

COMPARATIVE ANALYSIS OF SUPPLIER SELECTION METHODS IN INDUSTRY-SPECIFIC CONTEXTS

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Abstract: Supplier selection is a key strategic decision in logistics and supply chain management, directly influencing a company's competitiveness, cost efficiency, and sustainability performance. This paper provides a comprehensive overview of the main criteria and methodological approaches applied in supplier evaluation. It explores the importance of financial, quality, delivery, compliance, sustainability, and communication factors, as well as their industry-specific adaptations in sectors such as automotive, food, pharmaceutical, electronics, construction, and textile manufacturing. The methodological section presents and compares several decision-making techniques (including the Datum, Dodgson, Plurality, Weighting, and Analytic Hierarchy Process (AHP) methods) highlighting their advantages, limitations, and suitability for multi-criteria decision environments. Finally, the study discusses emerging trends such as digitalization, data-driven evaluation, ESG considerations, and resilience-oriented supplier assessment, emphasizing the growing need for continuous and transparent supplier performance monitoring in modern logistics systems.

Keywords: supplier selection, multi-criteria decision-making (MCDM), Analytic Hierarchy Process (AHP), supplier evaluation, decision support methods, procurement strategy.

1. INTRODUCTION

Supplier selection is one of the most critical decisions in supply chain management, as it directly influences cost efficiency, product quality, and overall operational performance. In today's highly competitive and globalized business environment, organizations depend on their suppliers not only for materials and components but also for innovation, sustainability, and strategic resilience. Selecting the right supplier therefore requires a systematic evaluation process that integrates financial, technical, environmental, and social dimensions.

Recent developments in logistics systems highlight the need for decision-making methods that can manage complex trade-offs between multiple, often conflicting, criteria. Traditional approaches focusing solely on price or delivery performance are no longer sufficient, as companies now face increasing pressure to ensure regulatory compliance, ethical sourcing, and environmental responsibility. This has led to the adoption of structured, multi-criteria decision-making (MCDM) techniques such as the Datum, Dodgson, Plurality, Weighting, Analytic Hierarchy Process (AHP), and Cost Ratio methods.

The aim of this study is to provide a comprehensive comparison of these supplier selection methods and to explore how their applicability varies across different industrial contexts. By examining both general and sector-specific evaluation criteria, the paper contributes to a deeper understanding of how companies can align supplier assessment practices with strategic, operational, and sustainability objectives in modern logistics systems.

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As illustrated in Fig. 1, research on supplier selection and evaluation has been conducted continuously and with increasing intensity over the past two decades.

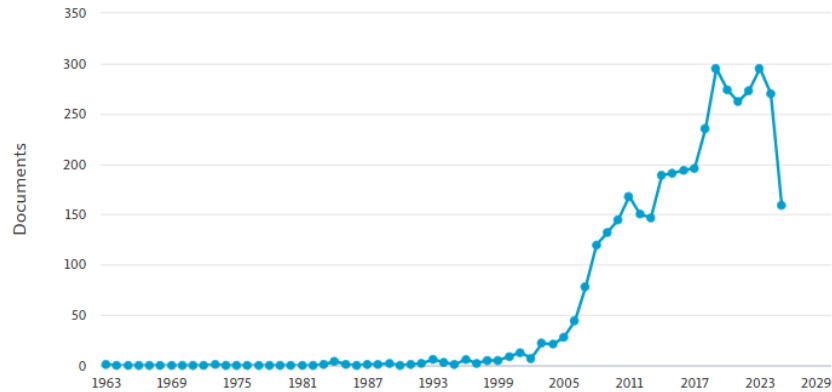


Figure 1. Documents by year in the field of supplier selection (Source: Scopus)

As Fig. 2 depicts, most of the articles were published in journals with production-related topics, but a significant number of the papers were accepted for publication in journals focusing on the application of expert systems, and sustainability.

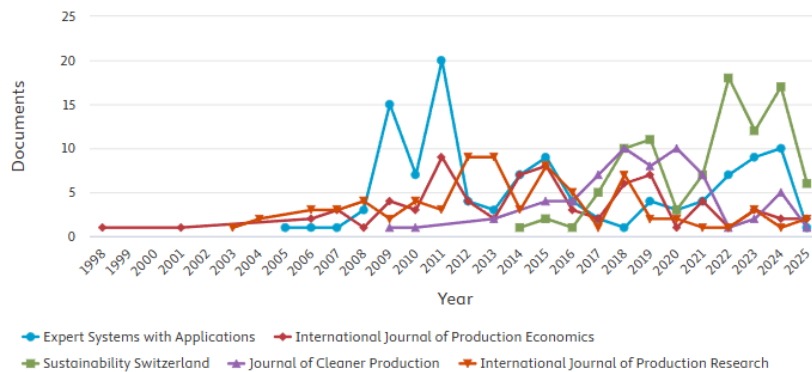


Figure 2. Documents by year per source in the field of supplier selection (Source: Scopus)

The studies on supplier selection can be categorized according to their research areas. Fig. 3 presents the distribution of the 2016 articles across ten subject areas. The classification indicates that most of the publications fall within engineering and computer science, while the presence of environmental science and energy reflects the growing emphasis on sustainability in supplier selection.

The evaluation and selection of suppliers is one of the key issues in corporate supply chain management, as it has a significant impact on cost efficiency, quality, flexibility, and sustainability. Over the past two decades, research in this field has expanded considerably - from classical, deterministic decision-support models to intelligent, data-driven approaches supporting sustainable and green supply chains. The following review is based on the

abstracts of the referenced studies and summarizes the main research directions, methodological trends, and thematic developments.

