



Key drivers of sustainable supply chain management in the automotive industry

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Abstract

The automotive industry, as one of the most prominent and impactful industrial sectors worldwide, plays a critical role in shaping economic development and societal lifestyles. Enhancing the sustainability of production and operational processes is therefore essential for improving overall supply chain performance. In recent years, sustainable supply chain management (SSCM) has attracted growing attention among Iranian automobile manufacturers. While prior studies have highlighted the importance of sustainability considerations in supplier selection, comprehensive investigations addressing the key determinants of SSCM across the Iranian automotive sector remain limited. Accordingly, this study aims to identify the most influential factors affecting sustainable supply chain management in Iranian automobile industries. A set of potential factors was first derived from the literature, after which expert opinions from 50 specialists were collected and analyzed using the fuzzy Delphi method. The findings indicate that quality, customer satisfaction, suppliers' green initiatives, top management vision, and supply chain configuration constitute the most critical drivers for achieving sustainability in the Iranian automotive supply chain.

Keywords: sustainable supply chain, automobile industry, fuzzy Delphi method

1. Introduction

The governments of the developed nations have started giving importance to environmental aspects, and as a result, organizations have started searching for operations that are environmentally, economically as well as socially sustainable. Sustainability in the meaning of services that build value and do not enact material depletion is paramount for these results. It is the management technique that focuses on access to cookies and their utilization in a green manner, working without polluting either water, soil or air, and being successfully viable for different communities, customers, and workers (Bahramimianrood, 2022; Bathaei et al., 2022).

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The automotive industry is one of the largest industries and plays a very important role in economy and social life and sadly has a very bad effect on the environment it uses a lot of material and fuel so the pollution and global warming. Consequently, motor manufacturers have incorporated sustainability initiatives within organizations to offset such impacts and enhance citizens' quality of life (Amaral et al., 2020). It has been noted that more and more international companies recently pay much attention to environmental concerns while managing their business activities and processes because of the pressure from the legislation, clients, and competitors. Now, the environmental practices have become inevitable that business organizations integrate these practices into their tactical operational plans to either achieve or sustain their competitive edge (Abdoli et al., 2023). This involves implementing environmental programs and having responsibility for the environment of the whole supply chain (Kazancoglu et al., 2021) as well as considering categorizing and measure their circularity using circularity indicators (Bahramimianrood et al., 2024). Thus, car production in Iran has expanded through cooperation with European firms and through the granting of licenses to overseas manufacturers. The effects of sanctions and currency crises have been very severe within establishments affecting overall production and functionality. Renault and Peugeot are examples of international firms that stopped operations because of the new sanctions from the United States; automobile delivery has been affected, and there is a scarcity of spare parts. These issues raise attention that there are still so many deficiencies and problems regarding the sustainable and efficient supply chain management of Iranian automobile companies.

2. Literature review and a conceptual model

Sustainable supply chain management involves managing a wide range of factors and specific, extensive performance targets, that must cover the whole value delivery network and the life cycle of the actual products. Supply Chain Management for Sustainability involves the application of lean management strategies to enhance an eco-efficient supply chain, which focuses on the continuous improvement to supplying goods with minimal waste, in response to the market needs while incorporating environmental, social and ethical concerns into the process (Bathaei, Awang, & Ahmadi, 2022; Kenaria & Bahramimianrood, 2021; Yuniarti & Arvitrida, 2025). These supply chain relationships are therefore made more responsive and stronger by these alliances. This information means that through the lean system, organizational efficiency can be maintained and other sustainability issues tackled as well (Singh et al., 2020). A study by Bathaei et al 2022 conducted with Iran Khodro Company and found out that production flexibility, strategic flexibility, and supply chain agility correlated with the company's performance. Supply chain agility was affected by strategic flexibility, while both the latter and production flexibility impacted firm performance with supply chain agility acting as a mediator. Later in the year 2019, by employing the fuzzy AHP methodology, Zaidi drew attention to supply chain plans for the Iranian automotive sector, with customer orientation,

appropriate social network leverage, coupled with the direct engagement policy that was founded on the development of customer trust. The investigation revealed that in the best-selling scenario, Iran Khodro's best-suggested strategy was a 'Defensive' posture that focused more on customers as opposed to rivalries. Considering these observations, it can be suggested that the Iranian automotive industry needs to adopt effective SC management concepts such as the more appropriate, adaptive, and customer-oriented approaches (Bathaei et al., 2021; Bathaei, Awang, & Ahmad, 2022; Streimikis et al., 2024).

