



## Requirements For The Realization Of Green Supply Chain Management In The Iranian Automotive Industry

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Article	Abstract
<p>Article history: Received: 10<sup>th</sup> July 2021 Received in revised form: 29<sup>th</sup> July 2021 Accepted: 17<sup>th</sup> August 2021</p> <p>Keywords: Supply Chain Management, Green Supply Chain Management, Environmental Sustainability, Iran Automotive Industry</p>	<p>Globalization, increasing regulation of governmental and non-governmental organizations, and pressure and demands from customers to comply with environmental issues have led organizations to consider the necessary measures to apply green supply chain management to improve economic and ecological performance. Green supply chain management, integrating supply chain management with environmental requirements in all stages of product design, selection and supply of raw materials, production and manufacturing, distribution and transfer processes, delivery to the customer, and finally after consumption, recycling management and Reuse to maximize the efficiency of energy and resource consumption along with improving the overall performance of the supply chain. Green supply has been discussed in the Iranian automotive industry. The necessary measures to achieve the management of green supply chains were extracted, and these measures were finalized through a questionnaire of experts. Finally, fuzzy efforts were prioritized with the help of the method.</p>

### Introduction

Global organizations are always looking to gain a competitive advantage by creating innovations and new methods. Some of these organizations gain a competitive advantage today by ensuring sustainable environmental development by improving environmental performance by complying with environmental laws and standards, increasing customer knowledge in this regard and reducing the negative environmental impact of their products and services. The country depends on the conservation and optimal use of limited and irreplaceable resources in that country. Governments have taken various measures to address this issue, including using environmentally friendly raw materials in production centres. And industrial, reducing the use of fossil and petroleum energy resources and reusing waste. Accelerate government laws and regulations to meet environmental standards and increase consumer demand for green products to supply chains that include all activities related to the flow of goods from the raw material stage to the delivery of goods to final consumers, including The flow of information across the chain has given rise to a new concept in recent years that includes the "green supply chain management" stages of the product life cycle from design to recycling [1].

Adopting an investment strategy Will bring to improve the environmental performance of the supply chain has many benefits, such as wasting energy resources, reducing pollutants, eliminating or reducing waste, creating value for customers, and ultimately increasing productivity for manufacturing and service organizations [2].

As an old and essential industry with a large share of the country's GDP, the automotive industry, in all parts of its life cycle, from exploiting natural resources, manufacturing, production, consumption, and after consumption in There is direct and indirect interaction with the environment. Due to necessities such as joining the World Trade Organization, increasing international environmental laws and customers' emphasis on using environmentally friendly green products, creating green management in providing products and services in the country's industries is necessary and inevitable [3-5]. Also, given that the domestic car market is becoming saturated, domestic carmakers need to focus on the regional and global markets.

Due to increasing pressures and regulations of governmental and non-governmental organizations and consumer demand, car manufacturers around the world have strengthened their sustainable and green management. Thus, the identification and implementation of green management in the automotive industry can effectively control and reduce the negative consequences of industrial development on the environment. Therefore, supply chain managers in the automotive sector must consider their decisions in addition to current costs, environmental dimensions and social costs in their decisions. According to the review of previous research records on the subject of management and green supply chains, it was determined that in this regard, few research activities had been done in Iran. Therefore, addressing this position seems to be one of the necessities of academic-industrial research activities and includes innovation [3-7].

This article identifies the requirements (drivers, barriers, measures and results) necessary to achieve green supply chain management in the Iranian automotive industry. For this purpose, according to the literature on the subject, the measures needed to achieve green supply chain management, extraction and these measures to be finalized through a questionnaire have been prioritized by fuzzy experts. Finally, the implementation measures are done using the TOPSIS method.

### **Supply chain management**

The Supply Chain Management Professional Association defines supply chain management as follows: Supply chain management includes the planning and management of all sourcing and procurement activities, the conversion of goods from the raw material stage (extraction) to Delivery to the final consumer are logistics activities and all coordination activities and cooperation between suppliers, intermediaries, retailers and customers [8]. Some other definitions of supply chain management include: Supply chain management involves the integration of supply chain activities, and related information flows through improved chain relationships to achieve competitive advantage. Thus, supply chain management integrates supply chain activities and related information flows by enhancing and coordinating activities in the supply chain of production and product width. Another definition of supply chain management is as follows: Coordination of production activities, inventory, positioning, and transportation among supply chain actors to achieve greater efficiency and meet customer expectations [9-11].