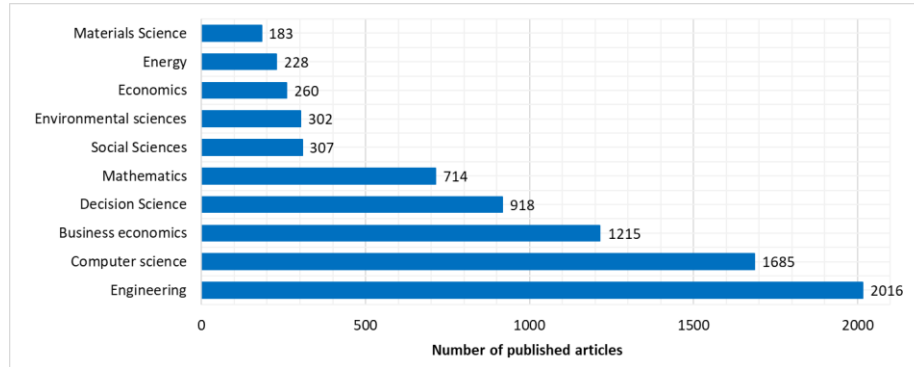


Figure 3. Documents by year per source in the field of supplier selection (Source: Scopus)

In the early 2000s, research on supplier evaluation mainly focused on the application of multi-criteria decision-making (MADM, MCDM) methods. Examples include the TOPSIS-based model [1] and the combination of fuzzy analytic hierarchy process (FAHP) and grey relational analysis (GRA) [2]. These methods relied on deterministic and expert-based evaluation and aimed to establish an objective ranking among suppliers.

The main advantages of classical models are their transparent structure and ease of application; however, their major limitations lie in their inability to handle subjectivity and incomplete information. Consequently, researchers have increasingly turned toward methods capable of managing uncertainty.

Since the early 2010s, approaches capable of handling data vagueness and incompleteness have become more prominent in supplier evaluation models. The application of fuzzy logic [3-5] and rough set theory [6, 7] made it possible to weight evaluation criteria and reduce redundant information in environments where data are imprecise or non-quantifiable.

These models were often combined with other techniques, such as the analytic network process (ANP) or unascertained measure methods, allowing a multidimensional assessment of complex decision-making processes. The purpose of such hybrid models is to objectify subjective expert judgments and make the decision-making process more robust.

Among the most recent trends is the incorporation of machine learning and artificial intelligence into supplier evaluation. For instance, Zhao et al. [8] applied a support vector machine (SVM) to determine the weights of evaluating experts based on historical assessment data. Such models are capable of learning and correcting the reliability of human judgments, thereby contributing to more objective and adaptive evaluation systems.

This direction aligns well with the general corporate trend of data-driven decision support, where the analysis of historical and real-time data facilitates optimal supplier decision-making.

Several studies [9, 10] have examined the risk and psychological aspects of supplier decision-making. The integration of regret theory and prospect theory has enabled the modelling of decision-makers' irrational behaviour, which is particularly relevant in situations involving crises or supplier risks. These new directions aim to make models better

reflect the complexity of human decision-making and to reduce errors stemming from risk sensitivity.

From the mid-2010s onwards, a distinct sustainability-oriented research stream has emerged, integrating environmental, economic, and social dimensions into supplier evaluation [11-13]. Green supplier selection has become a key area in terms of corporate social responsibility and the circular economy.

Such studies often employ fuzzy MCDM models to measure the “triple bottom line” (economic, environmental, and social dimensions) and increasingly move toward complex information fusion techniques, such as intuitionistic fuzzy sets or BPA-based models.

The most recent research [14-16] focuses on the development of integrated hybrid models, which combine multiple methods (AHP, TOPSIS, DEA, PROMETHEE, ANP, etc.) to achieve comprehensive and industry-specific evaluations.

Application domains have become highly diverse: energy, apparel, education, cloud services, and papermaking each require different sets of criteria and weighting logics.

Overall, research on supplier evaluation has shifted from quantitative decision-theoretic approaches toward dynamic, uncertainty-handling, and sustainability-integrated frameworks. Future studies are expected to concentrate on the development of data-driven, AI-based, and real-time decision-support systems capable of managing the rapidly changing environment of global supply chains.

2. SUPPLIER SELECTION CRITERIA

The effectiveness of supplier selection largely depends on identifying and prioritizing the right evaluation criteria. This chapter provides an overview of the key factors that influence supplier performance and decision-making in logistics systems. It first introduces a set of general criteria that are widely applicable across industries, including financial, quality, delivery, compliance, sustainability, and relationship aspects. Then, it explores how these criteria are adapted to specific industrial contexts such as automotive, food, pharmaceutical, electronics, construction, and textile manufacturing. By comparing general and sector-specific perspectives, this chapter highlights the need for a balanced, multi-dimensional approach to supplier evaluation that aligns with both operational requirements and long-term strategic goals.

2.1. General criteria

Selecting the most suitable supplier requires a comprehensive evaluation of multiple dimensions that influence cost efficiency, product quality, and long-term collaboration potential. While specific criteria may vary across industries, several fundamental aspects consistently form the foundation of supplier evaluation. These general criteria reflect the financial strength, operational performance, reliability, and ethical standards of potential partners, ensuring alignment with the buyer’s strategic and sustainability objectives.

2.1.1. Financial criteria. Financial aspects are among the most decisive factors in supplier evaluation. They include price competitiveness, cost stability, and the supplier’s overall financial health and investment capability. A financially stable supplier can ensure consistent production, absorb market fluctuations, and support long-term partnerships. Beyond the

initial purchase price, companies increasingly consider the total cost of ownership, including transportation, administrative, and quality-related costs.

2.1.2. Quality and performance. Quality remains a core determinant of supplier performance. It encompasses the reliability, consistency, and technical specifications of products or services delivered. Innovation capability is also an important dimension, as suppliers who invest in R&D can contribute to product improvement and technological advancement. Quality assurance certifications (e.g., ISO 9001) often serve as a prerequisite for qualification.

2.1.3. Delivery and logistics. Efficient and reliable delivery processes are essential for maintaining smooth logistics operations. Key factors include lead time, punctuality, flexibility in response to changing demand, and geographic proximity. Suppliers with strong logistics capabilities, such as Just-in-Time (JIT) delivery systems or advanced warehousing, enhance supply chain resilience and minimize disruptions.

2.1.4. Compliance and risk. Compliance with legal, regulatory, and industry standards is critical, especially in sectors with strict quality or safety requirements. Risk management practices, such as business continuity planning and supplier audits, help mitigate supply chain vulnerabilities. Increasingly, companies expect suppliers to maintain transparent documentation and robust traceability systems.