A conceptual model of Sustainable Supply chain Management (SSM) (Ageron et al., 2012) introduced seven factors which are Reasons for SSCM, Performance criteria for SSCM, Greening supply chains, Characteristics of suppliers, Managerial approaches for SSCM, Barriers for SSCM, Benefits and motivation for SSCM. Tables 1 shows all of the sustainable supply chain factors based on three dimensions of sustainability: Economics, environment and society. Those are obtained from previous studies.

Table 1
Sustainable supply chain management factors

Group	Factor	Notation
Reasons for SSCM	Top management vision	A1
	Government regulatory requirements	A2
	Nature of business	A3
	Customer expectations	A4
	Competitor actions	A5
	Stakeholders such as NGOs	A6
	Suppliers' green initiatives	A7
Performance criteria employed for SSM	Quality	B1
	Price	B2
	Reliability	B3
	Service rate	B4
	Delivery	B5
	Flexibility	B6
	Certification	B7
	Associated services	B8
	Long term relationships	B9
	Geographic proximity	B10
	Environmental issues	B11
	Economic dependency	B12
	Personal relationships	B13
	Social responsibility	B14
Greening supply chain	Waste reduction	C1
	Savings from packaging	C2
	ISO 14 001 certification	C3

Table 1 continued

Group	Factor	Notation	
	Lean management	C4	
	Eco-design	C5	
	Production resources system	C6	
	Clean programs	C7	
	Product life cycle management	C8	
	Green transportation channels	C9	
	Reverse logistics	C10	
Characteristics of suppliers	Large scale companies	D1	
	Strategic suppliers	D2	
	Small and medium-sized enterprises	D3	
	Geographically near suppliers	D4	
	Non-strategic suppliers	D5	
Managerial approaches for SSCM	Active	E1	
	Collaborative	E2	
	Reactive	E3	
	Pro-active	E4	
	Individual	E5	
Barriers for SSM	Financial costs	E6	
	Green investments	E7	
	Return on investment	E8	
	Supplier's facilities	E9	
	Focal company's facilities	E10	
	Supply chain configuration	E11	
	Suppliers' firm size	E12	
	Supplier's location	E13	
	Product characteristics	E14	
	Green induced changes	E15	
	Focal firm's previous sustainability experiences	E16	
		Top management commitment	F1
		Suppliers' human skills	F2
		Supplier's top management commitment	F3
		Suppliers' firm culture	F4
		Company human skills	F5
Benefits and motivations for SSM	Customer satisfaction	G1	
	Supplier's capabilities to innovate	G2	
	Trust in suppliers	G3	
	Supplier lead-time	G4	

3. Methodology

The purpose of this study is to determine the key factors influencing sustainable supply chain management. Initially, a total of 61 potential factors were compiled through an extensive review of previous scholarly works. Subsequently, the fuzzy Delphi method, combined with expert judgment, was employed to screen and identify the most significant factors. A panel consisting of 50 experts participated in the questionnaire survey.

The fuzzy Delphi methodology is a structured forecasting technique that does not require large sample sizes and is widely applied to achieve informed consensus on complex decision-making problems (Hartman, 1981). Compared with the classical Delphi approach, the fuzzy Delphi method enhances efficiency by integrating fuzzy logic, thereby reducing ambiguity in expert opinions and lowering the time and cost associated with multiple survey rounds.

Fuzzy Delphi Method (FDM) is applied as follows:

Step 1: Experts evaluate the importance level of each factor using predefined linguistic terms.

Step 2: Linguistic assessments are transformed into corresponding triangular fuzzy numbers.

Step 3: The aggregated fuzzy value for each factor is calculated using the vertex method.

Step 4: Defuzzification is performed to convert fuzzy values into crisp weights.

