

A Green Logistics Network Design to Increase Responsiveness to Eco-Friendly Consumers

Eungoo KANG¹

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Abstract

Purpose: The industrial sector, especially in developed countries, is seen as the primary threat to sustainability. As a result, contemporary organizations prioritize establishing sustainable business practices. This sustainability can be achieved by organizations being concerned with their external environments, which is referred to as going green. This study aims to provide a green logistics network design to explain how to attract green consumers. **Research design, data and methodology:** This study conducted a comprehensive process to obtain textual dataset in the current literature and finally the author could collect total 26 relevant prior studies to achieve the purpose of the study. All dataset was thoroughly screened and selected for the high-degree of validity. **Results:** Based on the intensive literature review, the author insists that the four findings presented in this study will be useful as they provide evidence of the importance of technology in achieving global sustainability. In the situation we face that technology has become an important part of human life. **Conclusions:** This study provides meaningful insights into the environmental strategies that organizations across the world can implement to achieve a green supply chain based on the solutions in this study. The strategies presented in this study are evidence-based and have been tested through different studies.

Keywords : Green Logistics Network, Green Business Strategy, Eco-Friendly Consumers, CRM

JEL Classification Code: Q11, F64, P46, E26

1. Introduction

The green concept refers to "doing actions while integrating environmental or ecological concerns" (Tseng et al., 2019). The supply chain is an essential branch in any organization and has considerable impacts on the environment, including health hazards of the community, pollution, and emission. In recent years organizations have developed various strategies to reduce environmental pollution and promote global sustainability. One strategy

that they have implemented to achieve this goal is by integrating environmental concerns with their supply chain management. This approach is broadly referred to as the green supply chain (GSC). The concept has been established as a crucial discipline for promoting global sustainability (Li et al., 2020).

Generally, supply chain design problems include defining where and how to deploy assets such as distribution centers, warehouses, and plants. It also consists of determining the flow of materials between customers, retailers, suppliers, manufacturers, and distributors. Applied

¹ First and Corresponding Author. Full-Time Faculty, Becamex School of Business, Eastern International University, Vietnam. Email: ekang@eiu.edu.vn

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mathematical modeling used to assess supply chain optimization can form the basis for developing effective approaches to the design of GSC. Existing research indicates that there are two types of SC design optimizations, including single objective (SO) and multi-objective (MO). Similarly, these models can be aggregated into two other clusters, namely closed-loop optimization and open-loop optimization. The closed loop dimension focuses on backward flows such as packaging, unused raw materials, and end-of-life of products (Fontes & Freires, 2018).

Unfortunately, the recovery of end-of-life products has been ignored by many manufacturers, especially in developing countries, including the US, China, and European countries. The organizations face challenges due to the increased legislation imposed on them, setting targets in several areas, including disposal options, material recycling, waste prevention, and the use of toxic and dangerous chemicals (Bányai & Kaczmar, 2021). In recent years, this framework has forced companies across the world to rethink and redesign their supply chains. Previous studies suggest that mathematical models can provide significant insights into the development of new GSC that ensure global sustainability.

New models and practices struggle to provide support to effective decision-making in terms of ensuring sustainability. Previous studies have suggested various approaches that organizations can use to integrate environmental concerns into their supply chain management. However, more research is needed to evaluate the strategies that have been proposed in previous studies and develop new solutions to the problem. This study provides a literature review of the existing knowledge on green supply chain design. Based on this literature, the study provides evidence showing how organizations can design their supply chain to become eco-friendlier and more become more responsive to environmentally educated customers.

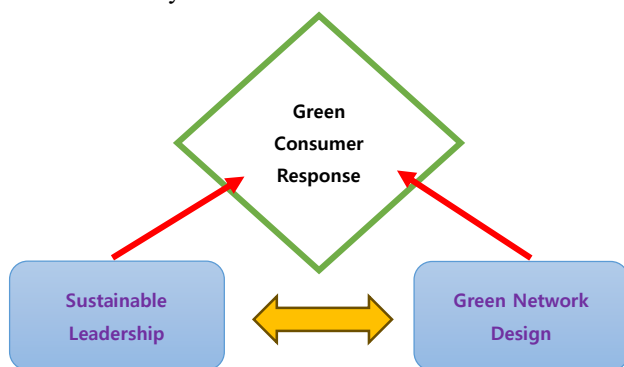


Figure 1: Desired Outcome of the Research

2. Literature Review

Numerous studies have been conducted in the past focusing on green supply chain management. Tseng et al. (2019) indicate that practitioners, scientists, and academicians have proposed the concept of a green supply chain as a potential solution to ensuring global sustainability. This concept can be found in the 1990s literature. However, the trend in research suggests that the concept gained traction in 2000. Since then, the concept has evolved over the years, taking a formal shape in the past two decades. Bányai and Kaczmar (2021) outlines the application of the concept in various activities in the customer order cycle. Organizations are more concerned about environmental sustainability and are willing to adopt this concept to inform their business practices.

