

# Conceptual Framework and Hypothesis Development for Green Supply Chain Practices

A. S. Dube<sup>1\*</sup>, S. B. Ambekar<sup>2</sup>, N. L. Bhirud<sup>3</sup>, P. R. Baviskar<sup>4</sup>, P.P. Kulkarni<sup>5</sup>

## Abstract

*In recent decades, sustainability has gained significant attention. Green Supply Chain Management (GSCM) ensures that corporate and governmental initiatives effectively make operations more environmentally friendly, increase market share, enhance brand recognition, and boost profitability. Sustainable or "green" supply chain management integrates both financial and environmental objectives into the strategy for managing supply chain operations. This integration helps reduce carbon footprints while improving profitability and financial returns. GSCM encompasses various aspects, including product design, usage, reuse, disassembly, and end-of-life disposal. It also involves storage, transportation, developing suppliers to meet green purchasing standards, and promoting environmental certifications like ISO 14000. Successful implementation of GSCM can significantly enhance an organization's environmental performance. The success of GSCM heavily relies on Green Supply Chain Practices (GSCPs), which are specific techniques aimed at improving the environmental performance of the supply chain. This research critically examines the GSCM literature to identify key practices and develop a conceptual framework for assessing their impact on organizational performance. A conceptual framework and hypotheses were constructed by identifying distinct GSCPs highlighted in multiple published studies. The framework provides valuable insights into how GSCPs can influence an organization's financial, operational, and environmental performance. It also outlines the motivations behind GSCP adoption and implementation, emphasizing the role of top management commitment and external pressures as key drivers. This study recommends that organizations prioritize critical green practices to enhance their overall performance. Eight key green practices, identified through an extensive literature review, were selected due to their significant impact on organizational performance. The proposed conceptual framework and hypotheses aim to support organizations in improving their operational, financial, and environmental outcomes through the adoption of GSCPs.*

**Keywords:** Conceptual framework, hypothesis development, green supply chain management (GSCM), green supply chain practices (GSCPs), sustainability

### \*Author for Correspondence

A. S. Dube

<sup>1</sup>Professor, Department of Mechanical Engineering, Sandip Institute of Engineering and Management, Nashik, Maharashtra, India

<sup>2,5</sup>Assistant Professor, Department of Mechanical Engineering, Sandip Institute of Engineering and Management, Nashik, Maharashtra, India

<sup>3</sup>Professor, Department of Mechanical Engineering, Ajinkya D.Y. Patil University, Pune, Maharashtra, India

<sup>4</sup>Professor, Department of Mechanical Engineering, SNJB's K.B.Jain COE Chandwad, Nashik, Maharashtra, India

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## INTRODUCTION

The adoption of green supply chain development (GSC) is gaining momentum because it offers a competitive edge and financial benefits when combined with the reduction of environmental damage caused by government regulations and supply chain operations. GSCM is a strategy to enhance product and process performance in compliance with environmental standards (Hsu and Hu, [1]). The effectiveness of GSCM is largely dependent on the effective use of Green Supply Chain Practices (GSCPs). According to Giannis et al. (2019), GSCPs are a collection of strategies used to enhance the supply chain's environmental

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performance. Implementing GSCPs successfully improves an organization's performance. The GSCM concept has gained a great deal of acceptance and application worldwide, in both developed and developing countries (G. T. Tsoufas [2]).

In today's rapidly changing global landscape, the sustainability of supply chain practices has become a critical concern for enterprises and society at large. A more environmentally responsible paradigm of supply chain management has replaced the previous one, which was largely focused on cost effectiveness and profitability (P. Aital and J. P. Vijai [11]). The term Green Supply Chain Management (GSCM) originated from this paradigm shift towards ecologically friendly and sustainable supply chain practices. With the goal of minimising environmental effects and advancing sustainable company operations, green supply chain management (GSCM) integrates eco-friendly strategies and practices throughout the whole supply chain, from procurement to distribution and beyond.

A clear framework and a thorough grasp of the guiding principles are necessary. Conceptual framework functions as the fundamental framework that directs the investigation, examination, and use of green supply chain techniques. It offers a methodical way to understand the intricate interactions between variables that affect the uptake and accomplishment of sustainable supply chain projects. Researchers and practitioners in this discipline can identify important factors, linkages, and mechanisms with the aid of a well-constructed conceptual framework, which provides an organized road map for attaining sustainability objectives

To improve our understanding of green supply chain practices and their impact on environmental stewardship and corporate success, more hypotheses must be developed in the field of green supply chain management (S. M. Lee et.al. [23]). Developing hypotheses entails putting forth verifiable claims that are grounded in the conceptual framework. By using these assumptions as the foundation for empirical study, academics and industry professionals can explore the connections between various factors and the results of green supply chain practices. By means of empirical testing, theories are verified or disproved, resulting in a more profound comprehension of the elements that propel the uptake and efficacy of sustainable supply chain endeavours.

Developing hypotheses within the framework of green supply chain practices involves numerous facets. Researchers may try to look into how various factors—such as environmental laws, supplier collaboration, customer demand, and acceptance of green technology—affect how well green supply chain management is carried out. Once validated, these theories offer valuable insights that support decision-making inside organizations and contribute to the growing body of knowledge in supply chain management and sustainability.

Conceptual framework and development of hypotheses for green supply chain practices are examined in this introduction. Through an organized analysis of the interactions and connections among elements in the framework of GSCM, we may get a more profound comprehension of how companies might shift to sustainable supply chain management while maintaining equilibrium with ecological and financial concerns. Including green supply chain practices can help businesses save money, enhance their reputation as a brand, and gain a competitive advantage in the global market in addition to helping them lessen their environmental impact [27, 28]. As a result, this field of study is extremely important, and developing a strong conceptual framework and formulating hypotheses are crucial stages towards furthering the theory and practice of green supply chain management.