2.1.5. General sustainability and ethics. Sustainability considerations have gained prominence in supplier selection. Environmental performance, waste reduction, energy efficiency, and ethical labour practices are now evaluated alongside traditional cost and quality factors. Suppliers demonstrating corporate social responsibility (CSR) and compliance with ESG (Environmental, Social, and Governance) standards contribute positively to a buyer's reputation and long-term strategy.

2.1.6. General relationship and communication. Effective communication and collaboration are vital for successful supplier relationships. Criteria in this category include responsiveness, openness, and the ability to engage in joint problem-solving and innovation. A supplier's reputation, references, and service quality also influence the overall assessment. Strong relationship management fosters trust and long-term value creation within the supply chain.

2.2. Industry-specific adaptations

2.2.1. Automotive industry supplier selection. The automotive industry represents one of the most demanding environments for supplier selection, characterized by strict quality standards, cost pressure, and the need for global coordination across complex supply chains. In this sector, suppliers are not only evaluated for their price competitiveness but also for their ability to meet continuous improvement expectations, technological innovation, and zero-defect quality goals. Automotive industry-specific supplier selection standards and requirements are summarized in Fig. 4. Automotive supplier assessment is therefore based on a mix of financial, technical, and operational excellence criteria. Financial strength and

long-term cost competitiveness are essential, as suppliers are often required to commit to multi-year contracts.

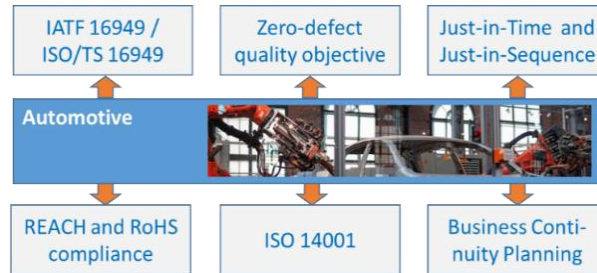


Figure 4. Automotive industry-specific supplier selection standards and requirements
(Source: own edition)

From a quality perspective, compliance with international standards such as IATF 16949 (formerly ISO/TS 16949) is a prerequisite, reflecting adherence to rigorous quality management systems [17,18]. The pursuit of zero-defect manufacturing and full traceability of components is critical, ensuring reliability and safety throughout the vehicle lifecycle [19].

Delivery and logistics play a decisive role in automotive operations, where Just-in-Time (JIT) and Just-in-Sequence (JIS) delivery capabilities are essential to minimize inventory and maintain production continuity [20]. Suppliers must demonstrate robust packaging systems, efficient returnable logistics, and global coordination across multiple production sites.

Risk and compliance management is another vital dimension, involving safety regulations (e.g., REACH, RoHS) and business continuity planning to mitigate potential supply disruptions [21, 22]. Increasingly, sustainability and ethics have become integral to supplier evaluation, with a strong focus on environmental management (ISO 14001) [23], carbon reduction, and corporate social responsibility (CSR).

Finally, relationship and communication criteria emphasize technical collaboration, co-development capability, and transparency in supply chain communication. The most successful automotive suppliers are those capable of acting as innovation partners—integrating closely with OEMs (Original Equipment Manufacturers) and contributing to design, engineering, and process optimization.

2.2.2. Food industry supplier selection. Supplier selection in the food industry is shaped by the sector’s stringent safety, hygiene, and regulatory demands. Unlike many other industries, where cost or technological innovation may dominate, food suppliers are primarily evaluated based on their ability to guarantee product safety, traceability, and compliance with food quality standards throughout the entire supply chain [24]. Food industry-specific supplier selection standards and requirements are summarized in Fig. 5.

Financial criteria remain relevant, particularly in terms of maintaining competitive pricing while ensuring a stable cost structure that supports long-term partnerships. However, financial efficiency must never compromise food safety or quality performance.

Quality and performance criteria are central to supplier evaluation in this sector. Compliance with HACCP (Hazard Analysis and Critical Control Points) [25], ISO 22000 [26], or BRC (British Retail Consortium) [27] standards is often mandatory, serving as proof of a supplier’s commitment to food safety management. Consistency, freshness, and hygiene

practices are monitored closely, as even minor deviations can result in serious reputational and legal consequences.



Figure 5. Food industry-specific supplier selection standards and requirements
(Source: own edition)

From a logistics perspective, food industry suppliers must ensure temperature-controlled transportation and storage (cold chain management) to maintain product integrity. The ability to provide short lead times and flexible replenishment systems is critical to managing perishable inventories efficiently and reducing waste.

Compliance and risk management are equally vital, encompassing full traceability from raw material to final product and adherence to food labelling and safety regulations. Suppliers are increasingly expected to demonstrate transparency in ingredient sourcing and to respond promptly to audits and corrective actions.

Sustainability and ethical considerations are becoming more influential, reflecting consumer and corporate demands for sustainable sourcing practices, eco-friendly packaging, and waste reduction initiatives. Certifications such as Fair Trade or organic labelling further enhance supplier credibility [28].

Finally, the relationship and communication dimension in the food sector places strong emphasis on transparency, responsiveness, and trust. Continuous dialogue between manufacturers, suppliers, and auditors ensures compliance and supports rapid problem resolution, factors that are essential for maintaining consumer confidence and supply chain integrity.

2.2.3. Pharmaceutical industry supplier selection. The pharmaceutical industry operates within one of the most strictly regulated environments, where supplier selection directly affects product safety, efficacy, and patient health. Consequently, suppliers are assessed not only for cost efficiency or delivery performance but primarily for their compliance with global quality and regulatory standards and their ability to maintain data integrity and process transparency [29-32]. Pharmaceutical industry-specific supplier selection standards and requirements are summarised in Fig. 6.

Financial criteria play a supportive but significant role. Suppliers must demonstrate cost-effectiveness under stringent quality conditions, as well as investment capability in specialized equipment, documentation systems, and validation processes. However, low-cost sourcing is secondary to maintaining the integrity of the pharmaceutical product and ensuring uninterrupted supply of critical materials.

Quality and performance criteria are at the core of supplier evaluation. Certification under Good Manufacturing Practice (GMP) is mandatory [33], as are ISO 13485 [34] (for medical

devices) and other relevant quality standards. Suppliers are expected to provide complete validation and qualification documentation, as well as traceability and batch records for all raw materials and components. The accuracy and reliability of documentation are key determinants of supplier approval.