According to Li and Sarkis (2022), GSC refers to "integrating environmental concerns into the inter-organizational practices of sustainable supply chain management, including reverse logistics." Generally, this concept is broad, and many researchers have come up with different definitions. As a result, it is difficult to define it using a single definition. While there is a significant difference in the definition of the concept, researchers have used GSM in a common way to promote environmental sustainability. Stekelorum et al. (2021) acknowledge the differences that exist in the definition of the concept and suggest all these definitions lead to the same outcome, ensuring global sustainability.

Waltho et al. (2019) noted the importance of collaborative efforts between organizations and supply chain partners to promote sustainability based on their business processes. Collaboration with logistic service providers, customers, and suppliers is essential to minimize pollution aspects, share environmental information and mutually realize sustainability goals and objectives. Stekelorum et al. (2021) support these findings and indicate that collaboration between organizations and their suppliers is essential in ensuring the entire supply chain integrated environmental protection strategies to promote sustainability. Similarly, Amini and Kianfar (2022) emphasize the importance of collaboration among different stakeholders to ensure supply chains integrate environmental issues.

Bányai and Kaczmar (2021) provided significant insights into the disciplinaries of GSCs design. Different aspects of disciplinarity can be used to design and implement GSC management. One aspect of GSC design is material handling. Robotized and modular material handling solutions provide a path to achieving effective material handling in GSC solutions. An interesting aspect of the reusability of packaging materials, containers, and pallets is that reusability is based on both environmental and

economic dimensions. Environmental sustainability in material handling operations is essential in logistic centers, warehouses, and third-party logistic partners.

Another critical aspect of the supply chain is transportation. Electronic mobility provides an environmentally friendly solution for transportation, including home delivery, waste collection, and energy generation. Similarly, Cousins et al. (2019) indicate that transport plays a critical role in supply chain management. As a result, pollution from transportation contributes significantly to global warming. As a result, GSC management must incorporate strategies that aim to minimize pollution caused by transportation (Cousins et al., 2019). E-mobility is one of the prospective solutions proposed for this issue.

Information technology is also another area that has been extensively reviewed with a focus on environmental sustainability. Advanced information technology (IT) solutions can support the greening tendencies and sustainability dimensions of supply chain management. Bányai and Kaczmar (2021) indicated that "the Internet-of-Things technologies of the fourth industrial revolution make it possible to transform conventional supply chain solutions into cyber-physical systems, where the greening tendencies can be supported by IT solutions including cloud computing, fog computing, edge computing, big data, digital twin for forecasting, identification and tracking solutions."

Energetics is another dimension of the greening focus. Bányai and Kaczmar (2021) found that this aspect of the GSC involves the reduction of emissions and consumption of energy. Additionally, it focuses on other areas, including sustainable raw materials, recycling, combined transportation and distribution, waste reduction in production, and clean technology. Elhedhli et al. (2021) support these findings and indicates that energy production and use is an area of interest when it comes to GSC management. Companies can promote global sustainability in the use of energy by reducing emissions and managing waste in an effective manner. Similarly, recycling can help manage waste from energy production.

Systems theory also has significant impacts on the implementation of GSC design. As a complex system, the research of GSC design can be broken down into network theory, collective behavior, nonlinear dynamics, and game theory. Moreover, decision-making degrading the implementation of GSC in organizations is an area that has been investigated extensively in previous studies. Bányai and Kaczmar (2021) postulated that complex decision-making methods and models have significant impacts on GSC design and processes. These models are linked to sustainability constraints, objective functions, and multiple dimensions. Production technology is also an important dimension of GSC management. Sustainable climate

technologies and energy are essential in ensuring the transition to environmentally friendly business practices.

2.1. Research Gap

The literature review conducted on this topic provides insights into various areas regarding the green supply chain that needs to be investigated further. There is limited research on GSC design aimed at increasing the responsiveness of environmentally educated customers. Previous studies have focused on the broad topic without considering the impacts of these designs on customers. Similarly, little is known regarding the GSC trend over the past few years. Researchers have not focused on how GSC management has changed over the years since it was established in the 1990s. As a result, an inquiry into this trend is needed to provide new knowledge on the trajectory that it may take in the future.