The hypothesis will direct empirical investigations intended to examine the relationship between certain factors and green supply chain practices, while the conceptual framework produced will provide a theoretical foundation for future research on green supply chain practices. In the end, this research seeks to advance knowledge on green supply chain practices, their uptake, and the variables influencing their application. This will help firms interested in adopting sustainable practices by offering guidance [30,31,32,33].

GSCM models were presented in a limited number of research, most of which only addressed a portion of the issue. Few GSCM models are acknowledged, despite the fact that numerous published empirical investigations (case studies) exist. The purpose of this paper is to close this gap by providing a systematic method to direct GSCM analysis. It achieves this by providing a conceptual model framework that takes into account characteristics and categories in order to make the discussion of green practices in GSCM easier.

This study examines, evaluates, and successfully applies green supply chain strategies to address the environmental issues related to production and design. By aligning theoretical insights with cutting-edge technologies, the paper's relevance extends into the realm of innovative and sustainable solutions, shaping the future of environmentally conscious supply chain management.

## **METHODOLOGY**

The selection of Green Supply Chain Practices (GSCP) and the development of a conceptual framework to guide their implementation require a methodical and multidisciplinary approach. Literature survey is carried out to get a better understanding of current theories, concepts, and practices related to green supply chains, by thorough examination of the literature.

### **Determine Applicable Practices**

A group of GSCPs that are in line with the goals of the research are chosen based on available literature and in consultation with industry and academia experts concerned with supply chain management and sustainability. The applicability and practicality of selected practices in real-world settings can be verified with the assistance of experts.

### **Creation of a Conceptual Framework**

Create a robust conceptual framework that describes the essential components, factors, and connections between sustainability outcomes and GSCPs. This framework should take into account the particular study setting and be based on expert consultations and an assessment of the literature.

### **Formulation of Hypotheses**

Create hypotheses that outline the anticipated connections between a few chosen GSCPs and several performance metrics, like supply chain resilience, cost reduction, and carbon footprint reduction. These theories ought to give testable claims and be grounded in the conceptual framework.

This methodology creates a strong conceptual framework that directs their sustainability efforts while methodically choosing and implementing Green Supply Chain Practices. This strategy guarantees that GSCPs are in line with corporate and environmental goals and encourages evidence-based decision-making. A conceptual framework was developed for eight GSCPs after they were determined to be often occurring in the literature and based on expert opinion [41,42,43,].

## **OVERVIEW OF GSCP**

In addition to being necessary for environmental responsibility, green supply chain techniques also have financial advantages because they cut down on waste, use less energy, and improve brand image. Businesses which integrate sustainability into their supply chains will be in a better position to adjust to changing consumer needs and help create a more sustainable future.

The extensive literature review was carried out to develop the construct for each GSCP and impact of these practices on performance of an organization. The content analysis of available literature shows that (Zhu and Sarkis [3], Hervani et al. [4], Zhu and Sarkis 2006, Zhu and Sarkis 2006, Zhu and Sarkis [5], Zhu et al. [6], Holt and Ghobadian [7], Ninlawan et al. [8], Diabat et al. [9], and Laosirihongthong et al. [10], discussed global issues. There is no indication regarding priority /ranking or higher and lower importance amongst the sequence of selected green practices.

Authors that has studied GSCP are: Klassen & Johnson [12], Rao & Holt [13], Chien & Shih [14] Studies that have addressed both GSCP and green supply chain performance are: Zhu and Sarkis [25], Rha [16], Green et al. (2012), Zhu et al.[22] (2012), Perotti et al. (2012) in Table 1.

The literature that was accessible helped in the identification of the eight GSCP: External pressure (EPR), Top management commitment (TMC), Eco- Design (GD), Green procurement (GP), Green manufacturing (GM), Environmental training (ET), Customer cooperation (CC), and Reverse Logistics (RL).

The detailed overviews of selected GSCPs are as follows:

*External pressure (EPR):* States now have increasingly stringent laws as a result of growing environmental issues and a shortage of natural resources. The government has developed a number of laws, rules, and regulations pertaining to environmental protection, which require enterprises to adopt green practices into their operations. Punitive action against these industries will occur for breaking these rules and regulations.

**Table 1.** GSCP-related research.

Scientific name	Year of publication	Green supply chain practices	Reference
<i>Mohmad Taj et.al</i>	2023	Internal environmental management Green design (ED) Customer Collabroration (CC).	[64]
<i>Rao &amp; Diane Holt</i>	2005	Green logistics Green Production Reverse logistics	[13]
<i>Chien and Shih</i>	2007	Environmentally friehdly purchasing methods Environmentally friendly manufacturing techniques Green design Product recovery and reuse	[14]
<i>Zhu</i>	2011	Internal environmental management Green purchasing Customer cooperation Investment recovery Eco- design	[19]
<i>Sarkis</i>	2004	Industrial ecology Environmental management systems Increased accountability for producers Life cycle assessment Environmentally conscious design	[25]
<i>Zhu .</i>	2010	Cooperation from customers regarding environmental considerations Eco- design Recovery of Investments	[17]
<i>Kirchoff</i>	2016	Eco-design Recovery of Investments Collaboration with clients Eco-friendly shopping	[18]
<i>Lalit Toke</i>	2011	Top management commitment Customer delight through environmental performance Systems for environmental management (ISO- 14001) Environmentally friendly purchasing methods Using environmentally friendly technology Lean manufacturing techniques Reverse logistics practices	[21]
<i>Luthra et al.</i>	2014	Green product development Green purchasing and Procurement Environmentally friendly production Green distribution and transportation	[24]