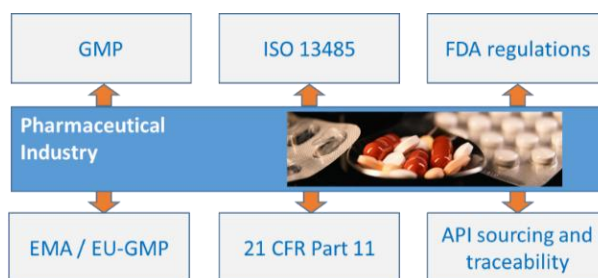


Figure 6. Pharmaceutical industry-specific supplier selection standards and requirements (Source: own edition)

In terms of delivery and logistics, pharmaceutical supply chains require secure, temperature-controlled transportation and validated storage conditions to maintain the quality of active ingredients and finished products. Delivery reliability is particularly crucial for critical and time-sensitive materials, where supply interruptions could halt production or compromise patient safety.

Compliance and risk management dominate this industry's supplier evaluation framework. Suppliers must adhere to FDA (U.S. Food and Drug Administration), EMA (European Medicines Agency), and regional regulations, ensuring readiness for audits and inspections at any time. Data integrity, electronic record security, and change control management are central components of risk assessment.

Sustainability and ethical sourcing have also gained relevance, particularly concerning the responsible procurement of active pharmaceutical ingredients (APIs) and the environmental impact of chemical manufacturing. Suppliers are increasingly evaluated on their ability to reduce emissions, manage waste responsibly, and maintain ethical labour practices within their supply chains.

Finally, relationship and communication criteria emphasize technical support, responsiveness during audits, and collaborative problem-solving. Successful pharmaceutical partnerships rely on open communication, trust, and long-term cooperation to ensure regulatory compliance, continuous improvement, and consistent product quality.

2.2.4. Electronics industry supplier selection. The electronics industry presents a highly dynamic and technology-intensive environment, where supplier selection is driven by innovation, product reliability, and rapid adaptation to changing market and technological demands. Due to short product life cycles, globalized production networks, and strict environmental regulations, suppliers in this sector must demonstrate exceptional technical capability, quality assurance, and compliance performance [35, 36]. Electronics industry-specific supplier selection standards and requirements are shown in Fig. 7.

From a financial perspective, cost-performance balance is more critical than low pricing alone. Electronics manufacturers prioritize suppliers who can invest in automation, advanced manufacturing technologies, and process optimization, ensuring efficiency and consistency

in high-volume production. Financial stability is also vital for supporting joint R&D activities and long-term technological partnerships.

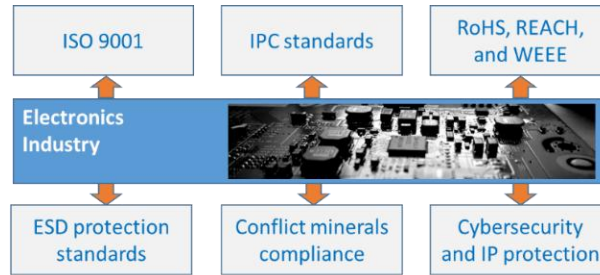


Figure 7. Electronics industry-specific supplier selection standards and requirements (Source: own edition)

Quality and performance are fundamental selection factors. Compliance with ISO 9001 and IPC standards ensures adherence to rigorous design, assembly, and testing requirements. Reliability testing, lifespan evaluation, and ESD (Electrostatic Discharge) protection are essential components of quality management, given the sensitivity of electronic components. Suppliers are also expected to provide traceability data, ensuring accountability throughout complex supply chains.

Delivery and logistics considerations centre on on-time delivery for complex Bills of Materials (BOMs) and the supplier's ability to manage component obsolescence and global sourcing challenges. Electronics supply chains rely on precise coordination to maintain production flow, making flexibility and risk mitigation essential competencies.

Compliance and risk criteria are particularly strict due to the industry's exposure to environmental and data protection regulations. Suppliers must comply with RoHS (Restriction of Hazardous Substances), REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) [21, 22], and WEEE (Waste Electrical and Electronic Equipment) directives. Additionally, intellectual property (IP) protection and cybersecurity have become critical, especially when suppliers handle sensitive design or firmware data.

2.2.5. Construction industry supplier selection. The construction industry operates in a project-oriented and highly variable environment, where supplier selection decisions have direct implications for cost control, project timelines, and overall build quality. Unlike manufacturing sectors characterized by repetitive production, construction projects require flexibility, reliability, and compliance with safety and sustainability standards across diverse contexts and locations [37-39]. Construction industry-specific supplier selection standards and requirements are shown in Fig. 8.

Financial criteria are a central aspect of supplier evaluation. Contractors and developers prioritize competitive pricing combined with long-term financial stability, as projects often involve extended payment schedules and high upfront material costs. Suppliers must demonstrate sufficient financial capacity to manage large orders, delayed payments, and fluctuating raw material prices without compromising delivery performance.

Quality and performance considerations are equally critical. Suppliers are expected to comply with building codes, technical material standards, and durability requirements, ensuring structural integrity and performance over the building's lifespan. Proven quality

records and certification of materials (e.g., ISO standards or national equivalents) serve as key indicators of reliability.



Figure 8. Construction industry-specific supplier selection standards and requirements
(Source: own edition)

Delivery and logistics criteria focus on on-site delivery reliability and adaptability to dynamic project schedules. The ability to coordinate deliveries with construction phases and avoid delays is essential for maintaining workflow continuity. Suppliers who can provide just-in-time deliveries, local warehousing, and flexible transport solutions are especially valued in large-scale construction projects.

Compliance and risk criteria hold particular importance due to the industry's exposure to safety and liability concerns. Adherence to OSHA (Occupational Safety and Health Administration) [40] or equivalent safety standards, proper insurance coverage, and liability management are fundamental prerequisites. Suppliers are also evaluated based on their risk mitigation strategies, including contingency planning for supply disruptions or regulatory changes.