Step 5: In accordance with Cheng and Lin (2002), a consensus level of at least 70% is required for acceptance. If this threshold is not satisfied, an additional FDM round is conducted (Cheng & Lin, 2002).

4. Results

At the initial stage, 61 factors associated with agile and sustainable supply chain management were identified from the literature and classified into seven main groups. The fuzzy Delphi method was then applied to determine the most critical factors based on responses obtained from 50 experts. Table 2 presents the final crisp importance scores of the retained factors. In line with the FDM acceptance criterion, only factors with defuzzified values greater than 0.70 were selected as significant.

Table 2 presents the coding of each factor derived from the questionnaire completed by the 50 experts. The second column reports the corresponding fuzzy weights expressed as triangular fuzzy numbers, where L , M , and U denote the lower, middle, and upper bounds, respectively. The third column provides the defuzzified (crisp) importance values. Based on the predefined threshold, only 26 factors with final scores exceeding 0.70 were retained. These values represent the aggregated evaluations of experts obtained through the fuzzy Delphi procedure and were subsequently transformed into linear crisp scores. Table 3 summarizes the accepted factors along with their relative ranking.

Table 2
Final FDM weights

Code	Fuzzy numbers (L,M,U)	Final score	Code	Fuzzy numbers (L,M,U)	Final score
A1	(0.53, 0.77, 0.91)	0.73*	D2	(0.51, 0.76, 0.92)	0.73*
A3	(0.50, 0.75, 0.90)	0.72*	E1	(0.51, 0.75, 0.88)	0.71*
A4	(0.52, 0.77, 0.89)	0.73*	E3	(0.52, 0.76, 0.90)	0.72*
A5	(0.52, 0.76, 0.90)	0.72*	E11	(0.51, 0.76, 0.90)	0.72*
A7	(0.56, 0.80, 0.93)	0.76*	E14	(0.36, 0.58, 0.79)	0.57*
B1	(0.65, 0.90, 0.98)	0.84*	F1	(0.51, 0.75, 0.89)	0.72*
B2	(0.52, 0.76, 0.90)	0.72*	F2	(0.51, 0.76, 0.92)	0.73*
B3	(0.50, 0.75, 0.90)	0.72*	G1	(0.55, 0.77, 0.89)	0.74*
C5	(0.52, 0.76, 0.92)	0.73*	G2	(0.52, 0.77, 0.93)	0.74*
C6	(0.51, 0.76, 0.92)	0.73*	G3	(0.52, 0.76, 0.89)	0.72*
D1	(0.51, 0.76, 0.90)	0.72*	Total	*20 factors were accepted	

Table 3
Accepted factors of sustainable supply chain

Rank	Factor	Code	Weight	Rank	Factor	Code	Weight
1	Quality	B1	0.84	11	Competitor actions	A5	0.72
2	Suppliers' green initiatives	A7	0.76	12	Price	B2	0.72
3	Supplier's capabilities to innovate	G2	0.74	13	Return on investment	E3	0.72
4	Customer satisfaction	G1	0.74	14	Large scale companies	D1	0.72
5	Top management vision	A1	0.73	15	Supply chain configuration	E11	0.72
6	Eco-design	C5	0.73	16	Trust in suppliers	G3	0.72
7	Production resources system	C6	0.73	17	Nature of business	A3	0.72
8	Strategic suppliers	D2	0.73	18	Reliability	B3	0.72
9	Collaborative	F2	0.73	19	Active	F1	0.72
10	Customer expectations	A4	0.73	20	Financial costs	E1	0.71

5. Discussion

The fuzzy Delphi results help to better understand what experts see as the key motivators for sustainable supply chain management (SSCM) within the Iranian

automotive sector. Of the original 61 factors, 20 were above the 0.70 acceptance threshold. This shows that experts perceive SSCM within this context of a broader managerial domain of the quality of suppliers, customer focus, green innovation, strategic leadership, cost feasibility, and structure of the supply chain, rather than a narrow environmental concern. These findings resonate with the multidimensional approach of sustainable supply management of Ageron et al. (2012), where the sustainability of the supply management system is a product of the interplay of the drivers, barriers, suppliers, the level of performance, and the management system (Ageron et al., 2012). Therefore, the factors that were accepted should be viewed as a list of practical considerations for realizing sustainable automotive supply chain management in the context of prevailing economic, institutional, and market constraints, rather than a technical appraisal.