Environmental education raises people's awareness of green activities and their level of environmental understanding. Global ecological concerns are growing, which is pushing governments and regulatory agencies to create stringent laws. Organisations must reduce the detrimental effects of their supply chains on the environment in order to make it green and sustainable. Regulatory agencies have been enforcing strict environmental standards in an effort to limit environmental damage. In order to stay competitive in today's competitive climate, regulations are essential. It is becoming increasingly important to implement proactive ecological measures in order to attain environmental performance compliance with legislation. Companies have implemented a range of green practices, such as cleaner production and ISO 14001 certification, at different phases of their operations in response to socio-political changes. Bigger companies encourage voluntary initiatives to improve environmental performance, which makes them more dynamic in implementing environmental practices. Environmental regulation is defined by government environmental policies, domestic environmental rules, and international environmental acceptances. A strong environmental performance leads to an improvement in financial performance, which in turn results in a decrease in costs and an increase in market share as per the review shown in Table 1.

Competitiveness and related issues may be crucial while applying GSCM practices. To compete in the global market, nations like India have been under intense pressure to adopt green practices.

*Top management commitment (TMC):* Vision of top management of an organization downwards and reflected in the work culture entire organizational. Commitment of top management towards Green policies and procedures, acting as a big driver of in adoption of GSC. Dedication and support from middle and upper level managers are critical for the successful implementation and execution of GSCM. Zhu and colleagues, [25]). The level of maturity and dedication of senior management leadership is a critical factor in the success of any environmental management practices. Numerous writers have addressed how senior management affects a company's environmental proactiveness. Without the support of upper management, green idea implementation cannot even be started, let alone completed, without sufficient funding, technology, and people resources. In order to ensure the strategy and action plans are implemented successfully, additional top management support may be given. Pressure from current employees, senior management's leadership and support, and the perception of the environmental dangers involved can all influence modifications or an increase in the adoption and level of implementation of environmental practices.

*Green design (GD):* Creating a product with an emphasis on environmental consciousness. The impact of design elements on the energy and material requirements for production, use, and product performance must be taken into account by product designers.(capability to repair, remanufacture, and recycle). Only when redesigned products can perform at least as well as the services of the items they are meant to replace will they prove to be effective. By extending the equipment items' useful lives, more raw materials are saved for the production of new goods. Create and create recoverable items that are environmentally friendly to dispose of, technically sound, repeatedly useful, and recoverable after use Both life-cycle assessment and analysis (LCA) and environmentally conscious design (ECD) are emphasised in the literature. Gaining knowledge of how design choices impact a product's environmental suitability is the goal. Green design resulted in a product life-cycle study. It is vital to concentrate on fuel-efficient and energy-efficient goods and designs that work with natural, renewable, and environmentally friendly resources in order to achieve sustainability and adopt GSCM.(Rao [34], Green et al. [35], Zhu et al. [36], Zhu et al. [5]).

*Green purchasing (GP):* An effort to make sure that materials or products acquired meet the environmental goals established by the company making the purchase; it involves cutting back on wasteful spending, encouraging recycling and reuse, conserving resources, and switching out materials. In addition to the conventional purchasing criteria of cost, quality, and delivery, supply chain managers often consider sustainability when making purchases (Kannan et al. [26], Vachon and Klassen [37], Hsu and Hu 2009, Zhu et al. [38], Kumar et al. [39]).

When purchasing goods and services, green or sustainable procurement takes into account the life-cycle assessment of the products as well as possible costs and environmental effects. Purchasing goods and services that have less of an impact on the environment is part of this practise. The products that should be purchased are those that are manufactured with less hazardous materials or those, whether created, utilised, or consumed, would have the least negative effects on the environment. The influence of environmentalism prompted procurement specialists to adjust their current approach and function within the supply chain network (Hu and Hsu [1], Govindan et al. [40]).

*Green manufacturing (GM):* It ensures that process involved in manufacturing of components/products should be non polluting, saving energy, conserving natural resources. Eco-friendly production ought to be profitable while also protecting the environment and end users. Green manufacturing encompasses remanufacturing, recycling, eco-friendly material use, and pollution reduction capabilities. Green manufacturing takes the effects of manufacturing techniques on the environment into account at every level of the production process.

There are three field study methodologies to minimise energy and resource use, which in turn reduces the use of virgin materials: pinch analysis, industrial energy, and energy and life cycle analysis. It is best to prevent the waste of resources and energy brought on by either an improper design or an excessive number of flaws. Energy efficiency is always preferred from an environmental perspective. Businesses will also benefit from this since it lowers expenses and eliminates any environmental liability. Finding areas where a product is consuming a lot of energy might result in significant energy reductions and product redesign. Targeted initiatives to increase energy efficiency can be completed for very little money, if at all.

*Environmental training (ET):* Success rate of GSC largely depends on training and education to employees and suppliers. Environmental awareness of employees can be increased by environmental training. The skills necessary to satisfy their environmental responsibilities and accomplish their environmental goals will be improved via environmental training. Scope and content of Environmental training should be regularly reviewed and improved. Resource allocation for Environmental training is very important. To avoid environmental mistakes Training to newly join employee is must.