Sustainability and ethics are increasingly embedded in construction supplier assessment. Growing attention to environmental impact has led to the adoption of eco-certified materials, such as FSC-certified wood and LEED-compliant building components. Suppliers that demonstrate effective waste management, recycling practices, and a commitment to sustainable sourcing gain a competitive advantage in green construction projects.

Finally, relationship and communication criteria are essential in managing the complex network of contractors, subcontractors, and material providers typical of construction projects. Effective project management coordination, responsiveness to design changes, and technical support contribute to successful collaboration and overall project performance. In this industry, the most reliable suppliers act not only as material providers but as integrated project partners, contributing to innovation, safety, and sustainability outcomes.

2.2.6. Textile and fashion industry supplier selection. The textile and fashion industry presents a unique supplier selection landscape, shaped by seasonal demand cycles, globalized sourcing, and increasing ethical scrutiny. In this sector, supplier relationships must balance cost competitiveness, quality consistency, and flexibility, while also addressing environmental and social sustainability challenges inherent to fast fashion and global production networks [41, 42]. Textile and fashion industry-specific supplier selection standards and requirements are shown in Fig. 9.

Financial criteria are central to supplier evaluation, as price competitiveness and transparent cost structures significantly influence profitability and pricing strategy. Buyers

often seek suppliers who offer cost transparency in materials and labour, as well as favourable payment terms that align with the fashion industry's cash flow cycles. However, excessive cost-cutting is discouraged when it risks undermining product quality or ethical compliance.



Figure 9. Textile and fashion industry-specific supplier selection standards and requirements (Source: own edition)

Quality and performance criteria are defined by fabric quality, colour consistency, durability, and the supplier's ability to deliver accurate samples and reliable production outputs. Since product appearance and texture are directly linked to brand reputation, maintaining high-quality standards across batches is essential. Suppliers are also expected to adapt quickly to design modifications and short production timelines typical of fast fashion.

Delivery and logistics considerations revolve around lead time management and global sourcing flexibility. Suppliers must demonstrate the capability to meet tight seasonal deadlines and coordinate deliveries across multiple geographic markets. Efficient logistics networks and digital tracking systems support agility, enabling rapid responses to fluctuating market trends and consumer preferences.

Compliance and risk criteria have gained prominence as the fashion industry faces growing pressure to ensure labour rights, chemical safety, and social accountability throughout the supply chain. Compliance with certifications such as OEKO-TEX, which ensures textiles are free from harmful substances, and SA8000 [43] or Fair Wear, which verify ethical labour conditions, are increasingly viewed as non-negotiable prerequisites for supplier approval.

Sustainability and ethics represent a major differentiator among suppliers. Brands now prioritize partners who use sustainable fabrics, eco-friendly dyes, and low-impact production techniques. Initiatives to reduce water consumption, minimize waste, and promote circular economy practices are integral to supplier evaluation. Transparent sustainability reporting and third-party certifications further enhance supplier credibility and brand alignment.

Relationship and communication criteria are equally important in a fast-moving, design-driven industry. Successful collaboration requires open communication across time zones, responsiveness to design feedback, and the ability to support co-creation and innovation. Long-term partnerships are built on trust, transparency, and mutual commitment to responsible sourcing and creative excellence.

2.2.7. Healthcare and medical devices industry supplier selection. Supplier selection in the healthcare and medical devices industry is guided by the overarching priority of patient safety and regulatory compliance. The sector is characterized by strict legal requirements, traceability obligations, and the necessity of maintaining consistent product quality under

highly controlled conditions. Consequently, suppliers are assessed through a rigorous, multidimensional evaluation process that combines financial, technical, ethical, and regulatory considerations [44]. Healthcare/medical devices industry-specific supplier selection standards and requirements are summarised in Fig. 10.

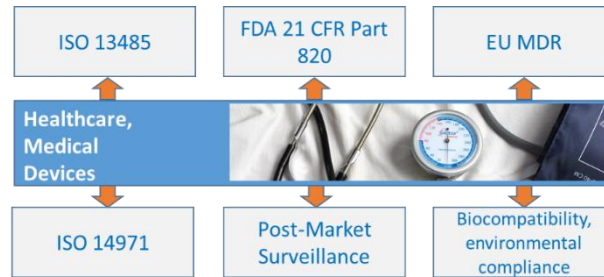


Figure 10. Healthcare/medical devices industry-specific supplier selection standards and requirements (Source: own edition)

From a financial standpoint, suppliers must demonstrate cost-effectiveness within stringent quality and safety parameters. Competitive pricing is important, but cost decisions are heavily influenced by risk management, long-term reliability, and the supplier's ability to invest in quality assurance systems and regulatory documentation. The financial stability of suppliers is essential to ensure continuity of supply for life-critical products.

Quality and performance criteria are central to the selection process. Suppliers are typically required to hold ISO 13485 certification [45], which specifies a quality management system for medical devices. Additional expectations include proven product reliability, clinical validation, and sterility assurance. Consistency and reproducibility are critical, as even minor deviations may have significant consequences for patient outcomes. Comprehensive testing, validation, and documentation are therefore non-negotiable elements of supplier evaluation.

Delivery and logistics considerations focus on controlled environment packaging, validated transportation, and consistent supply chains. Healthcare suppliers must be capable of maintaining sterile and temperature-controlled conditions throughout the logistics process. Reliability and precision in delivery scheduling are vital to avoid shortages of essential medical components or devices.

Compliance and risk management represent the most stringent evaluation dimension. Suppliers must comply with FDA (Food and Drug Administration) [46] and EU MDR (Medical Device Regulation) [47] requirements, along with relevant ISO standards. They are also expected to have robust post-market surveillance, traceability, and audit readiness systems. Risk-based thinking is embedded into every stage of supplier evaluation, from design to delivery.

Sustainability and ethics are becoming increasingly relevant in this sector, driven by public and regulatory expectations for responsible sourcing, biocompatible materials, and reduction of single-use plastics. Suppliers who adopt environmentally responsible practices, such as waste reduction or recycling of medical packaging, align more closely with healthcare institutions' sustainability objectives.

Finally, relationship and communication criteria emphasize transparency, responsiveness during audits, and technical support. Effective collaboration and continuous information exchange are crucial, particularly during product recalls, regulatory reviews, or design modifications. Suppliers who can provide comprehensive training, documentation support, and real-time communication contribute significantly to overall product safety and compliance integrity.