Among the accepted factors, quality was ranked highest. This was expected, as the automotive industry is especially quality sensitive. In the automotive sector, quality is associated with safety, reliability, customer trust and satisfaction, warranty costs, stable production, and long-term competitiveness. Low quality components can disrupt the entire production system and result in customer complaints, system delays, and production rework. Therefore, quality is among the metrics of operational performance experts use to measure sustainability. Any supply chain that generates defective items, wastes resources, or causes regular interruptions in production cannot be considered sustainable, even if it implements some eco-friendly initiatives. This assumption agrees with Saragih et al. (2020), who stressed the connection between quality control, supply chain activities, and competition (Saragih et al., 2020).

The top priority for quality also indicates that for sustainability in the Iranian automotive industry, the starting point is operational excellence. Sustainability is often described in terms of eco-friendly activities, green technology, and policy compliance. The outcome of this study, however, shows that experts link sustainability with an organization's ability to manufacture dependable products with efficiency and consistency. Waste management systems, standardizing processes, eliminating defects, and the commitment to steady improvement of systems align directly with Sustainable Supply Chain Management (SSCM). Similarly, Singh et al. (2020) contended that implementing lean practices within organizations is vital for sustainability, coupled with green supply chain management. In this particular study, quality is the operational backbone for green and social advancements to be integrated (Singh et al., 2020).

The second most influential factor was initiatives taken by suppliers. This finding illustrates how important suppliers are for the automotive supply chain's sustainability. Automotive manufacturers rely on complex supply and service networks, as suppliers of parts, raw materials, logistics, and services. Consequently, suppliers' practices affect the focal firm's overall environmental performance. Green supplier initiatives encompass cleaner production, waste reduction, recyclable materials, eco-friendly packaging, pollution control, resource use efficiency, and environmental management system (EMS) certifications. Kazancoglu et al. (2021)

stated that supply chain and circular economy practices are increasingly essential to corporate environmental management (Kazancoglu et al., 2021). Likewise, Bahramimianrood et al. (2024) placed high value on circularity indicators in the evaluation of progress toward circular economy systems (Bahramimianrood & Bathaei, 2021).

For the Iranian automotive industry, this observation is of considerable value. Without improved environmental practices from suppliers, automotive manufacturers are likely to face challenges related to emission reduction, waste management, resource use optimization, and compliance with upcoming economic and social sustainability requirements. This underscores the need for greater emphasis on green supplier selection and green supplier development within SSCM practices. Abadi et al. (2021) highlighted the critical role of supplier selection within the context of resilient supply chains, while Streimikis et al. (2024) emphasized the value of advanced multi-criteria decision-making frameworks for the green supplier selection process (Abadi et al., 2021; Bathaei, 2024; Streimikis et al., 2024). This study builds on that body of work by presenting evidence that professionals in the Iranian automotive industry have also identified supplier green initiatives as a specific activity that drives enhances sustainable supply chain performance.

Customer satisfaction and supplier capability to innovate were also rated highly. The two factors are interrelated. Sustainability-focused innovation is typically a result of shifting customer preferences. With growing pressure on customers the demand for cars that are safe, reliable, affordable, efficient, and not harmful to the environment Customer satisfaction can no longer be viewed as simply a result of the performance of the supply chain. It can also be a form of market pressure that drives companies to reduce defects, strengthen supply relationships and redesign products within the context of greater innovation. Junaid et al. (2022) have shown that sustainable supply chain integration has positive effects on green innovations and on improving the performance of companies. Similar to these, the current findings complement the arguments of Junaid et al. (2022) and show that supplier satisfaction and innovation capability are the main components of sustainable SSCM (Junaid et al., 2022).