## **Green supply chain management**

Due to the economic, social and environmental challenges that have threatened organizations in the last decade, the customer orientation approach focuses on its demands and designs the organization strategy accordingly (creating customer satisfaction) its ability to create an advantage. Competitiveness is lost in organizations. If customer orientation was the factor of organizational competitive advantage in the last two decades, today, due to the challenges created by customer orientation, organizations have moved away from this focus. The customer always wanted the best product, the cheapest and the fastest. This attitude polluted the environment and produced products and processes that were not in harmony with the environment. In this regard, organizations have found their survival in accountability in three areas: economic, social and environmental. Green attitude in the organization and the creation of organizational structures called "green assurance" have replaced administrative units such as "quality assurance" [12].

Supply chain greening is the process of considering environmental criteria or considerations throughout the supply chain. Green supply chain management, integrating supply chain management with environmental requirements in all stages of product design, selection and supply of raw materials, production and manufacturing, distribution and transfer processes, delivery to the customer and finally after consumption, recycling management and Reuse to maximize the use of energy and resources along with improving the performance of the entire supply chain [13].

In studying the environmental effects of supply chain activities, the impact of products on the environment is analyzed using a holistic approach (including researching the product life cycle from the beginning to the end of its life). In this approach, all the effects of odor (the science of habit and lifestyle of organisms and their interaction with the environment) of each activity at different stages of product life, such as the concept Product, design, raw material depletion, manufacture and production, assembly, maintenance, packaging, transportation and reuse of the product are measured and included in the product design [14].

A green supply chain is defined as (considering environmental issues in supply chain management, including product design, material selection and sourcing, manufacturing process, delivery of the final product to the customer and product management after consumption and during its useful life). Although the concepts of sustainable supply chain management and green supply chain management are commonly used interchangeably in the supply chain literature, the two ideas are slightly different. Sustainable supply chain management includes economic dimensions and social and environmental sustainability. Therefore, the concept of sustainable supply chain management is broader than green supply chain management, and green supply chain management is part of sustainable supply chain management [15].

## **Organizational drivers for accepting green supply chain management**

The drivers of an organization's move towards a green supply chain vary from the end customer, government agencies, private organizations, and regulators. The main drivers are laws and regulations that dictate compliance with environmental issues to organizations. On the other hand, some companies enforce these rules to increase

profitability or customer demand. Green supply chain management drivers are divided into internal and external drivers [16]. External stimuli that cause green are:

- Satisfying consumer demand and acting on social responsibility;
- Reacting to competitors' actions and adopting green and environmental strategies with the goal Maintain and expand market share;
- International and governmental regulations and laws that require organizations to implement management Supply green;
- Increased environmental pollution;
- Environmental activities of non-governmental organizations.

Among the internal stimuli, the following can be mentioned:

- Reducing the cost of reducing energy consumption and input raw materials;
- Considering environmental goals in the organization's mission;
- Creating a sustainable competitive advantage in the organization.

### **Executive activities to achieve green supply chain management**

Different industries and organizations carry out various activities to achieve green supply chain management. Executive activities to achieve green supply chain management are divided into two general categories of the organisation's internal and external executive actions. They are divided into 12 categories, as described in Table 1. Barriers, benefits and results of green supply chain management are shown in Table 1.

Some of the benefits of using a green supply chain include:

- Increase efficiency, improve productivity, create new markets, reduce costs, reduce pollutants, improve the public image of the organization, increase the commitment and social responsibility of the organization
- Optimize energy consumption, reduce waste, reduce costs, conserve natural resources, improve quality of life, create and maintain a better environment for future generations

The main obstacles to achieving green supply chain management, as mentioned in the articles, are described in Table 2.