2.3. Prioritization and trade-offs among criteria

In supplier selection, decision-makers must often navigate complex trade-offs between competing objectives. Financial performance, quality assurance, delivery reliability, compliance, and sustainability are all essential criteria, but their relative importance varies depending on corporate strategy, industry requirements, and market conditions. The ability to prioritize and balance these factors is therefore central to an effective and transparent supplier evaluation process.

Typically, organizations assign weights or priority levels to each criterion to reflect its strategic relevance. For example, manufacturing sectors driven by lean production may prioritize delivery precision and flexibility, whereas regulated industries such as pharmaceuticals or healthcare place stronger emphasis on compliance, documentation integrity, and quality control. In contrast, consumer-facing sectors like food or fashion often balance cost efficiency with sustainability and ethical sourcing to protect brand reputation and meet stakeholder expectations.

Trade-offs arise when improvements in one dimension necessitate compromises in another. For instance, achieving the lowest possible price may negatively affect product quality or ethical standards, while prioritizing sustainability could increase production costs or lead times. Decision-makers must therefore adopt multi-criteria decision-making (MCDM) approaches that enable transparent and rational balancing of these conflicting objectives.

The use of structured evaluation models, such as weighting methods or the Analytic Hierarchy Process (AHP), allows organizations to quantify preferences and integrate both tangible (e.g., cost, delivery time) and intangible (e.g., reputation, innovation capability) factors into a single decision framework. This quantitative prioritization supports consistent and auditable decision-making while aligning supplier choices with broader business goals, such as resilience, innovation, and sustainability.

Ultimately, effective prioritization in supplier selection requires more than numerical analysis, it demands strategic judgment. The optimal supplier is not simply the cheapest or fastest, but the one whose overall performance and values align most closely with the buyer's long-term operational, financial, and ethical objectives.

3. SUPPLIER SELECTION METHODS

This chapter presents and compares the main analytical and multi-criteria decision-making methods applied in supplier evaluation. Each subsection introduces a specific technique, outlining its theoretical background, calculation process, and practical application in supplier assessment. The methods discussed include both traditional approaches - such as the Datum, Dodgson, and Plurality methods - and more advanced quantitative techniques, including the Weighting method, Analytic Hierarchy Process (AHP), and Cost Ratio method. By

examining their advantages, limitations, and areas of applicability, the chapter provides a comprehensive understanding of how different methodological frameworks can support rational, transparent, and strategically aligned supplier selection decisions.

3.1. Datum method

The Datum method can be used as a supplier evaluation technique that uses pairwise comparisons against a reference supplier, called the datum. Each supplier is compared with this reference according to several predefined criteria. If a supplier performs better than the datum, it receives a score of +1; if worse, -1; and if equal, 0. The total score for each supplier is then summed, and the suppliers are ranked based on these totals. This method is simple and useful for obtaining a quick comparative ranking of supplier alternatives. Table I. demonstrates the application of the Datum method to evaluate five suppliers. The results in Table I indicate that Supplier C achieved the highest total score (+4 points), followed by Supplier B (+3) and Supplier A (+2). Supplier E reached a neutral result (0), while Supplier D had the weakest performance (-4 points). This ranking (C → B → A → E → D) suggests that Supplier C performs consistently better than the reference across most evaluation criteria, particularly in financial, quality, and compliance aspects. The differences also show that negative scores on delivery and sustainability criteria have a tangible effect on overall positioning.

Table I.
Application of Datum method to evaluate five suppliers (Source: own edition)

Criterion	Supplier					Reference
	A	B	C	D	E	
Financial	1	1	1	-1	1	X
Quality and performance	1	1	1	-1	1	X
Delivery and logistics	-1	-1	-1	-1	1	X
Compliance and risk criteria	1	1	1	1	-1	X
Sustainability and ethics criteria	-1	1	1	-1	-1	X
Relationship and communication	1	1	1	-1	-1	X
SUM	2	3	4	-4	0	X
RANK	3	2	1	5	4	X

3.2. Dodgson method

The Dodgson method can be used as a supplier selection technique based on pairwise comparisons between all supplier alternatives. For each criterion, suppliers are compared two at a time, and a score of +1 is given if one supplier performs better, 0 if they are equal, and -1 if worse. The Dodgson index is then calculated to show how many additional pairwise wins a supplier would need to become the best. The supplier with the lowest Dodgson index is considered the optimal choice, since it requires the fewest improvements to outperform all competitors. This method provides a detailed and logical ranking of suppliers. Table II. demonstrates the application of Dodgson method to evaluate six suppliers based on financial criterion, while Table III. shows the application of Dodgson method to evaluate five suppliers based on quality and performance criterion. The pairwise comparison results in Table II show that Supplier D, with an (n-1)-SUM value of 1, outperforms all other suppliers under the

financial criterion. Suppliers A (3) and B (4) follow as close alternatives, while C and E record significantly higher values (6 each), indicating weaker financial performance. Similarly, in Table III (quality and performance criterion), Supplier D again attains the most favourable result with $(n-1)\text{-SUM} = 0$, followed by E (3), C (2), A (5), and B (6). The two examples together confirm that Supplier D maintains a robust balance between financial efficiency and product quality, positioning it as the most competitive alternative overall.

Table II.

Application of Dodgson method to evaluate five suppliers based on financial criterion
(Source: own edition)

Financial criterion	Supplier				
	A	B	C	D	E
Supplier A	-	1	-1	0	-1
Supplier B	1	-	1	1	-1
Supplier C	-1	-1	-	1	1
Supplier D	0	-1	-1	-	-1
Supplier E	1	1	-1	1	-
SUM	1	0	-2	3	-2
(n-1)-SUM	3	4	6	1	6

Table III.

