

## **MULTICRITERIA ASSESSMENT OF STRATEGIC SUPPLY CHAIN DECISIONS: BENEFITS, OPPORTUNITIES, COSTS, AND RISKS**

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### **Highlights**

- Comprehensive supply chain strategy evaluation utilizing Benefits, Opportunities, Costs, and Risks (BOCR) criteria to investigate complex decision-making processes.
- Integration of customer-driven requirements into strategic design, focusing on performance within the supply chain strategy.
- Assessment of strategy performance across various functional categories, including speed, reliability, volume/mix flexibility, and quality, within the supply chain context.

### **ABSTRACT**

An adequate supply chain strategy must exhibit agility to respond to evolving circumstances while demonstrating resilience to ensure operational stability during disruptions. This paper systematically evaluates supply chain strategies, emphasizing the Benefits, Opportunities, Costs, and Risks (BOCR) framework through a multicriteria perspective. A significant contribution of this research lies in developing a methodology that leverages Multi-Criteria Decision Analysis (MCDA) for assessing these strategies. An exploratory analysis was performed using the Analytic Hierarchy Process (AHP). This evaluation incorporates BOCR as the criteria alongside various functional performance categories as alternatives. By providing a practical framework, this paper supports supply chain managers in identifying and addressing critical elements such as speed, dependability, volume/mix flexibility, and quality, enhancing overall performance. Additionally, this study contributes valuable theoretical insights into the application of MCDA methodologies in supply chain strategy, highlighting the benefits of adopting a structured decision-making approach.

**Keywords:** AHP, BOCR, supply chain strategy.

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## **1. Introduction**

An effective supply chain strategy hinges on the capacity to quickly adapt to changing conditions while ensuring stable operations during unexpected disruptions. By leveraging shared data, organizations can enhance their production processes, elevate overall quality, and align more closely with market needs. This seamless flow of information fosters collaboration among stakeholders, resulting in better resource allocation and minimizing the risk of bottlenecks. Furthermore, such transparency cultivates a more responsive system that can adjust to shifting consumer preferences while ensuring operational continuity (Yu et al., 2024; Tarigan et al., 2021; Nel, 2024).

In this context, crafting a robust supply chain strategy requires a deep comprehension of different integration models, collaborative partnerships, and adaptive capabilities. It is crucial to promote agility that allows for swift responses to evolving market demands, while simultaneously ensuring resilience to manage disruptions effectively. Moreover, maintaining transparency throughout all processes is vital for building trust and enhancing operational efficiency across the entire network.

From the customers' perspective, a supply chain's strategic design is crucial for fulfilling their expectations and requirements. An adequate supply chain must ensure that lead times match customer demands, delivering products within the promised timeframe. Moreover, maintaining the highest standards in product design and quality is essential for achieving consistency and reliability. Customers also appreciate diverse options, seeking flexibility that caters to their varying preferences. Additionally, the supply chain should be capable of managing the necessary quantities and scaling efficiently in response to changing demand. Ultimately, a supply chain focused on customer satisfaction fosters loyalty and positive experiences through dependable and seamless performance (Liu et al. 2024; Hendijani & Saei, 2024).

Considering customer-driven requirements, Multi-Criteria Decision Analysis (MCDA) offers effective methodologies to address the intricate challenges of decision-making in supply chain management. These approaches are specifically crafted to aid in making informed decisions, a vital managerial task that requires balancing customer-focused criteria, including lead times, quality, and flexibility. From an evaluation standpoint, this process should encompass a range of factors that can impact the effectiveness of supply chain strategies. Techniques within MCDA, incorporating the Analytic Hierarchy Process (AHP) as well as Benefits, Opportunities, Costs, and Risks (BOCR) (Testoni et al., 2024; Petrillo et al., 2023; Silva & Tramarico, 2022), are integral to evaluating these multifaceted decisions. Therefore, this research primarily aims to assess supply chain strategy. Specifically, this research aims to address the following question: (RQ1) How can the performance of a supply chain strategy be evaluated?

## **2. Literature Review**

A supply chain strategy can be influenced by various external factors, including customer expectations. These expectations encompass rapid design, product requirements, pricing, specific lead times (the duration from order placement to arrival), quality, delivery frequency, dependability, product and volume flexibility, and aesthetics. In this context, it is essential to review the concepts of order qualifiers and order winners (Pittman and Atwater, 2022).

Additionally, economic conditions have a profound effect on demand, material costs, and labor availability, which in turn influence product and service design as well as production processes. The political and social landscape, including growing sustainability concerns, shapes public expectations regarding effective supply chain practices, increasingly emphasizing the importance of sustainability. Consequently, both global and domestic competitors play a crucial role in shaping marketing and operational strategies (Arianpoor & Moghaddampoor, 2024).