*Customer cooperation (CC):* Customers may play a major role in greening supply chains. Customer cooperation becomes crucial. Customer collaboration becomes essential to achieving GSCM benefits. Consumer demand for eco-friendly goods and services is the main force behind green efforts. Chan and Lau conducted a study that compared the green shopping behaviours of Chinese and American customers. "Translation of green purchasing intent into identical behaviour is more effective among American consumers," according to their investigation. According to US consumer purchasing behaviour, 75% of consumers say that a company's reputation for environmental responsibility influenced their decision to buy, and 80% of them are willing to pay more for products that are ecologically friendly. Regulations and consumer pressures had followed the influence on green supply chain projects. Businesses that care about the environment tend to attract more investors and customers. Human aspect is significant in both situations. Government regulations, environmental concerns, and consumer awareness have led to an increasing number of companies focusing on green practices. Countries like India are under intense pressure to integrate green practices into their supply chains in order to meet the ever-increasing demands of their customers and remain competitive in the market.

*Reverse logistics (RL):* The manufacturer receives products that have already been dispatched from the point of consumption in this procedure in order to potentially recycle and remanufacture them. Reverse logistics aims to produce and distribute commodities in a sustainable manner by moving products down the supply chain. A distribution and transportation system that is efficient can reduce logistics overhead.

Reverse logistics are commonly used in the supply chains of well-known automakers like General Motors and BMW. As part of their supply chains, Hewlett Packard, Storage Tek, and TRW also employ reverse logistics. Transportation, remanufacturing, and recovery product collecting are all included in reverse logistics. The GSCM literature provided instances of reverse logistics in the areas of plastics, bottle recycling, and waste management. Green logistics will lessen its negative effects on the environment while enhancing quality, dependability, energy efficiency, and cost effectiveness.

### GSCPS AND ORGANIZATIONAL PERFORMANCE

Adopting GSCM practices has benefits that lead to improved organisational performance in terms of operations, economics, and the environment. The application of GSCM, according to a number of researchers, is enhancing environmental performance. Using GSCM makes it feasible to track and enhance the supply chain's environmental performance. According to Geffen and Rothenberg [44] adoption and growth of environmental initiative practices can be achieved by collaborative relation with suppliers. The most important driving factor to implement environmental practices are cooperation between supplier and customer, partnership programs and financial performance. Impact of GSCM practices on financial performance is positive or negative is still varied. However, a small number of research demonstrated the beneficial relationship between operational performance and environmental practices.

The adoption of green practices is increasing as a result of institutional pressures brought about by market and regulatory needs (Srivastava [45]). Based on a number of research that looked for a connection between GSCM practices and organisational performance, Zhu and Sarkis[5] conclude that manufacturers' top priority is still economic performance. Environmental practices and organisational performance have been found to positively correlate by Green et al. [35], Rao and Holt [13], and Zhu and Sarkis [25].

The literature that is currently accessible shows that opinions on how GSCM affects performance results are not unanimous. There are three likely explanations for the discrepancy seen in the literature. The first is how different green supply chain strategies affect performance (Zhu et al., 2012). Second, there is a complex link between practices and outcomes since different performance measurements are used. Finally, varied performance outcomes may arise from the application of GSCM practices in various circumstances (Koh et al. [47]). Murphy and Poist [48] noted that there isn't a single, comprehensive framework on green practices, which is consistent with some of these findings. Till date the research work carried out on GSC performance measurement given below in Table 2.

**Table 2.** Research carried out on measurement of GSC performance.

Scientific name	Year of publication	Green supply chain performance Parameters	Reference
<i>Beamon</i>	2008	Remanu facturing Reuse Recycling Waste emission Economic Environmental	49
<i>Zhu and Sarkis</i>	2004	Performance of the organisation Environmental results Financial outcomes	50
<i>Rha</i>	2011	Output of the supply chain Resources for the supply chain Flexibility in the supply chain	16
<i>Zhu et al.</i>	2010	Environmental results Performance financially Performance in operations	51
<i>Ninlawan et al.</i>	2010	Environmental results Financial outcomes	8
<i>Green et al.</i>	2012	Environmental results Financial outcomes Performance in operations	52
<i>Zhu et al.</i>	2011	Environmental results Performance financially Performance in operations	36
<i>Deepa Mishra et.al</i>	2017	Economic Environmental	67

## FRAMEWORK FOR FUTURE DEVELOPMENT

Framework is useful to understand relation between different the GSCPs and for the formation of hypotheses. Predictions about the GSCPs on environmental, operational and financial performance of an organization can be drawn from Conceptual framework [63]. A theoretical framework can be used to understand the reasons for the adoption of GSCPs and the intended outcomes.