Table 1 Executive activities to achieve green supply chain management

Operating activities
1. Internal environmental management of the organization:
• Commitment and support of the senior and middle management of the organization to the implementation of green supply chain management by the organization
Obtaining environmental management certificates such as ISO14000, EMS
• Existence of a policy and policy in the field of environment and social responsibility in the organization
• Codified planning to create green and sustainable marketing
2. Design for the environment:

<ul style="list-style-type: none"> <li>• Designing products and processes to reduce raw material consumption and energy consumption</li> </ul>
<ul style="list-style-type: none"> <li>• Design products and processes for reuse, reconstruction and recycling</li> </ul>
3. Improving environmental performance in the field of the production process:
<ul style="list-style-type: none"> <li>• Planning to reduce and eliminate the use of harmful elements of nature in the parts production process</li> </ul>
<ul style="list-style-type: none"> <li>• Codified planning to reduce soil and climate pollution by internal processes</li> </ul>
<ul style="list-style-type: none"> <li>• Use a timely delivery system, control inventory and minimize the amount of Additional order</li> </ul>
<ul style="list-style-type: none"> <li>• Use of reverse logistics system (collection, transport, separation, recycling and reuse</li> </ul>
Raw materials and reference parts and waste disposal)
<ul style="list-style-type: none"> <li>• Replacement of raw materials with nature-friendly raw materials</li> </ul>
4. Management of non-productive resources:
<ul style="list-style-type: none"> <li>• Managing and controlling the detrimental effects of the organization's facilities on the community and employees of the organization (include Environmental, health and safety issues)</li> </ul>
<ul style="list-style-type: none"> <li>• Execution of network and treatment of the central industrial and sanitary wastewater treatment plant</li> </ul>
<ul style="list-style-type: none"> <li>• Measuring the amount of water consumed annually and planning to reduce consumption</li> </ul>
5. Management and optimization of energy consumption:
<ul style="list-style-type: none"> <li>• Use of renewable energy in the production process (such as wind turbine and solar energy)</li> </ul>
<ul style="list-style-type: none"> <li>• Optimize energy consumption by using ceiling monitoring for ambient lighting Work, spotlight and turn off devices during off-hours</li> </ul>
<ul style="list-style-type: none"> <li>• Utilization of new and environmentally friendly technologies (to prevent the entry of pollutants Into the environment and optimization of consumables and energy)</li> </ul>
6. Waste management:
<ul style="list-style-type: none"> <li>• Codified planning to reduce soil, climate and waste pollution</li> </ul>
<ul style="list-style-type: none"> <li>• Implementation of the waste management system (production management, processing, storage, separation, transportation and Transportation, recycling and disposal of waste)</li> </ul>
7. Education, research and culture:
<ul style="list-style-type: none"> <li>• Acting in the final domestic and international environmental association and conducting ecological research with Universities and scientific centres</li> </ul>
<ul style="list-style-type: none"> <li>• Holding a training seminar on the importance and observance of environmental issues for employees, customers and suppliers</li> </ul>
<ul style="list-style-type: none"> <li>• Promoting a culture of reducing paper consumption in various activities of the organization using the system Office automation and software emptying used in the network</li> </ul>
8. External environmental management of the organization:
<ul style="list-style-type: none"> <li>• Obtaining ISO 14000 certification by suppliers</li> </ul>
<ul style="list-style-type: none"> <li>• Selecting suppliers based on environmental criteria and evaluating the performance of suppliers Basis of ecological criteria</li> </ul>
<ul style="list-style-type: none"> <li>• Existence of environmental instructions in the procurement unit for purchasing raw materials and parts environment lover</li> </ul>
<ul style="list-style-type: none"> <li>• Planting seedlings, trees and helping to develop green spaces</li> </ul>
9. Environmental cooperation with stakeholders:
<ul style="list-style-type: none"> <li>• Receive feedback and work with customers and suppliers for clean production</li> </ul>
<ul style="list-style-type: none"> <li>• Receive feedback and work with customers and suppliers to reduce energy consumption</li> </ul>
10. Improving environmental performance in the field of product:
<ul style="list-style-type: none"> <li>• Codified planning to reduce soil, climate pollution by the final product</li> </ul>

