in cooperative game and the VIKOR method." *Yugoslav Journal of Operations Research* 19, no. 2 (2009): 225-238.
[27]. Sasanka, C. Tara, and K. Ravindra. "Implementation of VIKOR method for selection of magnesium alloy to suit automotive applications." *International Journal of Advanced Science and Technology* 83, no. 5 (2015): 49-58.
[28]. Dev, Sanni, Amit Aherwar, and Amar Patnaik. "Material selection for automotive piston component using entropy-VIKOR method." *Silicon* 12, no. 1 (2020): 155-169.
[29]. Chang, C-L., and Y-T. Lin. "Using the VIKOR method to evaluate the design of a water quality monitoring network in a watershed." *International Journal of Environmental Science and Technology* 11 (2014): 303-310.
[30]. Jing, Shuwei, Zhanwen Niu, and Pei-Chann Chang. "The application of VIKOR for the tool selection in lean management." *Journal of Intelligent Manufacturing* 30 (2019): 2901-2912.

