

Greening The Automobile Supply Chain

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Abstract

Environmental concern has become more crucial with the passing time among the automobile industry and human beings. Government expectations regarding environmental safety are also getting much higher than the previous. Increasing the green supply chain in the manufacturing process is getting vital day by day. In order to analysis all the gaps and overcome from these this study reviews over the subject of sustainable supply chain management system. A systematic review and its proper analysis have been provided in this study to recognize the importance of the invention of greenhouse gas in the vehicle manufacturing process. Secondary qualitative data along with different themes the structure of this study has done to guide the industry positively. The entire structure of this study will help to understand barriers to reduce the obstacles.

Introduction

The world economy has been modernized especially in the *automobile industry* since the Second World War. Getting profitable form the lower cost of services and production many countries have modernized their economies. In the recent decade, the fast industrial modernization has led to negative environmental effects involving toxic pollution, greenhouse gas release and chemical pills. In order to develop global environment awareness, the subject regarding green supply chain has made an appearance as an important concept that considers sustainability elements of the automobile supply chain. The manufacturing processes of the majority of the automobile vehicles are swallowed in the growing countries towards the *green chain supply* method. The *automobile industry* is absolutely one of the most influential and largest industries all over the world.

In this industry manufacturing, design of the vehicle model, developing, selling, and marketing of the *automobile vehicles* are all involved. The main aim of this industry is manufacturing the products that don't harm the environment by supplying harmful gases. Due to anthropogenic activities the current issue of this world is reducing the adverse impact of the harmful gases. The activities of the supply chain are required to be managed in order to not produce the dangerous gases that can torment the environment. The proper practice regarding green supply chain has been required in order to fulfill the activities aim. The *automobile industry* is a great source of money contributors to balance the world's economy. Along with this, automobile vehicle manufacturing companies also affect the human's life exceptionally.

The industry is turnover to the sixth largest and strongest economy of the world. Due to the fast growth of the industry the production number of the more automobile vehicles is seen on the road. During the life cycle of the people automobiles affect the environment in several ways. Any *automobile vehicle* before ready to roll, absorbs a huge amount of glass, rubber, steel, plastics that are very expensive and difficult to recycle again that are not eco-friendly. The fuel consummation affects the air pollution that causes global warming. In order to increase the sustainability of the *automobile industry* on the environment, economy and also social activity there is required proper practice reading *supply of green chain*.

Bringing necessary changes in the manufacturing process in the *automobile industry* the management system should focus on the activities that can enhance sustainability. Fulfilling this desire the industry needs to plan an effective framework that provides the required criteria to supply the green chain to the environment. *Green supply chain management* overturned logistics and closed loop supply chains that emerged in the manufacturing process over the environmental aspect due to sustainability. In the automobile industry the pressure has constantly increased from the public and authorities for tracking the real environmental issues and to solve them. This study has been organized based on a few criteria that can help the automobile industry to overcome the current issue regarding lack of a green supply chain. Within proper research and data analysis this article has justified providing important information to the industry.

Research Problem

An automobile industry should focus more on energy and resources that are helping in the process of manufacturing vehicles by inventing greenhouse gas. Lack of advanced and new technological implementations

is one of the major barriers to make it real to increase the sustainability of the green supply chain. Along with absence of organizational encouragement the workers are not getting engaged in the invention method. Not having initiative support from the government is also considered as a barrier in this topic. Poor quality human resources such as providing proper education, training an automobile industry cannot get the opportunity to sustain a green supply chain.

Review of literature

The researchers have conducted a systematic overview as per the view of the journals and researches to recognize verifiable studies. In the field of supply chain management system, the concept of greening the environment is referred to as integrating environmental thinking. In order to lead the firm greenhouse supply chain can be seen as a vital important part of the dynamic environmental strategy. As observed by Chiappetta Jabbour *et al.* (2017), a dynamic industry refers to the organization that is oriented on preventing the environmental issues by changing manufacturing methods. Engaging the suppliers in the manufacturing process is a very effective way to bring the current required changes regarding greenhouse gas. In this part of literature review considered the effect of **greenhouse gas supply chain** practices in the manufacturing process of the **automobile industry**. In the field of science review studies are considered as primary sources that are able to summarize the entire body of knowledge. Under a proper investigation and study the researchers are getting to identify the strength and weaknesses of the industry and its possible solution. As opined by De Giovanni and Cariola (2020), in this recent era, the awareness reading green supply chain especially in the **automobile industry** has been increased in a large number. Manufacturing vehicles according to the supply of green gas to the environment can enhance the sustainability of the requirements of the people.