• Use environmental label labels on parts
• Planning to increase production and sales of clean vehicles (hybrid, dual-fuel and electric)
11. Improving environmental performance in the field of sales and after-sales service:
• Set up free engine products
• Implementation of the plan to replace worn-out cars
• Renovation and development of the taxi fleet
12. Increase vehicle safety and improve vehicle engine performance:
• Planning to achieve the Euro 3 and above emission standard in cars
• Codified planning to increase vehicle safety equipment (to comply with the responsibility of Social Organization)

Table 2 Obstacles to achieving green supply chain management

Obstacles to achieving green supply chain management
Lack of active approach and volunteers of organizations and suppliers regarding compliance with environmental standards and social responsibility
The inability of suppliers (in terms of technical knowledge and technology) to obtain the ISO 14000 standard
Lack of tangible competitive advantage due to the implementation of green supply chains
The difficulty of organizing and coordinating units in the implementation of green supply chain
Lack of sufficient incentives and incentives from the government to achieve green supply chain management
The high cost of implementing a green supply chain
Lack of sufficient legal leverage to enforce environmental laws
Lack of proper information and communication technology infrastructure to facilitate the implementation of the green supply chain
Lack of knowledge and education on environmental issues
Lack of support from senior and middle managers of the organization
Lack of presence and competition in global markets
Lack of environmental goals and strategic plans in the organization
Lack of sufficient legal leverage to enforce environmental laws
Additional costs required to implement the green supply chain

This study, by studying the literature and previous records of articles, benefits and results of green supply chain management in five categories of positive economic results, environmental results, negative economic results, improving production performance, and stakeholder satisfaction, is categorized.

- Environmental results: reduction of air, water and soil pollutants, reduction of solid and liquid wastes, reduction of consumption of toxic, destructive and dangerous substances for the environment, reduction of the rate of destructive environmental accidents, improvement of the environmental reputation of the organization

- Positive economic results: increase market share, create a competitive advantage for the organization, reduce costs due to reduced consumption of energy, water and raw materials, reduce costs due to reduced waste rates, reduce environmental crimes, reduce costs due to waste management

- Improve production performance: improve quality, reduce component inventory, increase production capacity, increase efficiency and improve efficiency

- Stakeholder satisfaction: customer satisfaction, shareholder satisfaction, employee satisfaction, public satisfaction
- Negative economic results: increase in investment costs, increase in operating costs (research and development, design, etc.), increase in training costs, increase in product cost

### Research Methodology

This research is applied in terms of purpose. It is in the framework of descriptive study because the researcher describes the benefits of the green supply chain in organizations and seeks to identify the requirements (drivers, barriers, actions and results) needed to achieve Manage the green supply chain in the Iranian automotive industry. In this research, the library method (books, articles and Internet texts) has been used to identify the requirements (features, barriers and measures) necessary to achieve green supply chain management. On the other hand, field study in the automotive industry has been used by distributing questionnaires among experts in green supply chain management. The statistical population in this study is experts from the automotive industry who are familiar with green supply chain management and environmental issues. The scope of the research in terms of time is the first six months of 2009. In this paper, to prioritize and determine the importance of the most critical executive measures to achieve green supply chain management, the use of necessary MADM decision models according to the compensatory models to prioritize the implementation of administrative actions.

Multi-criteria decision models include different methods. In this research, the TOPSIS method has been used. This method is in the group of compensatory models. TOPSIS method is one of the most common methods used in multi-criteria decision making. In this method, m options are evaluated by n indicators. In this method, the selected option must have the least distance from the positive ideal solution and, at the same time, have the highest space from the perfect negative solution. In fuzzy sets, unlike definite sets, elements are not divided into a member and non-member sets. Instead, according to what we define, the membership of elements in fuzzy sets varies between zero and one. The basis of classical mathematics is Aristotelian logic, in which different phenomena have only two aspects: "zero or one", "true or false".

There is no middle ground in Aristotelian logic, and the method of reasoning is definite and explicit. On the other hand, Fuzzy mathematics is based on approximate reasoning that is consistent with the nature of human systems. In this type of argument, the zero and one states express only the boundaries of the debate. The approximate statement is the generalized state of the definite and explicit Aristotelian idea.