With regards to the rapid pace of technological and environmental change in the automotive sector, it makes it critical to extend industry requirements to include innovation in automotive products and to ensure that suppliers of products are able to enhance modify their products. In the field of automotive products in Iran, where sanctions and restrictions are likely to adversely affect foreign technology and international suppliers, it also makes innovation of domestic suppliers a vital strategic capability. Bathaei et al. (2021) identified key drivers of agile supply chains in the Iranian automotive industry. Bathaei et al. (2021) have shown that firm performance highly depends on flexibility and agility. The current findings extend these arguments to show that innovation capability is a sustainability requirement, and agility and innovation are also sustaining requirements (Bathaei et al., 2021).

Another important accepted factor was the vision of top management. This result was expected because SSCM generally involves long-term planning, commitment,

and organizational investment and coordination. Many sustainability efforts fail when they are confined to operational units and lack the backing of top management. Top management support is crucial for the avoidance of sustainability 'add-ons' to purchasing, production planning, supplier assessment, product development, and the measurement of performance. Giunipero et al. (2012) recognized the importance of support in purchasing and supply management sustainability, and Hsu et al. (2016) noted that in the context of developing markets sustainability efforts in supply chains are related to the strategic positioning of the organizations. In the case of the Iranian automotive industry, where organizations operate in an environment of sanctions, currency instability, and limited suppliers and technologies, the commitment of top management is critically important. Sustainability is not achieved via short-term initiatives; it requires a clear and defined strategic posture. (Giunipero et al., 2012; Hsu et al., 2016)

The acceptance of eco-design and production resource systems also provides a significant insight. Eco-design denotes that consideration of sustainability should occur in the design stage of products and not only post-manufacturing planning. Decisions concerning materials, recyclability, life, consumption of energy, design of components, and end-of-life management all have enduring consequences of a financial and environmental nature. Reverse logistics and closed-loop supply chains are very important, as Tseng and Bui (2017) emphasized the link between eco-innovation and industrial sustainability. This study confirms that experts value the integration of environmental concerns and sustainable development within design and engineering activities (Tseng & Bui, 2017).

Production resource systems form the backbone of the efficient employment of labour, machinery, materials, energy and information in firms. Better use of production resources in the context of industrial resource constraints or uncertain supply can enhance performance economically and environmentally. A weak production resource system results in idle capacity, waste, delays, high energy consumption, and poor responsiveness. Bathaei et al. (2025) notes the significance of flexible supply chain strategies for the long-term sustainability of businesses. In this context, production resource systems are an applicable framework to integrate agility, operational effectiveness, and sustainability (Bathaei et al., 2025).

The endorsement of strategic suppliers and a collaborative stance illustrate that supplier relationships are fundamental to the implementation of SSCM. In conventional purchasing systems, suppliers are usually assessed in terms of price, punctuality, and fundamental quality. On the other hand, sustainable supply chain management calls for a deeper form of collaboration. Strategic suppliers can foster innovation and quality, as well as the management of the environment and the mitigation of risks. Collaboration provides the opportunity to share information and facilitate the coordination of improvement activities, resolution of technical issues, and establishment of common goals for sustainability. Gopalakrishnan et al. (2012) stated that sustainable supply chain management practices are reliant on inter-firm activities, while the work of Rodríguez et al. (2016) underscored the importance of supplier development in social sustainability. Given that in the automotive industry

in Iran, most suppliers require assistance with technical issues and investments in order to build the capacity needed for their sustainability, collaboration is particularly important (Gopalakrishnan et al., 2012; Rodriguez et al., 2016)..

The accepted factors consider customer expectations, competitor actions, price, reliability, and nature of business. The influence of market pressure and the specifics of the industry on SSCM was apparent with these factors. Customer expectations compel firms to enhance quality, service, availability, and environmental performance. Competitor actions can also promote sustainability, especially when firms engage in efforts to protect their legitimacy and market position. Price remains a strong factor as automotive customers are price sensitive, especially in the case of emerging markets. Reliability is closely related to the quality and trust of a customer, while the nature of business encompasses the complexity of the automotive industry and the long supply chains and dependence on suppliers with the many components that are involved. This supports the findings of Shaverdi et al. (2013) and Su et al. (2016), who focused on the fact that sustainable supply chain evaluation requires comprehensive and multi-faceted decision-making (Shaverdi et al., 2013; Su et al., 2016)..