Application of Dodgson method to evaluate five suppliers based on quality and performance criterion (Source: own edition)

Quality and performance criterion	Supplier				
	A	B	C	D	E
Supplier A	-	0	1	1	-1
Supplier B	0	-	1	1	0
Supplier C	-1	-1	-	-1	1
Supplier D	-1	-1	1	-	1
Supplier E	1	0	-1	-1	-
SUM	-1	-2	2	0	1
(n-1)-SUM	5	6	2	0	3

3.3. Plurality method

The Plurality method can be used as a supplier selection technique where each evaluation criterion is scored by the members of an evaluation team. Every team member distributes a fixed number of points among the supplier alternatives. The supplier receiving the highest total number of points is considered the best option. This method is simple, fast, and democratic, as it reflects the collective preference of the decision-makers. However, it may not always capture small performance differences between suppliers. Table IV. demonstrates the application of Plurality method to evaluate six suppliers. According to Table IV, the total point distribution across six suppliers shows Supplier E in first place with 15 points, followed by Supplier C (12), Supplier A (11), Supplier D (8), and Suppliers B and F tied at 7 points. The ranking ($E \rightarrow C \rightarrow A \rightarrow D \rightarrow B/F$) highlights Supplier E's strong collective preference among evaluators, mainly due to its leading scores in sustainability and communication criteria. However, the relatively small gap between the top three suppliers indicates that the

group's preferences are moderately dispersed, reflecting a balanced perception of supplier performance.

Table IV.
Application of Plurality method to evaluate six suppliers (Source: own edition)

Criterion	Supplier					
	A	B	C	D	E	F
Financial	1	2	3	4	0	0
Quality and performance	0	0	1	2	3	4
Delivery and logistics	2	2	2	0	2	2
Compliance and risk criteria	5	0	0	2	3	0
Sustainability and ethics criteria	0	3	4	0	3	0
Relationship and communication	3	0	2	0	4	1
SUM	11	7	12	8	15	7
RANK	3	5	2	4	1	5

3.4. Weighting method

The Weighting method can be used as a supplier evaluation technique in which each selection criterion is assigned a specific weight based on its importance. All weights add up to 1 (or 100%). Each supplier is then rated on a numerical scale (for example, 1 to 5) for every criterion. The rating is multiplied by the criterion's weight, and the results are summed to obtain a total weighted score for each supplier. The supplier with the highest total score is considered the best choice. This method is widely used because it is clear, flexible, and easy to apply. Table V. and Table VI. demonstrates the application of Weighting method to evaluate five suppliers. The weighted results summarized in Table VI show that Supplier D achieved the highest total weighted score (3.45), followed by Supplier B (3.35), Supplier C (3.15), Supplier E (2.75), and Supplier A (2.45). The ranking (D → B → C → E → A) reveals that Supplier D performs strongly across almost all criteria, particularly in delivery, sustainability, and communication factors, while maintaining stable financial results. The narrow score difference between D and B (only 0.10 points) indicates that the outcome is sensitive to the weighting structure, underscoring the importance of accurately reflecting decision-makers' strategic priorities during evaluation.

Table V.
Weighting factor and the rating of criterion in the case of the evaluation of five suppliers using the Weighting method (Source: own edition).

Criterion	Weight	Criteria's rating value				
		A	B	C	D	E
Financial	0.30	1	4	3	3	4
Quality and performance	0.20	3	5	4	4	3
Delivery and logistics	0.15	5	4	5	5	2
Compliance and risk criteria	0.15	2	1	2	2	1
Sustainability and ethics criteria	0.10	4	2	3	4	4
Relationship and communication	0.10	1	2	1	3	1

Table VI.
Weighted rating value of criterion in the case of the evaluation of five suppliers using the Weighting method (Source: own edition).

Criterion	Weight	Weighted criteria's rating value				
		A	B	C	D	E
Financial	0.30	0.30	1.20	0.90	0.90	1.20
Quality and performance	0.20	0.60	1.00	0.80	0.80	0.60
Delivery and logistics	0.15	0.75	0.60	0.75	0.75	0.30
Compliance and risk criteria	0.15	0.30	0.15	0.30	0.30	0.15
Sustainability and ethics criteria	0.10	0.40	0.20	0.30	0.40	0.40
Relationship and communication	0.10	0.10	0.20	0.10	0.30	0.10
SUM		2.45	3.35	3.15	3.45	2.75

3.5. Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) is a multi-criteria decision-making method developed by Thomas Saaty (1980). It breaks down a complex decision, such as supplier selection, into a hierarchical structure with several levels: the goal at the top, followed by criteria, sub-criteria, and the supplier alternatives at the bottom. Decision-makers perform pairwise comparisons between criteria and between suppliers using a 1-9 scale to express their relative importance. From these comparisons, priority weights are calculated for each criterion and alternative. A consistency check (using the Consistency Ratio, CR) ensures that the judgments are logically consistent. Finally, the priorities are aggregated to identify the optimal supplier, the one with the highest overall score. AHP is valued for being systematic, transparent, and mathematically rigorous.

3.6. Cost ratio method

The Cost Ratio Method is a supplier evaluation approach that goes beyond comparing only the quoted prices. It takes into account the internal organizational costs related to quality, delivery, and service performance. In this method, each of these factors is first quantified and converted into a cost ratio, expressed as a percentage of the purchase value. These ratios are then summed to obtain the overall cost ratio, which is applied to the supplier's quoted price to determine the net adjusted cost. This adjusted cost represents the true cost of purchasing from a supplier, considering all hidden costs associated with managing quality issues, delivery delays, or service problems. Although this method provides a more accurate and realistic evaluation of suppliers, it is relatively complex and usually requires a computerized cost accounting system to be effectively implemented.

To demonstrate the Cost Ratio Method, assume that a company evaluates three suppliers (A, B, and C) for a material purchase valued at USD 100,000. The internal organizational costs related to quality, delivery, and service performance are identified and converted into cost ratios (expressed as a percentage of the purchase value). The adjusted cost is calculated as:

$$AC = QP \cdot (1 - TCR), \quad (1)$$

where AC is the adjusted cost, QP is the quoted price, and TCR is the total cost ratio.

Table VII.

Weighted rating value of criterion in the case of the evaluation of five suppliers using Weighting method (Source: own edition).

Supplier	A	B	C
Quality Cost Ratio	3%	1.5%	2%
Delivery Cost Ratio	2%	1%	1.5%
Service Cost Ratio	1%	0.5%	0.5%
Total Cost Ratio	6%	3%	4%
Quoted Price [USD]	100,000	103,000	101,000
Adjusted Cost [USD]	106,000	106,090	105,040

Applying this formula:

- Supplier A: $100,000 \times 1.06 = 106,000$ USD,
- Supplier B: $103,000 \times 1.03 = 106,090$ USD,
- Supplier C: $101,000 \times 1.04 = 105,040$ USD.