Table 2: The Description of the Literature Review

Effect	Summary
The key theme of GSC	(1)The importance of collaborative efforts between organizations and supply chain partners to promote sustainability based on their business processes. (2) Another critical aspect of the supply chain is transportation. (3) Information technology is another area that has been extensively reviewed with a focus on environmental sustainability. (4) Energetics is also dimension of the greening focus .(5) Systems theory also has significant impacts on the implementation of GSC design.
Necessity of fill out an insight to the Leterature	There is limited research on GSC design aimed at increasing the responsiveness of environmentally educated customers. Previous studies have focused on the broad topic without considering the impacts of these designs on customers. Similarly, little is known regarding the GSC trend over the past few years.

Additionally, there is limited knowledge regarding solutions for ensuring sustainability in supply chain management. Various studies in the past have proposed different solutions to the issue. However, the different studies have varying evidence regarding the solutions proposed. An inquiry into the solutions for ensuring the development of GSC is needed to ensure global

sustainability and inform strategies to be used by organizations to address issues associated with poor supply chain management. Finally, supply chain solution designs are complex and involve diverse knowledge. As a result, it is essential to create an understanding of the relationship and impacts of these sciences and knowledge.

Changes in biodiversity and increased global warming have put pressure on companies to adopt sustainable business practices. Moreover, stakeholders are aware of the environmental impacts of various business operations. The supply chain network plays an important role in the degradation of the environment. As a result, there is a need to create more insights into GSC to address environmental degradation. The absence of evidence regarding the effective implementation of GSC solutions is a significant issue of concern. This study will add more knowledge to the area and propose solutions that can help achieve sustainability in the supply chain.

3. Research Methodology

The content analysis investigates all kinds of textual dataset in the present literature warehouse. However, this study tried to take a look at only relevant peer-reviewed journal articles and books. That implies that This study conducted a comprehensive process to obtain textual dataset in the current literature and finally the author could collect relevant prior studies to achieve the purpose of the study. All dataset was thoroughly screened and selected for the high-degree of validity and reliability (Nguyen et al., 2022; Kang & Hwang, 2017).

A systematic data extraction procedure was carried out after selecting the final group of qualifying research. Data extraction is typically explicable through a diverse database screening process (Sarkis-Onofre et al., 2021). A consistent data extraction form was used to meticulously capture pertinent data from each study, including author names, publication details, research aims, techniques, significant findings, and implications (Phommahaxay et al., 2019).

Since the systematic examination of the literature served as the foundation for this study, the key ethical issues are those of proper source citation and usage. Throughout the study, all sources will be correctly mentioned, and the contributions of other scholars will be valued and acknowledged. This research will meticulously adhere to ethical norms for using academic resources and referencing to preserve the integrity of the research (Nantharath et al., 2016; Kim & Kang, 2022).

It's also crucial to remember that this study does not involve any primary data collection from individuals; instead, it analyzes academic publications that are publicly available, so ethical concerns regarding human subjects do

not apply. The qualitative content analysis visually represents this systematic process, ensuring clarity and accountability in the review process. This methodological rigor enhances the validity and reliability of the research findings (Nguyen et al., 2022).

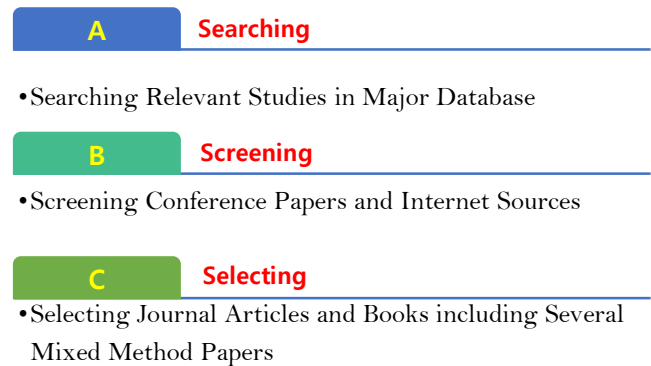


Figure 2: Methodology of the Research

4. Research Results

Various studies have proposed strategies that organizations can implement to become more eco-friendly in their supply chain. Various companies have already adopted these practices to improve their productivity and increase their responsiveness to environmentally educated customers.