In case of understanding the people that the vehicle can be eco-friendly, people will draw attention to the purchasing decision of the automobile vehicle. The workers and the management system should be more skillful and aware about the transformation system of the vehicle. More skillful and knowledgeable workers can invent vehicles that can provide the surety no harm to the environment. As opined by Afra and Behnamian (2021), in conducting a survey on GSCM practices in US manufacturing organizations, has been found demand of greening automobile supply chain became trendier. Attention regarding environmental sustainability among the people of the US has become pretty high because they require vehicles that cannot damage the environment. Products of environmental sustainable logistics and design need to manage the relationship with the suppliers in order to improve the global competitiveness and achieve economic performance. According to the Abdullahi *et al.* (2021), it has been analysis that outside pressure along with adoption of green supply chain are completely can be mediated by using the eternal pressure of the organization.

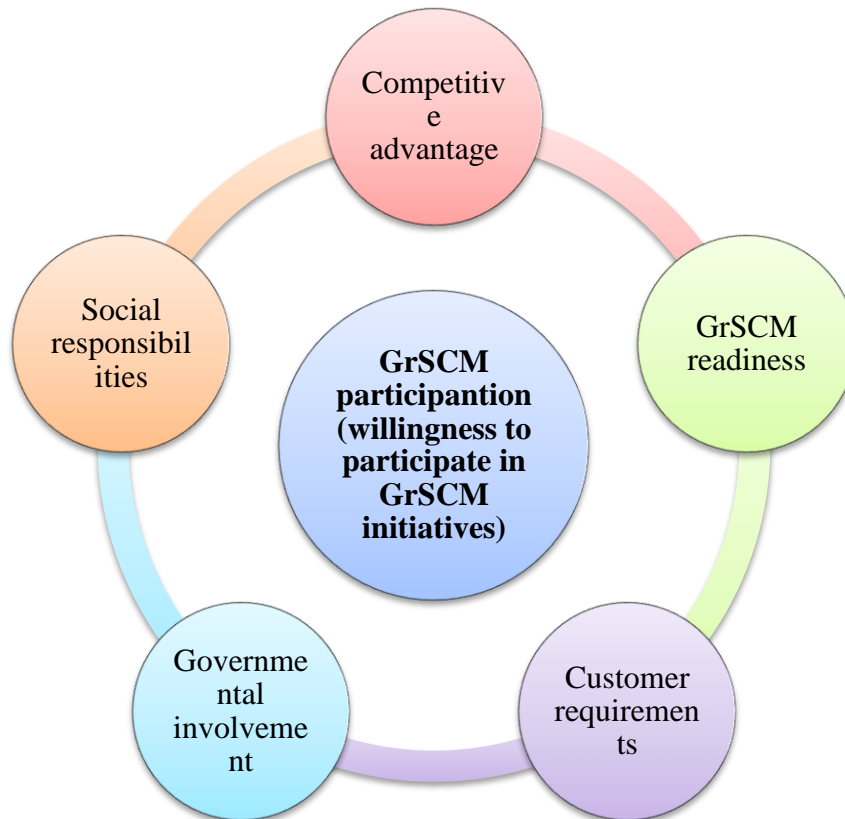


Figure 1: Drivers of GrSCM participation
(Source: Influenced by Abdullahi *et al.* 2021)

Based on the key term of “Green Supply Chain Performance” and “Green Supply Chain Practices”, entire research has been done to provide informative data to modify the industrial manufacturing process. The entire work of the study has been completed by depended on scholars and researches that supply different types of criteria that the automobile industry can develop itself. In the words of Atilhan *et al.* (2021), practices relating to the green supply chain have been required to find out the possibilities whether the manufacturing process can be possible or not. Along with this, Government involvement of the country has also a great influence over the manufacturing process. Due to having the full support from the US Government the automobile industry can create pressure over the manufacturing process to produce vehicles that are eco-friendly. Implementing the *GrSCM* in the automobile industry is a vital process and needs strong coordination from each employee and workforce. *Green supply chain* management *practices* and *performances* are very crucial to conduct any review. As per the view of Belhadi *et al.* (2021), customer requirements also have a vital impact over the changing decision to produce eco-friendly vehicles. In case the organization found that the customers are willing to purchase vehicles that can help in building the health of human and environment then they create pressure to manufacture. Pushing the whole system here both the government support and customer demand are important criteria.