Beyond these influences, effective strategies share several key characteristics. A well-designed strategy aligns with both internal and external environments, enabling organizations to respond swiftly and effectively to changes. It fosters a significant and sustainable competitive advantage that is challenging for rivals to imitate. Crucially, such a strategy steers clear of actions that could endanger the business in the long run, such as drastic cost-cutting measures that undermine product quality or future success and imposing unfavorable working conditions that could damage the company's reputation, lead to fines or portray the organization as an undesirable employer. Moreover, a well-executed strategy yields measurable performance improvements, such as revenue growth, market share expansion, increased stock prices, higher returns for investors, enhanced customer satisfaction and loyalty, and greater capital for reinvestment (Chen et al., 2024). Moreover, successful strategies possess several key characteristics. Leaders demonstrate discipline in adhering to the chosen path, ensuring that strategic plans are transformed into actionable steps. They allocate the necessary resources for effective strategy implementation and allow sufficient time for initiatives to produce tangible results. Leaders remain committed, resisting the urge to divert resources to unrelated projects. Each decision is assessed based on its contribution to the overall strategic objectives (Hendijani & Saei, 2024).

Furthermore, the strategy is communicated throughout the organization, enabling employees to grasp how their individual goals align with the company's broader mission. This sense of alignment serves as a powerful motivator. Strategies are harmonized at every level, ensuring that managers and employees utilize the same guiding principles in their daily decisions as those that shape the organization's overall direction.

When it comes to supply chain integration, both backward and forward approaches present unique benefits and challenges. Backward integration enables an organization to gain control over its supply sources, producing goods with equal or superior efficiency, reliability, and quality compared to external suppliers. However, this approach can introduce new risks by diverting attention from core competencies. On the other hand, forward integration provides greater authority over the distribution and sales processes, enhancing control over the value chain. While this can improve market positioning, it may also strain relationships with existing distributors or result in monopolistic practices, potentially harming the distribution network (Tarigan et al., 2021).

Supply chain strategic design principles aim to align with customer needs by focusing on several key areas. First, it is essential to meet customer expectations regarding lead times, ensuring that products are delivered within the expected timeframes. Additionally, the supply chain needs to adhere to established product design and quality standards, ensuring that items consistently meet or surpass customer expectations. Another essential element is flexibility; the system should be capable of handling different product types and

providing a variety of choices to cater to the diverse preferences of customers. Lastly, the supply chain must address quantity and capacity demands, ensuring that it can scale production efficiently to meet changing levels of demand without compromising service quality (Gital & Bilgen, 2024; Pittman & Atwater, 2022). Furthermore, functional performance categories, including speed, dependability, flexibility, and quality, serve as fundamental criteria for shaping priorities (Table 1).

**Table 1** – Functional performance categories

<b>Category</b>	<b>Description</b>
Speed	Refers to the duration of time that elapses from the initiation to the completion of a sales transaction.
Dependability	Entails fulfilling commitments made to customers, which may include meeting promised delivery times or ensuring the agreed-upon volume.
Volume/mix flexibility	Refers to an operation's ability to produce new or modified products while maintaining output levels and meeting delivery timelines. Flexibility encompasses the organization's capacity to quickly adapt to changes in product mix, delivery schedules, or throughput.
Quality	Determined by a product or service's defined attributes and its adherence to those specifications. Customers perceive quality when receiving expected value, regardless of price, while compliance affects overall satisfaction.

### **3. Objectives**

This paper seeks to present a systematic approach to evaluating supply chain strategy. This evaluation focuses on the BOCR framework and is based on a multicriteria approach. The steps involved in this procedure are detailed in Section 4, which outlines the hierarchy definition and subsequently discusses the application of the AHP to facilitate the evaluation.

## **4. Methodology**

### **4.1 Research Design**

The supply chain strategy assessment was carried out by a chemical corporation located in Brazil, which is one of the largest producers of crop protection in Latin America. The company's primary objective is to research, develop, manufacture, and supply products and services to the agricultural sector.

The company acquires active ingredients from a supplier located in Germany. After the purchase order is placed, the physical process comprises the following shipping patterns: shipper, pickup and delivery, cargo terminal at the origin, line haul using air modal, cargo terminal at the destination, pickup, and delivery to the consignee.

After receiving the active ingredient, the manufacturer formulates it and dispatches the finished crop protection product to customers nationwide. The company employs both full-

truckload and less-than-truckload configurations for its distribution network. Following the application period in the field, unused crop protection products and empty packaging are returned to the manufacturer through the reverse logistics flow.