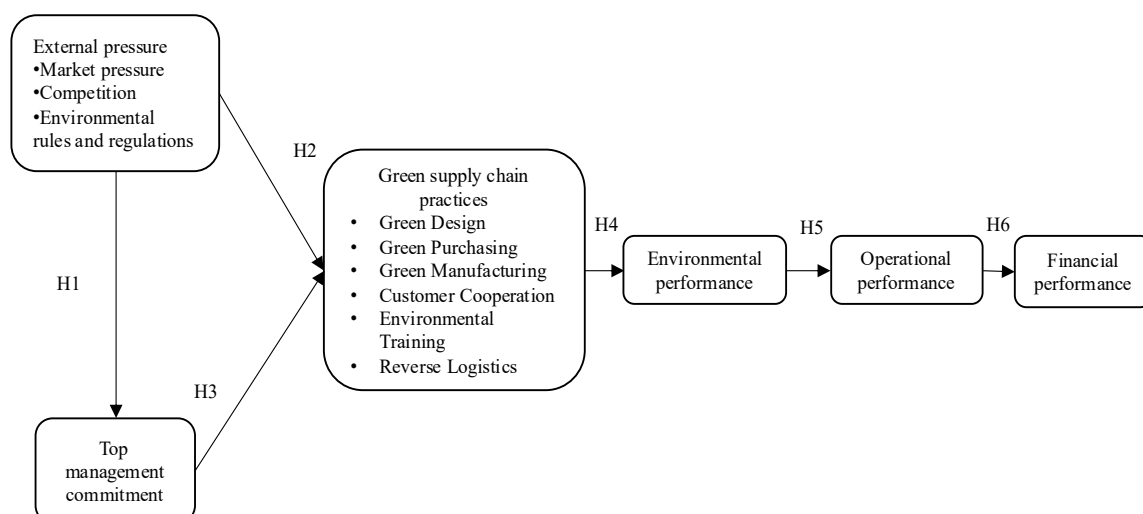
A framework that explains the causal linkages between certain practices and the impact of each practise on operational, environmental, and financial performance might help better understand the impact of GSCPs on operational performance. Conceptual framework shows that, external pressure facilitates the top management commitment. External pressure and top management commitment positively related to green supply chain practices implementation in industry. GSCP positively related to environmental performance and this results in better operational performance which leads to improvement in financial outcome.

The theoretical model illustrating the six assumptions is shown in Figure -1. The numbers next to each arrow correspond to the six hypotheses developed for this research. The model shown in Figure 1 which indicates direct, positive of GSCPs on environmental, operational and financial performance of an organization.

## RESEARCH HYPOTHESIS

### External Pressure

The modern market is client-driven, international, and dynamic. Stakeholders including worldwide environment, laws, and green consumerism are frequently cited as major GSCM driving drivers (Zhu et al., 50). One of the driving forces for the adoption of green practices by organisations is stakeholder demand. (Hervani and others, [4]). Zhu et al. [38] discovered that GSCM aids businesses in gaining a greater competitive edge and expanding their market shares. Green practices are seen as a competitive advantage when it is challenging for other manufacturers to be environmentally conscious, according to a number of researchers. There is increasing pressure on businesses to become more rational and environmentally conscious. A number of investors are pressuring businesses to lessen their adverse effects on the environment and society. Organisations now need to balance their financial, operational, environmental, and economic performance because of community pressures and market rivalry. Organisations are compelled to implement environmental practices by government laws and heightened environmental consciousness among stakeholders (Azevedo et al. [46]). The most significant external pressure on an organisation is that which comes from its customers (Chien and Shih [14]). The reasoning presented above lead to the following theories:



**Figure 1.** Theoretical framework.

### ***Hypothesis 1***

External pressure facilitates the GSC integration.

### **Top Management Commitment**

The process of implementing GSCM in industries is critical and requires cooperation from all labour levels, from lower management to upper management (Walker et al., [53], Mathiyazhagan et al., [54]). The implementation of green practices by an organization's top manager is extremely important, as top management decisions have a direct impact on the effectiveness of GSCM (Oluguet al., [54], Rao and Holt, [13], Zhu et al., [29]). Numerous scholars' empirical research demonstrates how important organisational goals and managerial support were to the effective implementation of GSCM practices. After investigating the function of top management, Zhu et al. [38] and Sakis et al. [36] come to the conclusion that support from top management is essential and frequently a major factor in the adoption and successful use of GSCM. Top management's commitment is essential to ensuring total environmental excellence.

Zhu et al. [6] discovered that in order to guarantee the adoption of a green life-cycle approach, management commitment to environmental sustainability is essential.

### ***Hypothesis 2***

Top management commitment positively related to green supply chain practices.

### **EXTERNAL PRESSURE ON TOP MANAGEMENT**

Regulations and outside stakeholders put pressure on businesses to implement GSCM practices, as noted by Seuring [55]. The adoption of EMS and GSCM practices by an organisation is influenced by regulatory pressures, as noted by Darnall [56] and Chien and Shih [14]. The data indicates that government agencies and market competition exert significant pressure on Indian enterprises, with these factors playing a more significant role in the adoption of GSCM than other categories (Zhu et al.[50], Zhu and Sarkis [38], Zhu et al. [6], Wu et al.[20]). Customer demand is a major factor in the adoption of environmental practices. (Al Khidir and Zailani [57], Zhu and Sarkis [50]).

### ***Hypothesis 3***

External pressure positively related to top management commitment.

### **ENVIRONMENTAL PERFORMANCE**

Green design is strongly associated with life-cycle analysis, environmental risk management, pollution control, waste management, and resource conservation. When designing a product, consideration for environmental sustainability is given to the avoidance of using hazardous or banned materials during manufacture. (Jabbour and others [58]). Among the eco-design activities are the reduction of environmentally hazardous substances, product reuse, waste material recycling, and remanufacturing design. (Eltayeb and others, [15]). Diabat and Govindan [59]) found that the performance of green supply chains is positively influenced by green design. Green materials is costly but it will be reducing disposal costs and improved resource conservation (Azevedo et al.[46]). According to Dubey and Bag's research [60], green purchasing, supplier relationships, green logistics, and regulatory frameworks all have a significant impact on the performance of Indian businesses. Through initiatives including collaborative ventures, customer education, customer assistance, and technical knowledge exchanges, customer environmental collaboration guarantees improved environmental performance for its clients. References: Vachon & Klassen [37]; Eltayebet al. [15].

Environmental performance is correlated with industrial facilities' capacity to cut back on the use of hazardous and toxic materials as well as their ability to reduce air emissions, effluent waste, and solid wastes (Zhu et al.[6]).