Inside it has been found the importance of the green gas and the risk in inventing green gas in the vehicle also has been discussed in this article. This will help the organization focus on the high risk and generate the strategy according to the organization's needs. Introducing greenhouse gas in the automobile vehicles there also needs a proper social responsibility that the people will use those vehicles instead of the harmful one. According to Balon (2020), if the people should be more responsible towards the maintenance of the environment so the manufacturing process can be under pressurized. Managing this factor the Government should take a vital responsibility to enhance the awareness regarding the environment among the citizens. In case of developing awareness among the people about the providing protection to the environment then the firms are being obtained to manufacture greening supply chain vehicles. Moreover, the US government has increased awareness about environmental health and its effect over the world is essential then greenhouse invention will be compulsory in the automobile industry.

In order, GrSCM participants for the automobile industry can increase their compatibility within the competitive companies in the global business market. It can deliver more encouragement to the automobile industry that can help them to rise the possibility of getting more successful. Developing competitive advantage has the ability to provide extra motivation to manufacture according to environmental needs and support the economic balance more perfectly. As observed by Belhadi *et al.* (2021), the automobile industry is connected with several contractors such as suppliers, designers, engineers that help to monitor the entire process systematically. As the automobile industry is the main provider of supporting economical parts so it has a major responsibility to maintain it. In order to enhance the condition of the country economically stable this is an essential need to invent green in automobile vehicle production. This study tries to cover all the required criteria to present a complete framework of review of this research with the considerations and restrictions.

Research methodology

In this study, the researchers have used a proper content analysis and a systematic review and also division of the body of the literature. The *grounded theory* has involved in the collection and data analysis. The process of data collection took place in *secondary method* and has been identified as *qualitative*. Based on the record of 2021, the sector of automobile industry has turnover up to 7.2 billion Euros (de Oliveira *et al.* 2018). The *grounded theory* refers to that all the information has been provided in the study after collecting the data. The main three facts of this strategy are to identify the area of interest, focus on the data only and analyze the meaning of the data. At first, the researchers have to recognize the required criteria that can provide them any kind of interesting information about the topic. After identification, the researchers have to concentrate over the effective and informative data only that can deliver a complete framework to do the complete study work. At the end of the all process, the researchers have to increase the awareness and analyze the meaning of the data that has been collected. The entire process of the research has been finished only after being reached to the *theoretical saturation*.