The research outlined in this chapter involved assessment sessions with five experts and a supply chain manager. The participants in the assessment were seasoned business consultants, each with a minimum of 15 years of expertise in overseeing IT projects. Their extensive experience primarily lies within Chemical production sites based in North America and South America. Those specialists have undergraduate degrees in Information Technology, Engineering, and Business Administration. The experts' judgments were consolidated into a single Excel spreadsheet and aggregated by consensus. The supply chain manager then assessed and approved the judgments provided by the experts.

## 4.2 Research Method

The implementation of the AHP methodology consists of four stages: establishing the hierarchy, performing pairwise comparisons, assessing consistency, and integrating the results (Testoni et al., 2024). At this stage of the research, the objective was to understand the evaluation hierarchy of supply strategy (Figure 1), BOCR model. As part of the AHP method, this model considers four types of merits proposed to represent different clusters, which define interactions concerning the established control hierarchy. The model has been applied to various decision-making problems, where **B** contrasts with **C**, and **O** contrasts with **R**. **B** represents the criterion that yields the greatest benefit, **O** represents opportunities, while **C** and **R** indicate, respectively, the alternatives with the highest costs and risks (Saaty & Ozdemir, 2005).

The hierarchy construction begins with the definition of the objective, criteria, and alternatives. This proposed model aims to evaluate a strategy for supply chain management. Criteria are identified as Benefits, Opportunities, Costs, and Risks. Alternatives were established as speed, dependability, volume/mix flexibility, and quality (Table 1).

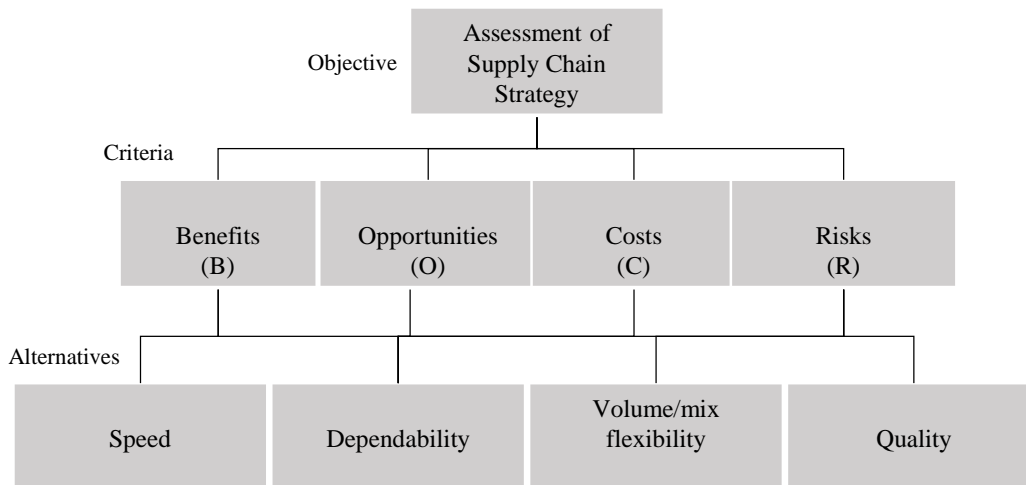


Figure 1 – Hierarchy for evaluating supply chain strategy

## 5. Results

Data collection and processing were conducted using spreadsheets, with inconsistencies in the judgments remaining below 10%. The pairwise comparisons were carried out during a single meeting, eliminating the need for additional judgments to clarify inconsistencies. This study aimed to evaluate the significance of different criteria, incorporating consistency ratios, which play a crucial role in determining the experts' actual importance ratings. The priorities in Table 2 indicate that the cost criterion is considered by experts the most important, followed by risks.

**Table 2** – Priorities of BOCR

Criteria	B	O	C	R	Priority
Benefits	1	3	1/3	1/5	13%
Opportunities	1/3	1	1/3	1/5	7%
Costs	5	5	1	3	55%
Risks	3	3	1/3	1	25%

Following that, the experts provided judgments for the alternatives. Table 3 presents the aggregated priorities for the evaluated alternatives and Table 4 illustrates their ranking.