Organisations' environmental performance is improved by GSCM practices, which include a decrease in all waste types, a decrease in emissions, a decrease in the use of energy and resources, and a decrease in the amount of hazardous and toxic materials (Eltayeb et al. [15], Zhu & Sarkis [50]). Adopting GSCM has improved economic and environmental performance, as seen in the Chinese auto industry. Dheeraj and Vishal [61] discovered a positive correlation between the implementation of green supply chain practices and enhancements in both environmental and economic performance. Zhu as well as Sarkis [50]). Strong ties and tight cooperation with the supplier lead to better environmental performance, according to Geffen and Rothenberg [44].

Zhu and associates, [38]). concluded that internal environmental management, external GSCM, eco-design and investment recovery dimensions for GSCM practices, and environmental, operational, and economic performance dimensions for firm performance were the factors influencing GSCM practices and performances in Chinese manufacturing firms.

#### ***Hypothesis 4***

Green supply chain practices positively related to environmental performance.

#### **Operational Performance**

Environmental awareness of consumers has been an upsurge in last few years. Many industries thought that green SCM does not improved operational performance and only helps to improve environmental performance. However, improving operational and financial performance should follow from various greening stages of the SC, either directly or indirectly. However, it's not always the case that operational performance should directly improve as a result of greening every step of the SC. There is still little evidence to support the claim that operational performance and environmental management are positively correlated. An inventive policy to enhance an organization's operational performance is the environmental management system[65]. A case study illustrated how an organization's operational performance might be enhanced by environmental management systems. The performance and competitive position of the company are positively impacted by environmental practices including reverse logistics and green supply chain management. According to Tooru (2001), an organization's operational performance can be enhanced by implementing environmental management systems. An organization's environmental and economic performance are positively correlated when it comes to environmental management, such as GSCM.

#### ***Hypothesis 5***

Environmental performance positively related to operational performance.

#### **Economic/ Financial Performance**

Organisations' economic performance can be used to gauge how well the manufacturing plant is able to control costs related to energy use, waste treatment, waste discharge, and purchased supplies. (Zhu and others, 62). to improve their ecological efficiency and financial situation by lowering their negative environmental effect and increasing their market share. According to Azevedo et al. ([46], Rao & Holt [13], Zhu et al. ([62], Govindan et al., [40]), GSCM has been proposed as an organisational philosophy. Adopting GSCM practices in organisations can lead to long-term performance benefits, such as increased market share and profitability, as well as sustainable competitive advantages. Positive economic enhancement is indicated by profitability, revenue and market share growth, and productivity improvement. Zhu and Sarkis [25]). Using GSCMPs can result in significant cost reductions, a rise in market share, and higher profit margins. Improvements in economic performance are positively correlated with the implementation of green supply chain practices, according to Sarkis [25]. GSCM practices concentrate on the elimination of wastes related to environmental sustainability. Waste minimization leads to lower expenses and better economic performance. As stated by Shih and Chien [14] Green supply chain strategies have a positive financial performance impact in terms of cost savings, market share expansion, and profit growth.

### ***Hypothesis 6***

Operational performance positively related to financial performance.

### **FUTURE SCOPE**

The future scope of conceptual framework and hypothesis creation for green supply chain operations is wide and complex, as it involves studying new technology, developing trends, and evolving customer preferences. In order to better understand how sustainable supply chain practices might help businesses and the environment, researchers will be essential.

This research develops a simple, abstract framework that can be empirically tested to determine the impact of GSCPs on organizational performance. It is possible to conduct additional study to determine whether an organization with high GSCP levels also has high levels of organizational performance. Further empirical research might be considered, such as examining the many factors that contribute to the adoption of different GSCPs within an organization. Research questions such as "Which practices are more implemented in manufacturing, process, and service organizations" might be formulated to conduct the pragmatic test. Which procedures are more widely used in small, medium, and large businesses depending on the size of the organization? Which procedures are commonly used by regional, global, and joint venture organizations? How does a change in governance affect the degree to which practices are applied? etc.

The future of green supply chain strategies will likely involve the integration of developing technologies like block chain, artificial intelligence, and the Internet of Things (IoT) for greater visibility and traceability. Researchers can construct hypotheses to examine the influence of these technologies on the sustainability and efficiency of supply networks. Further researchers can study how applying circular economy principles within supply chains can minimize waste and promote sustainability. Research on the connections between circular supply chain practices and both economic and environmental outcomes may be conducted using hypotheses. Future study can investigate the role of cross-sector collaboration, where organizations from many industries work together to create and implement green supply chain projects.

Researchers can explore whether consumers' understanding and choices influence the adoption of environmentally friendly supply chain methods. Future research should also examine the long-term effects of green supply chain strategies, going beyond short-term gains. Hypotheses can study the durability and lasting influence of sustainability initiatives on supply networks and the environment.

### **CONCLUSIONS**

This research study has examined the important topics of conceptual framework and hypothesis development in the context of green supply chain practices. In light of the escalating environmental challenges of our day, supply chains are beginning to understand how important it is to adopt eco-friendly and sustainable practices. As businesses try to combine profitability and responsibility, developing a solid conceptual framework is essential for guiding decision-making and understanding the intricacies of green supply chain management.

A review of the literature identifies the eight keys. According to their size, small, medium, and large organizations all use these recognized GSCPs. Figure 1 illustrates the conceptual framework that was created using these important GSCPs. It is discovered from the literature that there isn't a single study that looks at all of these GSCPs at once. In addition, these lists of recognized practices will undoubtedly assist newcomers who intend to introduce GSCPs into their company for the first time in achieving the intended outcomes. Furthermore, understanding the relationships between various GSCPs and how they affect organizational performance is made much easier with the help of the framework this study produced.