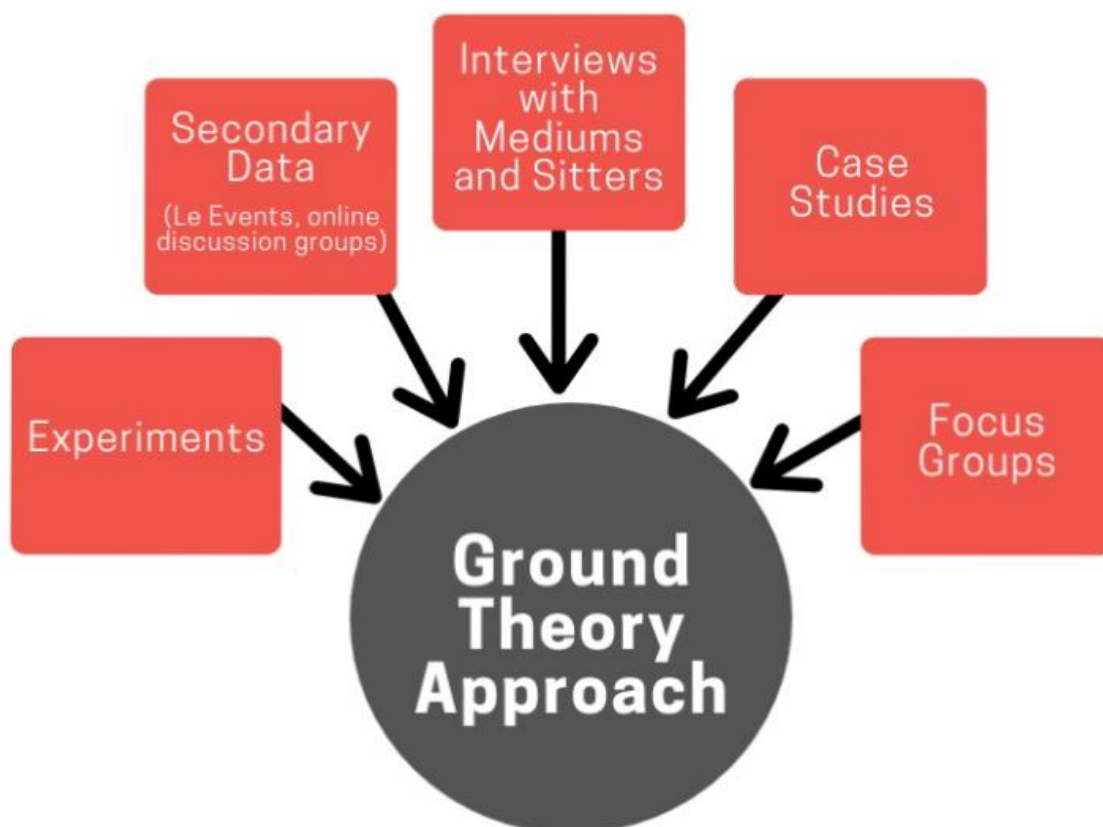


Figure 2: Grounded Theory
(Source: Influenced by de Oliveira *et al.* 2018)

Until all the collected informative data have exhausted the process of the research has not ended. *Grounded theory* delivers *qualitative* researchers with a proper framework for gathering and analyzing data. This theory follows some common specific criteria such as social processes, demanded of the people, need of greenhouse gas and the categories that are integrated into a *theoretical framework*. Each and every individual criterion is

very initial and important in finding data and analyzing its meaning. As per the view of Fang and Zhang (2018), depending on the collected informative data the *secondary data* can be analyzed and those can be *qualitative*. Here in this study all the factors in grounded theory have been followed properly. After doing each and every part with proper justification step by step this study has been completed properly (Muzylyov *et al.* 2020). *Grounded theory* is the most well-known and effective process of methodology employed in several research studies. In this case scenario, the need of invention of the greenhouse gas in the automobile industry has been analyzed after doing all the researches by maintaining every individual criterion under the *grounded theory*.

Resulting in a response rate of 27%, it can be found that there are 350 suppliers connected to the automobile industry (Liu *et al.* 2020). The role of big and initial data has a major influence over the making process and its sustainability. Important data is always able to supply those crucial key factors that can enhance the motivation and willpower to manufacture something new and demandable. Overall, the researchers agreed over the influence of the method of variance in the study of the greenhouse gas invention in the automobile industry, green supply chain. The success of economic innovations can supply the green chain and desiring a low level of carbon economy. The goal of this research is to describe the way the grounded theory would be helpful for conduction of research on the automobile supply chain greening process. Discussing the essential human critical success factor this study qualitatively analyzed that there are three types of innovations those can provide low-carbon economy. As per the view of Wolf *et al.* (2018), the companies that are related to the supply green chain are having maturity with respect for the environment. Grounded theory offers educations regarding environment by delivering qualitative data collection. Involving more grounded theories in the entire system of sustainability of the green supply chain will be able to make sure about more theoretical reach. This theory is helping in the process to make it more flexible and wise so that the organizations can do the approach smoothly.

Using comparative analysis grounded theory embarks to construct or discover the theory from the collected data with maintaining systematic methods. As observed by Roman *et al.* (2017), the main objective of the theory is to deliver a proper and accurate contemporary research framework. Accompanied with these research frameworks the responsible organization can supply the green chain perfectly. The grounded theory is not a straight process at all rather its framework illustrates the interaction between inactive and necessary methods regarding grounded theory and comparative actions. The constant comparative system is providing an original way of analyzing and organizing the all collected qualitative data. Using the framework the organization can understand the systemic method step by step and the progress can be fulfilled. The entire theory is based on the three main objectives such as categories, propositions and concepts. Each step is helpful and has a clear abstraction power to lead the work finely.