The influence of financial costs and return on investment as accepted factors are also significant. Despite the fact that financial costs had the lowest accepted score, it was still in the group. This indicates that a cost factor is perceived as a real barrier to sustainability efforts by these experts. Green efforts may involve capital investment to purchase new equipment, cleaner technologies, and to provide training, etc. In the Iranian automotive industry, these costs may be harder to control due to inflation, currency volatility and instability, sanctions, and restricted access to contemporary and advanced technologies.

Consequently, sustainability initiatives must be financially viable. Managers are more inclined to embrace sustainability initiatives when they clearly link to financial, operational, or strategic advantages, including cost decreases, risk mitigation, customer satisfaction, enhanced quality, or sustained competitiveness over time. This statement is supported by Bahramimianrood and Bathaei (2021), whose findings indicated that certain decision-making frameworks are required to select the appropriate criteria in relation to the green supply chain (Bahramimianrood & Bathaei, 2021).

There was also a consensus regarding the importance of supply chain configuration. This result has significant implications for the Iranian automotive industry, as the configuration of the supply chain directly impacts the industry's supply chain sustainability and resilience. Elements of supply chain configuration include where suppliers are located, how many suppliers are utilized, how much the supply chain relies on imports, the routes utilized for logistics, inventory methods, and the overall balance of how much supply is sourced from within the country versus outside the country. Because of sanctions and international restrictions, Iranian automotive industries struggle with supply chain constraints. That is why supply chains need to be sustainable and resilient. There is a need for localization of critical components in the automotive industry, as well as improved logistics, a

diversified supply base, and enhanced domestic suppliers. Sustainability and supply chain risk management need to be integrated.

The fact that large corporations can qualify as suppliers is associated with experts believing that bigger companies possess the capability to invest in quality controls, certifications, advanced technologies, and handle large and complex orders. These companies may also have higher potential to invest in environmental management systems. Wiengarten et al. (2017) describe how certification standards and their application can significantly influence supply chain performance, and larger companies may have more potential to fulfill these standards. Care should also be exercised in interpreting this outcome and, more importantly, the role of small and medium-sized companies in automotive supply chains, especially in the domestic supplier networks, should be considered. Therefore, reliance on bigger companies should not be the focus. Instead, larger companies with the capabilities and strategic importance in the supply chain should be aligned with the company's smaller, less developed suppliers (Wiengarten et al., 2018).

The role of trust was another factor considered. Sustainability relies on long-term goals, therefore, collaboration, and the sharing of information. If trust is weak, companies focus mainly on price negotiations and ignore the sharing of information. On the other hand, trusted relationships with suppliers will lead to reduced costs with improved order and delivery. In the context of SSCM, trust can be established through a transparent evaluation of suppliers, fair contracts, prompt payments, the provision of technical resources, and common goals in sustainability.

Overall, the identified elements imply that SSCM in the Iranian automotive sector represents an integrated system focused on quality, greening of supplies, innovation, collaboration, and cost-effectiveness. Quality gives the system its operational foundation, green supply initiatives direct the system's environmental concerns, satisfaction of the customer needs provides justification for the market, innovation of supplies assists in the necessary adaptation, and the vision of top management provides the necessary commitment. It connects the current study with the earlier works on agile and sustainable supply chains. Bathaei et al. (2021) studied agility and performance within the Iranian automotive industry. In this regard, the current study incorporates a perspective which emphasizes that, in addition to agility and flexibility, sustainable transformation of the context also necessitates the development of supplying ecosystems, green improvement, quality enhancement, eco-design, and commitment to the practice of sustainability in the management of the organization for the long haul (Bathaei et al., 2021).