Furthermore, the work's formulation of hypotheses has provided a methodical technique to use empirical methods to assess connections between different variables in the context of the green supply chain. The proposed theories offer a structure for more research and empirical studies aimed at broadening our understanding of the factors impacting the adoption and effectiveness of environmentally friendly supply chain practices.

In addition to establishing the foundation for future research into the intricacies of green supply chain practices, this study offers a conceptual framework and hypotheses that might guide academics and practitioners in their pursuit of environmentally conscious and sustainable supply chain management. The application of these tactics will benefit particular businesses as well as contribute to a more sustainable and ecologically friendly future for all living things.

### SCIENTIFIC CONTRIBUTION

This research paper formulates hypotheses on the links between various characteristics in the context of green supply chain practices, thereby providing a scientific foundation for more empirical research. Through empirical study, academics can investigate the causal chains and relationships involving multiple components by using these testable hypotheses, which will advance the field's understanding of green supply chain management.

The paper's conceptual framework can be used as a tool to help managers and policymakers make decisions while implementing green supply chain practices. Its methodical methodology makes it easier to pinpoint important areas that require development and directs resource distribution to optimize sustainability initiatives.

### REFERENCES

1. Hsu, C.W. and Hu, A.H, *Green Supply Chain Management in the Electronic Industry*, International J. Environ. Sci. Technol., vol. 5, pp. 205–216, doi: <https://doi.org/10.1007/BF03326014>.
2. G. T. Tsoulfas and C. P. Pappis, "Environmental principles applicable to supply chains design and operation," J. Clean. Prod., vol. 14, no. 18, pp. 1593–1602, 2006, doi: 10.1016/j.jclepro.2005.05.021.
3. Q. Zhu and J. Sarkis, "Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises," J. Oper. Manag., vol. 22, no. 3, pp. 265–289, Jun. 2004, doi: 10.1016/j.jom.2004.01.005.
4. A. A. Hervani, M. M. Helms, and J. Sarkis, "Performance measurement for green supply chain management," Benchmarking, vol. 12, no. 4, pp. 330–353, 2005, doi: 10.1108/14635770510609015.
5. Q. Zhu and J. Sarkis, "The moderating effects of institutional pressures on emergent green supply chain practices and performance," Int. J. Prod. Res., vol. 45, no. 18–19, pp. 4333–4355, Sep. 2007, doi: 10.1080/00207540701440345.
6. Q. Zhu, J. Sarkis, and K. hung Lai, "Confirmation of a measurement model for green supply chain management practices implementation," Int. J. Prod. Econ., vol. 111, no. 2, pp. 261–273, Feb. 2008, doi: 10.1016/j.ijpe.2006.11.029.
7. D. Holt and A. Ghobadian, "An empirical study of green supply chain management practices amongst UK manufacturers," J. Manuf. Technol. Manag., vol. 20, no. 7, pp. 933–956, Sep. 2009, doi: 10.1108/17410380910984212.
8. Ninlawan, C., Seksan, P., Tossapol, K., Pilada, W., "The implementation of green supply chain management practices in electronics industry," Scopus Rev..
9. A. Diabat, R. Khodaverdi, and L. Olfat, "An exploration of green supply chain practices and performances in an automotive industry," Int. J. Adv. Manuf. Technol., vol. 68, no. 1–4, pp. 949–961, Sep. 2013, doi: 10.1007/s00170-013-4955-4.
10. T. Laosirihongthong, D. Adebajo, and K. Choon Tan, "Green supply chain management practices and performance," Ind. Manag. Data Syst., vol. 113, no. 8, pp. 1088–1109, Aug. 2013, doi: 10.1108/IMDS-04-2013-0164.