The *procedures* and *techniques* of the *grounded theory* are the most two important advocates. This helps the organization to use a systematic set of procedure and deliver the information as a phenomenon. Data collections are considered as the direct theoretical sampling process for the theoretically relevant construction method to supply a proper green chain to the global environment. This structure is able to help in identifying objects, individuals and documents properly to analyze the early stage whether the procedure can be possible or not. In the words of Roy-Davis *et al.* (2017), maintaining the groundedness of the selected approach, *grounded theory* suppressed several unique characteristics. Adopting this theory in the work process the organization or the researchers can get the opportunity to enhance the possibility of their saturation and destiny. Bringing sustainability in the green chain supply process this theory is justified as it has the capability to work systematically and conceptually.

Analysis

Author	Findings	Research Methods
Prakash <i>et al.</i> (2018)	<ul style="list-style-type: none"> Supply chain of the entire system is getting tougher to get Finding a pair wise comparison matrix also has been difficult in order to manufacture greenhouse gas in vehicle After the application of the method the meaning of the extent analysis has been cleared The automobile industry needs to implement risk management practices 	Here Aditya Prakash has used Chang’s <i>Extent Analysis Technique</i> to find all informative data and information regarding involvement in greening in the automobile supply chain.
Quintana-García <i>et al.</i>	<ul style="list-style-type: none"> Inventing greening in the automobile supply 	<i>Empirical evidence</i> has

(2021)	<p>chain management has the ability to boost the corporate reputation</p> <ul style="list-style-type: none"> ● The selection of the suppliers of the greenhouse gas is very important ● Measuring the impact of the greenhouse gas has been done after doing the research. 	<p>been collected to do the entire research process successfully.</p>
Mardani <i>et al.</i> (2020)	<ul style="list-style-type: none"> ● Sustainable SCM is very important to find the crucial data ● Before doing the research there should be a proper structure or framework that can guide the research process ● It needs theories that have the capability to provide the need able criteria 	<p>Structural Equation Modelling (SEM) has been used by researchers to obtain all the findings.</p>
Luthra and Mangla (2018)	<ul style="list-style-type: none"> ● Eighteen types of obstacles initiatives are found in order to increase the sustainability of the automobile industry ● Future scopes are identified after doing this entire research method ● Several types of ethical and legal issues are found at the end of the research 	<p>Emerging economies altogether to enhance the sustainability of the usage of greenhouse gas in automobile vehicles.</p>
Kaur <i>et al.</i> (2018)	<ul style="list-style-type: none"> ● In order to complete the research multi criteria decision making process is required ● Managing the green chain supply management is another vital criteria to observe ● Lack of expertise in the technological field and lack of environmental awareness causes the delay of invention of the green chain supply process 	<p>A dematel related approach has been used in investigating the obstacles in the case of green chain supply management system.</p>
Belhadi <i>et al.</i> (2021)	<ul style="list-style-type: none"> ● Service operations are a crucial need to emerging the situation with each other to create a complete overview ● Both for the short and long term sustainable issue inventing a green supply chain in the automobile industry has a great and positive effect ● Balancing the economy of the country is also very important ● Developing the local supply sources also it has been important to focus 	<p>In order to manufacturing automobile vehicles by the production firms more actively this research has been done with the help of supply chain resilience (SCRes)</p>
Muzylyov <i>et al.</i> (2020)	<ul style="list-style-type: none"> ● Providing transportation that can attract customers towards the organization is very important ● The quality of the product and its sustainability should be focused ● Considering over the logistic suppliers that can reduce the risk factors 	<p>Focusing the technological features of transportation has been done here to finish the project work properly.</p>
Nadeem and Siddiqui (2017)	<ul style="list-style-type: none"> ● Involving strategic orientation is essential for inventing greenhouse gas in vehicles ● The organizational efficiency regarding operational approach is another key factor to invent green gas in the automobile industry ● Customer effectiveness also has a great impact over making the decision regarding it 	<p>Both environmental and SCM strategic orientations are depending on the finding process and helps in finishing the research appropriately</p>