The study has value in its innovation, and especially in its use of the fuzzy Delphi technique to interpret expert insights as quantifiable, consensus-based findings. In supply chain management (SCM) research, this is particularly useful since the majority of the factors related to sustainability are qualitative and context driven. While Hartman (1981) noted that the Delphi technique is appropriate for the attainment of consensus among experts, Cheng and Lin (2002) described how the fuzzy decision-making approach has the ability to interpret and adequately respond to the vagueness of natural language (Cheng & Lin, 2002; Hartman, 1981). The fuzzy

Delphi technique enabled the identification of a substantial, yet simplified, composite of the 20 most salient factors in this research. This contributes to the practical applicability of the findings to management practice, especially in the domains of supplier evaluation, strategic management, and sustainability performance assessment.

From a management perspective, the results indicate several management priorities. First, automotive companies need to consider the improvement of their product quality as a key element of their sustainability strategy. Quality improvement processes, including quality audits of suppliers, the prevention of defect processes, control of processes, and improvement processes, should be part of a sustainability strategy. Second, the selection and assessment of suppliers should include the 'green' criteria. Suppliers should be assessed for their environmental practices, the ability to innovate, the efficient use of resources, and their certifications, in addition to cost and delivery. Third, automotive companies should discontinue purchasing practices that are purely transactional and move toward establishing partnerships with their suppliers. It is likely that such partnerships will promote eco-design, the production of cleaner products, cost savings, and sustainability of the business. Fourth, the top managers should create a sustainability strategy that provides a clear picture of the organization's sustainability objectives and incorporates the balancing of the environmental, economic, and customer satisfaction elements.

Regarding the policymakers, the research results provide significant direction. For sustainable change in the automotive industry, the addition of environmental regulations is essential, but not sufficient. While the regulations provide the necessary pressure, the firms also need financial assistance, as well as the support of structured and targeted assistance. For sustainable supply chain management, the policymakers' support of 'green' investment, the development of suppliers, the promotion of certifications, the provision of improved access to cleaner production technologies, and the support of collaboration among manufacturers, suppliers, and the educational and research communities are of great value. Within the Iranian environment, this supportive approach becomes even more necessary, as due to external sanctions, the availability of new technologies and the ability to form international collaborations is extremely limited.

The findings indicate that sustainability in the Iranian automotive supply chain is broader than an environmental concern. It also encompasses innovation, resilience, governance, and competitiveness. Accepted factors comprise operational issues such as reliability and quality, environmental issues like eco-design and green initiatives, relational issues like collaboration and trust, strategic issues such as the top management vision, and the financial and economic issues like the price and return on investment. This shows the complexity of SSCM and aligns with Bahramimianrood (2022), who stressed the importance of circular economy practices in product lifecycle management, as well as Yuniarti et al. (2025), who pointed out the importance of resilient supply chain network design in the context of sustainability (Bahramimianrood & Bathaei, 2021; Yuniarti & Arvitrida, 2025).

The results come with certain limitations. Current results stem from interviews with experts in the Iranian automotive industry and are therefore not generally applicable to other sectors and countries. Furthermore, while the fuzzy Delphi method is effective in demonstrating the degree of expert consensus, it is not effective in demonstrating the degree of causation among the factors. Other approaches, such as fuzzy AHP, BWM, DEMATEL, TOPSIS, or SEM, may be applied in future studies to establish the causation of the selected factors and rank them according to their potential impact on sustainability outcomes. Future studies may also focus on the Iranian automotive industry and other emerging markets, evaluate SSCM digitalization, and examine the impact of supply chain disruptions and economic sanctions on sustainability. Such extensions would provide a stronger empirical basis for understanding how automotive supply chains can become more sustainable, resilient, and competitive.

6. Conclusion

Monitoring the supply chain is very important for companies where updating their supply chain can improve performance. One of the customers and governments' demands is paying attention to the environment and for this purpose, the companies are trying to increase their sustainability functions. Sustainable supply chain is popular these years in aspect of social, economic and environment. This paradigm increased in paying attention to environment and materials in the whole chain. The automobile industry is a great industry in the world. Countries are trying to invest on this industry to decrease their cost and improve the performance. If the companies' managers focus on the supply chain, it can improve performance. However, for the automobile industry, it is very important to pay attention to green environment invitation because if it does not pass the environment test, the company will not be allowed to send their automobile to the market. At the same time, designing based on market demand to satisfy the customers is very important because it will attract attention.

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