Table 3 Qualitative words and fuzzy triangular numbers corresponding to them

Linguistic Variables Ranking The Options		Linguistic Variables Importance Of Indicators	
Weakly	(0,0,1)	Not Important	(0,0,0.1)
Relatively Weak	(1,3,5)	Less Important	(1,3,5)
Medium	(3,5,7)	Medium	(0.3,0.5,0.7)
Fair	(5,7,9)	Important	(0.5,0.7,0.9)
Good	(7,9,10)	Very Important	(0.7,0.9,0.1)

## Data Analysis

This section analyzes the identification questionnaire of the importance of implementing green supply chain management and the identification questionnaire and prioritization of administrative measures to achieve green supply chain management in the Iranian automotive industry. In the validity stage of the questionnaires, experts' opinions were used to reduce the interdependence between the results and organizational measures. First, according to the findings of the results questionnaire, the evaluations performed based on the linguistic words of the five Likert spectra (very important to not important) into fuzzy triangular numbers corresponding to Table 3, the significance of the results were calculated using EXCEL software. The final results of the calculations are given in Tables 4 and 5. Finally, using fuzzy TOPSIS method and executive measures were prioritized according to their impact on the results. According to the findings of the action research and "environmental cooperation with stakeholders", executive "design for the environment" had the first to third priority, respectively, and include the following executive "waste management" activities.

Table 4 Fuzzy weights Results

Result	Name of result	Fuzzy weights
c1	Satisfaction of stakeholders	(0.56,0.76,0.92)
c2	Environmental results	(0.58,0.78,0.93)
c3	Positive economic results	(0.48,0.68,0.86)
c4	Improve production performance	(0.5,0.65,0.83)
c5	Negative economic results	(0.35,0.54,0.72)

Table 5 Calculate the proximity coefficient of options and prioritize options

Rank	Proximity coefficient	FNIS	FPIS	Executive measures
4	0.469	1.95	2.21	P1
1	0.489	2.04	2.14	P2
11	0.430	1.76	2.34	P3
9	0.437	1.81	2.33	P4
5	0.457	1.88	2.23	P5
3	0.475	1.95	2.16	P6
12	0.384	1.58	2.53	P7
10	0.437	1.82	2.34	P8
2	0.489	2.05	2.15	P9
7	0.445	1.82	2.27	P10
6	0.450	1.84	2.25	P11
8	0.444	1.81	2.26	P12



**Design for the environment is:**

- Designing products and processes to reduce the consumption of raw materials, energy consumption and environmentally harmful substances

- Design products and processes for reuse, reconstruction and recycling of products

- Educate designers on the use of green design methods and selection of raw materials

Aiming to optimize energy consumption

Environmental cooperation with stakeholders includes:

- Receive feedback and work with customers and suppliers for clean production

- Receive feedback and work with customers and suppliers to reduce energy consumption

- Receive feedback and work with customers and suppliers on green packaging and design

Waste management is:

- Codified planning to reduce soil, climate and waste pollution

- Implementation of the waste management system (production management, collection, storage, separation,

Transportation, recycling and disposal of waste)

A review of the findings and a comparison with similar research conducted among Chinese automakers shows that organizational design measures for the environment, environmental cooperation with stakeholders, and the organization's internal ecological management are the first to third priorities. The findings of the present study are consistent with the results of Chinese research.

Also, the prioritization of the first to third executive measures of the present study is consistent with similar research findings among the power industry, electric vehicle and power industry industries in China.

The executive action of "Education, Research and Culture" has gained the last rank. According to experts, this means that so far, extensive training activities by automakers and government agencies (Environmental Protection Organization, etc.), and non-governmental organizations aim to promote a culture of environmental protection among customers, suppliers, employees, and The public has implemented or is implementing.