Thus, Supplier C achieves the lowest net adjusted cost (USD 105,040), even though its quoted price is not the lowest. This example shows that when hidden internal costs are considered, the supplier with the lowest initial price may not represent the most economical choice. The method therefore highlights the importance of integrating quality, delivery, and service-related costs into supplier evaluation. In this calculation, the quoted price represents the initial purchase price offered by the supplier in their quotation. It reflects the supplier's direct selling price for the product or service, without considering any additional internal costs that may arise on the buyer's side during the procurement process. The adjusted cost expresses the true total cost to the purchasing company. It is calculated by adding internal organizational costs to the supplier's quoted price. These additional elements are represented as cost ratios (percentages of the purchase value) and applied to the quoted price to obtain the adjusted cost.

3.7. Comparison of methods

Supplier evaluation can be carried out using various analytical methods, each differing in complexity, accuracy, and practical applicability. The Datum method is the simplest technique, comparing each supplier to a fixed reference supplier (the "datum"). It provides quick results but only gives a relative ranking without showing the magnitude of differences.

The Dodgson method also relies on pairwise comparisons but is more systematic, as it identifies how many improvements each supplier would need to become the best. This makes it slightly more analytical but also more time-consuming. The Plurality method is democratic and intuitive, as it summarizes the opinions of decision-makers through point allocation. However, it is less objective and can overlook small performance differences between suppliers. The Weighting method introduces objectivity by assigning numerical weights to criteria based on their importance. It allows decision-makers to quantify trade-offs between cost, quality, and delivery, making it one of the most widely used techniques in practice. The AHP method takes weighting a step further through structured pairwise comparisons and mathematical consistency checks. It provides the most accurate and transparent evaluation but requires significant data and expert input, making it suitable for strategic or high-value supplier decisions. Finally, the Cost Ratio method focuses on the real economic impact by

incorporating internal costs associated with quality, delivery, and service. It provides a realistic total cost of ownership but is the most complex and data-intensive approach, typically requiring computerized systems.

In summary, simpler methods like Datum, Dodgson, and Plurality are useful for quick or preliminary assessments, while Weighting, AHP, and Cost Ratio methods offer greater precision and reliability for strategic supplier selection decisions.

4. FUTURE TRENDS AND PRACTICAL INSIGHTS

The supplier selection process is undergoing a significant transformation due to digitalization, sustainability requirements, and global supply chain challenges. In the past, supplier evaluation primarily focused on cost, quality, and delivery performance; however, in modern logistics systems, strategic alignment, transparency, and resilience have become equally critical. This section summarizes the most relevant future trends and practical insights that are shaping supplier evaluation and decision-making including digitalization and data analytics, ESG and sustainability focus, risk management and resilience, collaboration and innovation.

The increasing use of digital technologies is revolutionizing how companies collect and analyse supplier information. Artificial Intelligence (AI), data dashboards, and predictive analytics support faster and more objective evaluations by processing large amounts of data in real time. Automated performance monitoring and integrated procurement systems enable continuous tracking of supplier reliability, quality deviations, and risk indicators. As a result, decision-makers can move from reactive to proactive supplier management.

Environmental, Social, and Governance (ESG) factors are now integral parts of supplier evaluation. Beyond traditional economic performance, organizations assess suppliers based on carbon footprint, ethical labour practices, and compliance with sustainability standards such as ISO 14001 or GRI reporting. Companies that integrate sustainability criteria into their selection processes not only improve brand reputation but also ensure long-term supply chain stability and compliance with stakeholder expectations.

The COVID-19 pandemic and recent geopolitical disruptions have highlighted the vulnerability of global supply networks. Consequently, risk management and supply chain resilience have become key evaluation dimensions. Buyers increasingly expect suppliers to provide evidence of business continuity planning, multi-sourcing strategies, and geographic diversification. A resilient supplier base helps mitigate the impact of disruptions and enhances overall supply chain reliability.

Modern supplier relationships are evolving from transactional interactions toward strategic partnerships. Joint research and development (R&D) projects, technology sharing, and co-innovation initiatives foster mutual growth and competitiveness. Effective communication and knowledge exchange are essential for continuous improvement, as suppliers are no longer merely vendors but innovation partners contributing to value creation.

Finally, supplier assessment is no longer a one-time activity performed during initial selection. Leading companies implement continuous performance monitoring through scorecards, periodic audits, and feedback loops. This ongoing evaluation supports early detection of issues, ensures compliance with evolving requirements, and strengthens long-term collaboration.

In summary, the future of supplier selection lies in the integration of digital intelligence, sustainability principles, and resilience-oriented management. Organizations that adapt to

these trends will gain a more transparent, ethical, and robust supplier network, an essential foundation for competitive advantage in modern logistics systems.

5. DISCUSSION

The comparative analysis presented in this study demonstrates that there is no universally optimal method for supplier selection; rather, the choice of method should reflect the complexity, data availability, and strategic importance of the decision context. Simpler approaches such as the Datum, Dodgson, or Plurality methods offer transparency and ease of application, making them suitable for preliminary or routine evaluations. In contrast, more advanced techniques like the Weighting method, AHP, and Cost Ratio approach provide higher analytical accuracy, enabling decision-makers to incorporate both quantitative and qualitative factors into a coherent framework.

The results also emphasize that the relevance of selection criteria varies significantly between industries. For instance, the automotive and pharmaceutical sectors prioritize quality assurance and regulatory compliance, whereas the food and textile industries place stronger emphasis on sustainability and ethical sourcing. These contextual differences underline the need for flexible decision models that can adapt to specific operational and strategic requirements.

Finally, the study reinforces the growing importance of digitalization and continuous supplier performance monitoring. As supply chains become more data-driven, integrating real-time analytics, sustainability metrics, and risk indicators into supplier evaluation will be essential. Future research should therefore focus on hybrid models that combine traditional MCDM approaches with AI-based decision support, offering a more dynamic and predictive framework for supplier selection in modern logistics systems.

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