**Table 3** – Priorities of alternatives

Alternative/Criteria	B (0.13)	O (0.07)	C (0.55)	R (0.25)	Overall
Speed	0.41	0.43	0.47	0.13	38%
Dependability	0.37	0.19	0.05	0.08	11%
Volume/mix flexibility	0.07	0.14	0.14	0.52	22%
Quality	0.15	0.25	0.34	0.27	29%

**Table 4** – Ranking of alternatives

Alternative	Overall	Rank
Speed	38%	1st
Quality	29%	2nd
Volume/mix flexibility	22%	3rd
Dependability	11%	4th

In the prioritization ranking, the speed category showed a nine-percentage-point difference from quality, securing the top position. The quality category, in second place, exhibited a seven-percentage-point difference from volume/mix flexibility, which ranked third. Following them was dependability. A detailed and comprehensive sensitivity analysis was conducted for the risk criterion to evaluate the impact of changes on the outcomes of the

alternatives. The black vertical line in Figure 2 represents the risk criterion with a 25% priority. It is observed that for values above 45%, the speed alternative is surpassed by volume/mix flexibility and quality.

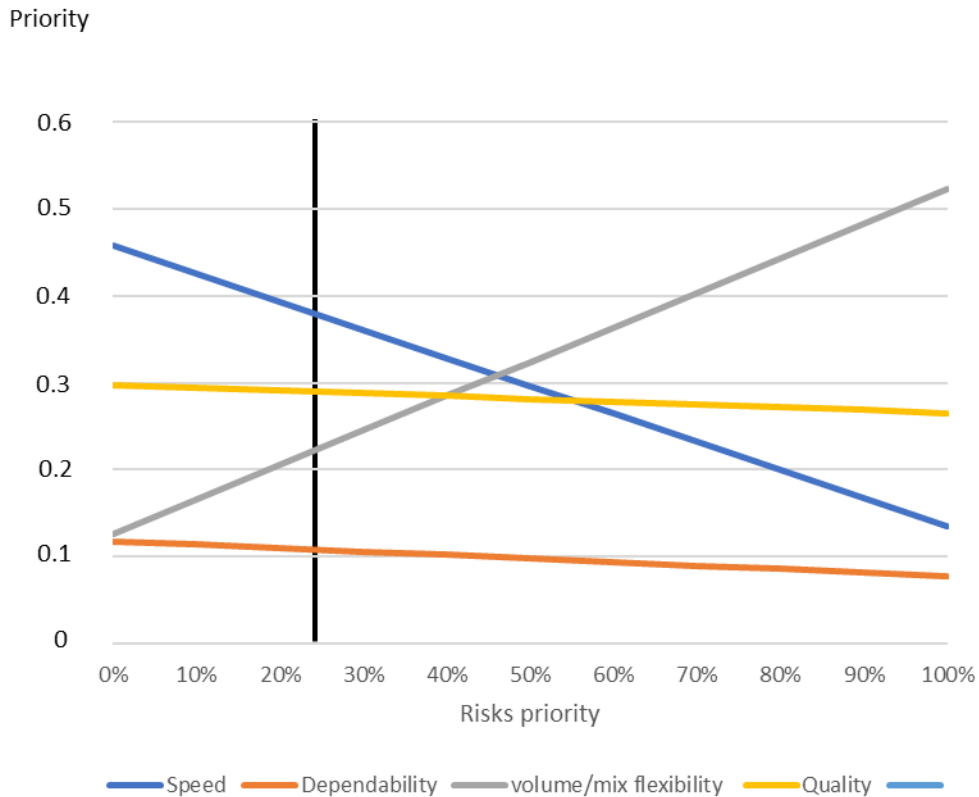


Figure 2 – Sensitivity analysis

## 6. Conclusions

The assessment considered key factors identified in the literature related to functional performance categories within supply chain strategy. The BOCR model and the AHP method, both part of MCDA, were integrated into the evaluation process. Performance categories for supply chain strategy were identified and ranked, providing a comprehensive understanding of the critical aspects that influence successful strategies. The performance category of speed has emerged as a crucial factor, emphasizing the significance of the time taken from the start to the finish of a sales transaction. The research presented a thorough approach addressing the challenges related to supply chain strategy, particularly in response to RQ1. The findings offer valuable insights for practitioners, managers, and decision-makers, guiding them in effectively managing supply chain strategies. This includes practical advice on evaluating functional performance categories, enabling organizations to overcome challenges and seize opportunities within their supply chain operations.

## **7. Limitations**

This study acknowledges certain limitations, which means that its findings are specific to the context explored and cannot be broadly applied elsewhere. Extrapolating these results to different scenarios requires careful consideration of the unique dynamics and characteristics that exist in various organizational environments. To strengthen the applicability of these findings, future research should aim to replicate and validate them across a wider array of organizations, including different industries, geographic regions, and organizational structures. This approach will enhance the understanding of supply chain strategies and their implications within diverse organizational contexts.

## **8. Key References**

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