	<ul style="list-style-type: none"> • Desire to create a better social image is very important to reach the destiny • Economic performance should be stable to do the approach initiative 	
Liu and Chang (2017)	<ul style="list-style-type: none"> • The approach of green supply chain management still stands in the infant stage due to lack of proper motivation • It has been implemented only to a limited extent till now • Closed loop has direct impact over the implementations of the inventory green gas in the automobile vehicles • The entire relationship between economic and environmental performances provide the assurance regarding the green gas invention 	<i>Closed loop</i> orientation has been adopted to do this research successfully in order to inventory green gas in the automobile vehicles
Bag <i>et al.</i> (2018)	<ul style="list-style-type: none"> • The relationship between buyers and suppliers are very crucial to balance to develop the work • Unethical practices also have importance in order to make it possible • Design a proper framework before starting the process also considered as a crucial need to increase the sustainability green supply chain in automobile vehicles • Recycling and reuse of harmful gases prove successful in maintaining cost-effectiveness for the organization 	Maintaining a positive and professional relationships among the major criteria that are important in this entire process this research has been done

Table 1: Systematic Review
(Source: Self-made)

Theme 1: Digitalization is supporting automation supply chain to adopt greening strategy

Maximizing the productivity level and reducing cost reading production, smarter operations are a very crucial need. Diminishing environmental impact over the people and economy digitalization has the ability to support automation supply chains. In the process of innovation green supply chain energy is considered as the highest contributor to the manufacturing cost. Complying with ordinance on waste and emission the cost is depending on the construct process. In the article of 2019, *The United Nation* has released that while stimulating economic growth envision the 2030 framework in order to get clean and affordable energy. There is a presence of 60 percent of ABB’s global profits that directly connect with the environmental sustainability process that comes from technologies. As observed by Ramachandran and Eschermann (2020), the chief digital officer has predicted that this project has the capability to reach \$136.83billion by the year 2026. Accompanied with more technological innovations the organization can easily enhance the intention of the customer towards the purchasing method to green products. In order to establish the communication process faster digitalization has an outstanding impact. Developing production by reducing cost and difficulties a proper modern and advanced theological system is required.

Theme 2: The role of the government to support the automation supply chain

In the process of evolution of green supply chain boosting and technologies green product market shares all companies require proper Government support. Under hybrid and electric vehicles majority of appealing abroad automotive manufactures have found major obstacles due to lack of government support. As opined by Hossein (2016), all non-governmental organizations feel the pressure of green gas inventory production vehicles. Government as a powerful stakeholder of the green supply chain can easily force the firms by influencing their both external and internal resources. Government also has the capability to encourage the media to modify the legitimacy of green as inventory companies. In the UK the government took an initiative to supply the green chain by recycling the harmful gases to provide hydrogen (influenced by Balon 2020). Compressing natural gas in the vehicle and creating alternative fuel to use in the vehicle US has taken their step forward.

Accompanied with accurate government policy an organization can invent green gas in their vehicle production method without any barriers. As stated by Balakrishnan and Suresh (2018), the government can push the people to purchase green products that can enhance the share rate of the organizations and provide them appropriate profits. Another way is possible for the government to apply taxes on the organizations those are not practicing the green supply chain sustainability method. In this case the companies and the people have no other option in their hands without producing green vehicles or purchasing green products.

Theme 3: The role of the customer to support the automation supply chain

In the process of innovation in the green supply chain the role of the customer is equally important as the government to enhance production methods. In case of providing customer satisfaction by only delivering green products then the organizations can feel pressure to provide faster and customized order perfection to balance a competitive edge. As stated by Khan *et al.* (2018), if the customers can increase their awareness about their health and the environment then the suitability of green gas innovation can be possible. Accompanied with customer demand the organization can realize the pressure and can analyze clear understanding customer value. Customers have the capability to create a strong pressure on the organization that they concentrate on the construction process by investing in green gas. In case the companies can produce vehicles with green gas at low cost then consumers also increases their intention to purchase the automotive vehicles. As opined by Karurkar *et al.* (2018), in order to fulfill the customer demand the firms will enhance their production to fulfill the requirements of the people. In this modern decade, every person can easily be attracted to modern and advanced technologies. So in case of innovation in the green supply chain in automotive vehicles then the selling rate also can be enhanced. Currently people are conscious about their health so in order to fulfill their health concern also the invention of the green supply chain automobile vehicle can increase popularity among the people.