4.1. Green Material Sourcing

Green purchasing is one of the effective approaches to promoting an eco-friendly supply chain. It refers to purchasing or sourcing components and materials which have eco-friendly characteristics, including nonuse of hazardous chemicals, recyclability, and reusability (Sellitto, 2018; Park & Kang, 2022). Procurement experts are focusing on developing new approaches to sourcing materials due to the increased concerns among customers regarding environmental protection. Remanufacturing and recycling are involved in the role of eco-friendly purchasing. Sellitto (2018) emphasizes that green purchasing reduces wastage in the manufacturing process and encourages recycling. Firms can benefit significantly from remanufacturing and recycling their products due to the reduced costs of sourcing new raw materials.

Suryanto et al. (2018) postulate that green sourcing can promote the reusability of raw materials. This technique ensures the greater value of raw materials by ensuring they

do not go to waste once they have been used. Additionally, the reusing of raw materials ensures they do not have negative impacts on the environment. Moreover, green purchasing promotes investment recovery (IR). This technique involves the redeployment and recycling of raw materials to extract greater value from the products or raw materials by the company. "IR is also a unique technique to generate revenue by selling useless assets, for reducing storage, space and deploying idle assets from other corporate locations to avoid extra purchasing additional requirement of equipment for materials and processes" (Suryanto et al., 2018).

Similarly, Abdel-Baset et al. (2019) notes that companies can achieve green purchasing by providing design directives for suppliers by including green concepts in sourcing. Green purchasing encompasses environmental material substitution, refuse reduction, and serious material minimization. As a result, companies play an essential role in ensuring suppliers' environmental performance. Abdel-Baset et al. (2019) categorize green purchasing into various dimensions, including environmental authentication, Supply chain management, design operation management, and ecological and environmental management. Generally, green purchasing improves the overall performance of an organization. This approach is effective in mitigating water, air, and waste pollution.

Cherrafi et al. (2018) found that green purchasing plays an important role in promoting sustainability. The approach ensures that the material purchased by an organization are reusable and can be recycled. As a result, these materials do not go to pollute the environment once they have served the purpose intended. Wong et al. (2020) supports these findings and indicates that green purchasing is an effective approach to improving the environmental and cost performance of an organization. It entails ensuring that the raw materials sourced by an organization can be recycled or reused, reducing their ability to pollute the environment.

4.2. Green Transportation and Reverse Logistics

Wang et al. (2020) postulates that reverse logistics and green transportation provide an opportunity for companies to reduce their costs and improve their images. Companies can save logistic overheads by promoting the efficiency of transportation systems and enhancing customer satisfaction. The logistics activities involved in this approach incorporate reverse logistics that can lead to the development of products that can be used again. Green logistics result in improved quality of products and reduced costs of manufacturing and distribution. Reverse mobility involves the collection of products and materials used by customers for recycling and reusing. These materials are treated as important industrial inputs rather than going into wastage.

Lu et al. (2019) indicate that green transportation can be achieved through e-mobility. This solution involves the use of one or more electric motors to generate transportation. It reduces the emission of toxic gases significantly. Vehicles using these motors do not consume fossil fuels. As a result, they do not emit greenhouse gases that contribute to global warming. Evidence shows that the use of electric vehicles in transportation can help prevent global warming and climate change. Moreover, the maintenance costs for the vehicles used in e-mobility are significantly lower than other modes of transport (Wang & Sun, 2019). As a result, companies can benefit considerably from low costs of transportation and use these financial resources to improve the quality of their products and services.

A reverse logistics management system streamlines the return process to minimize impacts on transportation. It helps to reduce the social, environmental, and economic impacts of an organization (Prajapati et al., 2019). It also improves a company's asset utilization and increases its profitability. As a result, this technique is essential for organizations that want to improve sustainability. Companies can benefit significantly from reverse logistics, and it ensures that products that would have otherwise been disposed of and polluted the environment are returned back to the organization and are used in manufacturing new items (Prajapati et al., 2019).

Richnák and Gubová (2021) indicated that green transportation ensures sustainability by eliminating environmental burdens, ensuring efficient use of natural resources, natural resources protection, and ensuring high quality of the environment. Similarly, the use of green transportation and reverse logistics helps organizations to develop positive relationships with their customers. Environmentally educated customers want to relate with companies that understand the importance of environmental protection and sustainability. As a result, those organizations that implement effective strategies to ensure sustainability, including reverse logistics, are likely to develop good relationships with their customers and improve their performance (Richnák & Gubová, 2021).