**Research results**

In this article, while explaining the concepts of the supply chain, supply chain management and green supply chain management, review the literature and previous research in the field of green supply chain management and also identify the requirements (stimuli, obstacles, actions and results) necessary to Achieving green supply chain

management was addressed. According to the results of the research, the executive action "Design for the environment", "Environmental cooperation with stakeholders", and "Waste management" have the first to third priority, respectively. A review of the present study's findings with similar research conducted between Chinese automotive companies and the power plants, automotive, electrical and power plants industries of China shows that the current study's findings are consistent and similar to the results of the Chinese research. The following is also suggested for future research:

1. According to the research results, it is suggested that the country's car companies take the first and practical step to achieve green supply chain management by defining projects to implement each of the organizational measures (given their importance).

2. A case study of the combination of supply chain management and the environment in the service, hospital and insurance industries and the suppliers of goods in these sectors with an environmental approach and reduction of waste, water, air and soil pollution

3. Due to the high environmental pollution of manufacturing industries such as petrochemical, cement and chemical industries, it is suggested that research dissertations be defined and implemented to identify the requirements for the realization of the green supply chain in such sectors.

4. Selection and evaluation of green supply chain suppliers in various industries.

## References

1. Bathaei, A., S.R. Awanga, and T. Ahmadb, *Evaluation of Organizations Agility Using ANP FUZZY and Fuzzy VIKOR Method Case Study: Amol Dairy Companies*. 2021.
2. Ahmadi, J., et al., *The Impact Of Information Technology On Workforce Management*. Journal of Social, Management and Tourism Letter, 2021. **2021**(1): p. 1-8.
3. Abadi, S.K.G., et al., *Suppliers Selection In Resilient Supply Chain By Using Fuzzy DEMATEL Approach (Case Study In SAPCO Supply Chain)*. Journal of Social, Management and Tourism Letter, 2021. **2021**(1): p. 1-17.
4. Bathaei, A., et al., *Application of fuzzy analytical network process (ANP) and VIKOR for the assessment of green agility critical success factors in dairy companies*. Symmetry, 2019. **11**(2): p. 250.
5. Valipour Khatir, M., A. Bathaei, and B. Bahrami Mianrood. *Comparative study of factors affecting organizational agility in Iran*. in *Conference: 3RD INTERNATIONAL CONGRESS ON TECHNOLOGY - ENGINEERING & SCIENCE, 09 -10 FEBRUARY, KUALA LUMPUR - MALAYSIA*: KUALA LUMPUR - MALAYSIA. 2016.
6. Valipour Khatir, M., A. Bathaei, and B. Bahrami Mianrood, *Comparative study of factors affecting organizational agility in Iran*.
7. Bathaei, A., S.R. Awang, and T. Ahmad, *Important Factors for Agile Supply Chain in Iranian Automobile Industries*.
8. LeMay, S., et al., *Supply chain management: the elusive concept and definition*. The International Journal of Logistics Management, 2017.
9. Chen, C.-J., *Developing a model for supply chain agility and innovativeness to enhance firms' competitive advantage*. Management Decision, 2019.
10. Kenari, Z.D. and B. Bahramimianrood, *Selection of factors affecting the supply chain and green suppliers by the TODIM method in the dairy industry*. Journal of Social, Management and Tourism Letter, 2021. **2021**: p. 1-12.
11. Bahramimianrood, B. and M. Bathaei, *The Impact of Information Technology on Knowledge Management in the Supply Chain*. Journal of Social, Management and Tourism Letter, 2021. **2021**: p. 1-11.
12. Fischer, M., et al., *Strategy archetypes for digital transformation: Defining meta objectives using business process management*. Information & Management, 2020. **57**(5): p. 103262.
13. Al-Ghwayeen, W.S. and A.B. Abdallah, *Green supply chain management and export performance: The mediating role of environmental performance*. Journal of Manufacturing Technology Management, 2018.
14. Ahmed, W., et al., *Analyzing the impact of environmental collaboration among supply chain stakeholders on a firm's sustainable performance*. Operations Management Research, 2020.
15. Wibowo, M.A., N.U. Handayani, and A. Mustikasari, *Factors for implementing green supply chain management in the construction industry*. Journal of Industrial Engineering and Management, 2018. **11**(4): p. 651-679.
16. Burki, U., *Green supply chain management, green innovations, and green practices*, in *Innovative Solutions for Sustainable Supply Chains*. 2018, Springer. p. 81-109.