Discussion

The essentiality of changing the organizational or industrial activities, provide a more sustainable world with the help of *World Commission on Environmental and Development*. In the article, Prakash *et al.* (2018) has observed that the automobile industry needs to implement risk management practices to avoid the obstacles. As getting supply chain is considered as a tough problem so having a strong relationship with the supplier can give an opportunity to the manufacturer firms. On the other hand Quintana-García *et al.* (2021) has stated that green gas innovation has the capability to hold the reputation of the organization and increase profitability. Fulfilling these criteria the selection of greenhouse suppliers is very important. Eighteen types of barriers initiatives are found in order to increase the sustainability of the automobile industry as observed by Luthra and Mangla (2018). There is a positive future scope for the companies that are working to get innovative greenhouse gas in the automobile. Emerging altogether this invention can happen in real life is the thought of Luthra. As per the view of Mardani *et al.* (2020), finding the crucial data, sustainable SCM is very important. A proper structure of framework also other essential needs to increase sustainability of automobile industries.

In another viewpoint of Belhadi *et al.* (2021), balancing the economy of the country, the green supply chain is very important. Developing local supply chain sources is also considered of equal importance. Kaur *et al.* (2018) describes that lack of expertise in the technological field and lack of environmental awareness causes the delay of invention of the green chain supply process. So in this case the organizations should provide proper training and then involve any person into the work process. As for the invention of greenhouse gas in the automobile industry it is necessary to have proper technological knowledge. As opined by Muzylyov *et al.* (2020), providing transportation that can attract customers towards the organization is very important to enhance the sustainability of the green supply chain. The automobile industry should focus on the quality of the product that develops the firm's reputation and benefit level. Considering over the logistic suppliers that can reduce the risk factors also is required as a crucial need in the automobile industry.

In the words of Liu and Chang (2017), the approach of green supply chain management still stands in the infant stage due to lack of proper motivation. Maintaining relationships between economic and environmental awareness is very important to bring sustainability to the green supply chain. As observed by Nadeem and Siddiqui (2017), involving strategic orientation is essential for inventing greenhouse gas in vehicles. Operational approach is another essential criterion to invent greenhouse gas in automobile vehicles. Developing economic stability also this invention can be proved as a vital production. As per the view of Bag *et al.* (2018), the relationship between buyers and suppliers are very crucial to balance to develop the work. The organizations should practice unethical and technologies that can push the approach forward. Based on all the findings it can analyze that each author and articles are focusing on the progress of the invention of the green supply chain in the automobile industry.

Conclusion

The authentic shift from conventional supply chain to sustainable supply chain has been rehearsed in different industries for many years. The automobile industry is the largest and the prominent industries in the global business market. This industry has a sustainable effect on the development of suitable society. This study has presented an operation oriented review in the area of automobile green supply chain sustainability. Applying a proper framework and systematic approach this innovation can be fulfilled in real. To categorize the entire study a complete research has been done to create it more realistic. The viewpoints of different authors and their analysis also have been provided in this study to make it sustainable. This entire study can be helpful in doing further innovation and progression for sustainability to the green supply chain in the automobile industry.

Recommendations

The process of greening the automobile supply chain can be improved by various modifications. Increasing the supply chain visibility, the organization can avoid the lack of sources to produce the product. The automobile industry should be capable of tracking each and every component of them to reduce competition. Innovation supports in improvement of supply chain management as it enhances overall performances. Keeping all the necessary parts that required in the manufacturing process also can allow an automobile industry to progress further in the future growth. Engaging the IT department in their innovation power has also the ability to avoid the lack of technological invention. Implementing a good project framework an automobile industry can predict their possibility far before the start. Fulfilling all objectives and goals these recommendations can help the automobile industry in order to sustain the green supply chain.

Due to this research work getting different opinions from different authors makes the research work a bit lengthy. Collecting different samples and data are considered as tougher due to lack of previous research experiences. Time constraints are considered as other obstacles due to the research work. The technique and process of data collecting is also responsible for research limitations.

Following the proper framework and applying those in the construction process can bring an great opportunity for the automobile industry. Invention greenhouse gas in automobiles can provide the living being a beautiful and healthy world to live in. The automobile industry also can increase their profit margin by inventing a green supply chain and stable economy of the world.

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