4.3. Renewable Energy and Biofuels

Supply chain operations and logistics depend on energy and fossil fuels. Nevertheless, fossil fuels are the primary cause of pollution, global warming, and climate change. The high emissions of carbon and greenhouse gases lead to air pollution. As a result, biofuels and renewable energy are required in supply chain management to ensure sustainable environmental growth. Azevedo et al. (2019) posits that logistics consume significant energy. Renewable energy and biofuels can reduce carbon emissions to the atmosphere and promote the economic performance of companies. Similarly,

biofuels and green sources of energy are cheaper than fossil fuels, helping companies reduce the cost of operations.

Increased customer awareness and government regulations of the use of fossil fuels increase pressure for companies to adopt green energy sources and biofuels. These sources of energy help improve the company's reputation because they show customers that the company cares about its environment (Gawusu et al., 2022). Similarly, the use of renewable sources of energy reduces the overdependence on imported fuels. Interestingly, importations involve the use of fossil fuels, increasing pollution to the environment. Ships used to transport fossil fuels pollute the environment when they spill oil and produce carbon emissions from their engines. The use of renewable sources of energy can reduce the importation of fossil fuels and reduce the release of greenhouse gases into the atmosphere (Fontes & Freires, 2018).

Fernando et al. (2018) found that renewable energy could play an essential role in promoting GSC management. It reduces the emission of carbon dioxide into the atmosphere, which is the primary cause of global warming and climate change. Firms that use renewable energy are likely to send a message that they are responsible and committed to ensuring environmental sustainability. The use of green energy sources and biofuels is one of the potential approaches to ensuring companies reduce environmental pollution (Mastrocinque et al., 2020).

4.4. Information Technology

In the past few years, information technology has revolutionized different industries. Similarly, IT can play an essential role in ensuring GSC management. Updated IT solutions can support the greening tendencies and sustainability aspects of supply chain solutions in different ways (Lin, 2022). Advanced technologies such as the internet-of-things provide an opportunity for organizations to transform conventional supply chain solutions into cyber-physical systems. These tech-savvy systems support green tendencies through the use of IT solutions, including digital twins for forecasting, big data, edge computing, fog computing, cloud computing, and tracking solutions (Li et al., 2020). These solutions help companies to develop effective strategies that they can use to ensure sustainability (Khuntia et al., 2018).

Companies can automate warehouse operations, optimize sourcing relationships, manage inventory proactively, and improve customer experiences by utilizing a combination of technologies such as predictive analytics, machine learning, and artificial intelligence (Yildiz Çankaya & Sezen, 2019). The use of these technologies has gained traction in the past few years. Companies using them have benefited significantly from understanding their levels of

pollution and setting targets to reduce these emissions and reduce environmental pollution (Shahzad et al., 2020). The use of these technologies creates a public perception that an organization is committed to environmental sustainability, creating a positive relationship with customers.

Table 2: Key Theme of the Research Based on the Result

Main Theme	Previous Resources
The four findings presented in this study are useful as they provide evidence of the importance of technology in achieving global sustainability in the situation the world face that technology has become an important part of human life.	Sellitto (2018), Suryanto et al. (2018), Abdel-Baset et al. (2019), Cherrafi et al. (2018), Wong et al. (2020), Park and Kang (2022), Wang et al. (2020), Lu et al. (2019), Wang and Sun (2019), Prajapati et al. (2019), Richnák and Gubová (2021), Gawusu et al. (2022), Fontes and Freires (2018), Fernando et al. (2018), Mastrocinque et al. (2020), Lin (2022), Li et al. (2020), Khuntia et al. (2018), Yildiz Çankaya and Sezen (2019), Shahzad et al. (2020).

5. Implications for Practitioners in Companies

This paper has many contributions to this field of research. It provides insights into the strategies that organizations across the world can implement to achieve GSC. The strategies presented in this paper are evidence-based and have been tested through different studies. Similarly, the study reveals the importance of collaboration between various partners in supply chain management, including manufacturers, suppliers, distributors, warehouse services, and customers, to ensure global sustainability. This collaboration is essential in sharing environmental information, achieving environmental goals, and reducing pollution. Organizations that want to achieve sustainability goals need to promote collaboration among partners in the supply chain.

The findings presented in this article are also useful as they provide evidence of the importance of technology in achieving GSC and global sustainability. Technology has become an important part of human life. Various technologies developed in the past provide opportunities for improving supply chain management by reducing wastage and optimizing costs (Cui et al., 2020). The insights provided in this study suggest certain technologies that organizations can use in their greening transformation. These insights can be beneficial for organizations that emit significant amounts of greenhouse gases that can be

controlled through the use of technology. Moreover, organizations can use these insights to determine the level of funding needed to implement technologies that support GSC.

Furthermore, this study provides new knowledge into the roles of renewable energy in achieving GSC. Previous studies have indicated that the use of fossil fuels plays an essential role in global warming. These studies have suggested that reducing the use of fossil fuels in industries could be an important strategy for managing global warming and reducing climate change (Nunes et al., 2020). This study proposes the use of renewable energy in industries as a viable alternative to the use of fossil fuels. Various organizations across the world, especially those in developed countries, have already started developing strategies to reduce emissions. Renewable energy alternatives can be highly beneficial for these organizations.

The study also provides new knowledge into the use of reverse logistics management systems to streamline the return process to minimize impacts on transportation. Transportation is an area that has attracted significant research in the past regarding the greening process. Multiple studies have given recommendations on what needs to be done to reduce emissions in the transportation system. This study complements the existing literature and provides new insights into the greening process (Dallasega & Sarkis, 2018). It underscores the importance of using e-mobility in ensuring GSC. Organizations can use these insights to develop effective strategies that can be implemented to promote e-mobility. Similarly, the study findings create awareness about the impacts that eco-friendly mobility can create on the environment.

Similarly, this study provides significant insights into the directions that future studies on the topic should take. The study explores existing literature on the topic that can be used as the basis for future studies. It has outlined various gaps in the existing literature that needs to be addressed in future studies. Researchers who have an interest in this topic can benefit significantly from reviewing the findings of these studies. Moreover, Futures studies can focus on specific solutions to GSC presented in this study. The focus on one area of study is essential in creating more knowledge in that area and informing specific actions that organizations need to take to ensure GSC and increase their responsiveness to environmentally educated customers.

6. Limitations and Conclusions

This study has various limitations. One of the limitations of this study is the researchers' bias in selecting the studies reviewed. The findings presented in this study are based on the findings of previous studies focusing on the topic. As a

result, the researcher may have been biased in selecting the studies to be included in the project. Similarly, the researchers may have been biased in selecting the evidence to be included in the present study. This bias may have influenced the overall outcomes of the study and the recommendations given in the study. While various strategies have been used to limit this bias, it may have considerable impacts on the study outcomes.

Similarly, this study does not explore the role of mathematical models in the GSC design. Previous studies have indicated that mathematical models are essential in designing effective GSC design. Nevertheless, this study did not provide insights into how these models can be used to enhance the adoption of sustainable business practices among various organizations across the world. These models could have created more insights into best practices that can be used in promoting GSC. Moreover, the study does not explore tests that can be used to assess model behaviors from the GSC design developed.

Finally, this study has outlined various solutions to the development of a green supply chain design. However, it does not provide comprehensive approaches that organizations can use to implement these solutions. As a result, there are no actionable insights that can be translated into actual activities to ensure sustainability in the supply chain. These limitations have affected the applicability of the study findings in a real-world scenario.

In conclusion, the design of an effective GCS is a complex problem that can be addressed using various strategies. Poor supply chain management in recent years has led to poor waste management, pollution, and global warming. Consequently, contemporary organizations prioritize establishing sustainable business practices. Various companies have developed strategies to reduce pollution and promote sustainability. However, some of the solutions that these companies have developed have not yielded the expected results, and they continue to emit greenhouse gases and pollution throughout the supply chain (Karmaker et al., 2021).

GSC can be achieved through various strategies, including green material sourcing, green transportation, reverse Logistics, renewable energy and biofuels, and information technology. Procurement experts are focusing on developing new approaches to sourcing materials due to the increased concerns among customers regarding environmental protection (Koberg & Longoni, 2019). Companies can save logistic overheads by promoting the efficiency of transportation systems and enhancing customer satisfaction. On the other hand, Renewable energy and biofuels can reduce carbon emissions to the atmosphere and promote the economic performance of companies. Similarly, Companies can automate warehouse operations, optimize sourcing relationships, manage inventory

proactively, and improve customer experiences by utilizing a combination of technologies such as predictive analytics, machine learning, and artificial intelligence.

The findings presented in this article are also useful as they provide evidence of the various solutions that companies can implement to achieve GSC and global sustainability. Nevertheless, further studies are needed to validate the findings of this research. These studies need to focus on using mixed research methods to reduce the bias that may have been introduced by the researcher in this study. Additionally, future studies need to use mathematical models in designing GSC to create more understanding of the area.

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