11. P. Aital and J. P. Vijai, "Operational practices and performances of green supply chain management in Indian firms," *Int. J. Process Manag. Benchmarking*, vol. 5, no. 3, pp. 352–374, 2015, doi: 10.1504/IJPMB.2015.070819.
12. R. D. Klassen, "Exploring the linkage between investment in manufacturing and environmental technologies," # MCB University Press, 2000. [Online]. Available: <http://www.emerald-library.com>
13. P. Rao and D. Holt, "Do green supply chains lead to competitiveness and economic performance?," *Int. J. Oper. Prod. Manag.*, vol. 25, no. 9, pp. 898–916, 2005, doi: 10.1108/01443570510613956.
14. M. K. Chien and ; L H Shih, "An empirical study of the implementation of green supply chain management practices in the electrical and electronic industry and their relation to organizational performances," *Int J Env. Sci Tech*, vol. 4, no. 3, pp. 383–394, 2007.
15. T. Eltayeb and S. Zailani, "THE IMPLEMENTATION OF GREEN SUPPLY CHAIN MANAGEMENT PRACTICES: A CONCEPTUAL FRAMEWORK."
16. J. S. Rha, "DigitalCommons@University of Nebraska-Lincoln The Impact of Green Supply Chain Practices on Supply Chain Performance." [Online]. Available: <http://digitalcommons.unl.edu/businessdiss/11>
17. Q. Zhu, Y. Geng, T. Fujita, and S. Hashimoto, "Green supply chain management in leading manufacturers: Case studies in Japanese large companies," *Manag. Res. Rev.*, vol. 33, no. 4, pp. 380–392, Mar. 2010, doi: 10.1108/01409171011030471.
18. J. F. Kirchoff, W. L. Tate, and D. A. Mollenkopf, "The impact of strategic organizational orientations on green supply chain management and firm performance," *Int. J. Phys. Distrib. Logist. Manag.*, vol. 46, no. 3, pp. 269–292, Apr. 2016, doi: 10.1108/IJPDLM-03-2015-0055.
19. Y. Li, "Research on the Performance Measurement of Green Supply Chain Management in China," *J. Sustain. Dev.*, vol. 4, no. 3, Jun. 2011, doi: 10.5539/jsd.v4n3p101.
20. K.-J. Wu, C.-J. Liao, K.-H. Tan, A. S. Chiu, and M.-L. Tseng, "Exploring decisive factors affecting green supply chain practices under uncertainty."
21. L. K. Toke and R. C. Gupta, "Green Supply Chain Management; Critical Research and Practices."
22. J. Sarkis, Q. Zhu, and K. H. Lai, "An organizational theoretic review of green supply chain management literature," *Int. J. Prod. Econ.*, vol. 130, no. 1, pp. 1–15, 2011, doi: 10.1016/j.ijpe.2010.11.010.
23. S. M. Lee, J. S. Rha, D. Choi, and Y. Noh, "Pressures affecting green supply chain performance," *Manag. Decis.*, vol. 51, no. 8, pp. 1753–1768, 2013, doi: 10.1108/MD-12-2012-0841.
24. S. Luthra, D. Garg, and A. Haleem, *Green Supply Chain Practices Implementation in Indian Automobile Industry*. Abid Haleem Jamia Millia Islamia Green Supply Chain Practices Implementation in Indian Automobile Industry. [Online]. Available: <https://www.researchgate.net/publication/260289526>
25. Q. Zhu and J. Sarkis, "Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises," *J. Oper. Manag.*, vol. 22, no. 3, pp. 265–289, Jun. 2004, doi: 10.1016/j.jom.2004.01.005.
26. K. Mathiyazhagan, K. Govindan, and A. Noorul Haq, "Pressure analysis for green supply chain management implementation in Indian industries using analytic hierarchy process," *Int. J. Prod. Res.*, vol. 52, no. 1, pp. 188–202, 2014, doi: 10.1080/00207543.2013.831190.
27. S. K. Mangla, P. Kumar, and M. K. Barua, "Prioritizing the responses to manage risks in green supply chain: An Indian plastic manufacturer perspective," *Sustain. Prod. Consum.*, vol. 1, pp. 67–86, Jan. 2015, doi: 10.1016/j.spc.2015.05.002.
28. M.-L. Tseng and Y. Geng, "Evaluating the green supply chain management using life cycle assessment approach in uncertainty."
29. Q. Zhu, J. Sarkis, and K. hung Lai, "Initiatives and outcomes of green supply chain management implementation by Chinese manufacturers," *J. Environ. Manage.*, vol. 85, no. 1, pp. 179–189, Oct. 2007, doi: 10.1016/j.jenvman.2006.09.003.
30. K. Muduli, K. Govindan, A. Barve, and Y. Geng, "Barriers to green supply chain management in Indian mining industries: A graph theoretic approach," *J. Clean. Prod.*, vol. 47, pp. 335–344, 2013, doi: 10.1016/j.jclepro.2012.10.030.

31. Dongbei gong xue yuan, IEEE Control Systems Society, and IEEE Singapore Section. Industrial Electronics Chapter, The 26th Chinese Control and Decision Conference (2014 CCDC) : 31 May - 2 June 2014, Changsha, China.
32. R. K. Mudgal, R. Shankar, P. Talib, and T. Raj, "Computers and OR. He is the Executive Editor of *Journal of Advances in Management Research*. His research papers have appeared/accepted in *International Journal of Flexible Manufacturing Technology*," 2010.
33. R. K. Malviya and R. Kant, "Green supply chain management (GSCM): a structured literature review and research implications," *Benchmarking*, vol. 22, no. 7, pp. 1360–1394, Oct. 2015, doi: 10.1108/BIJ-01-2014-0001.
34. P. H. Rao, "Measuring Environmental Performance across a Green Supply Chain: A Managerial Overview of Environmental Indicators."
35. K. W. Green, P. J. Zelbst, J. Meacham, and V. S. Bhadauria, "Green supply chain management practices: Impact on performance," *Supply Chain Manag.*, vol. 17, no. 3, pp. 290–305, Apr. 2012, doi: 10.1108/13598541211227126.
36. J. Sarkis, Q. Zhu, and K. H. Lai, "An organizational theoretic review of green supply chain management literature," *Int. J. Prod. Econ.*, vol. 130, no. 1, pp. 1–15, 2011, doi: 10.1016/j.ijpe.2010.11.010.
37. S. Vachon and R. D. Klassen, "Extending green practices across the supply chain: The impact of upstream and downstream integration," *Int. J. Oper. Prod. Manag.*, vol. 26, no. 7, pp. 795–821, 2006, doi: 10.1108/01443570610672248.
38. Q. Zhu, J. Sarkis, and Y. Geng, "Green supply chain management in China: Pressures, practices and performance," *Int. J. Oper. Prod. Manag.*, vol. 25, no. 5, pp. 449–468, 2005, doi: 10.1108/01443570510593148.
39. R. Kumar and R. Chandrakar, "Overview of Green Supply Chain Management: Operation and Environmental Impact at Different Stages of the Supply Chain," 2012.
40. K. Govindan, R. Khodaverdi, and A. Vafadarnikjoo, "Intuitionistic fuzzy based DEMATEL method for developing green practices and performances in a green supply chain," *Expert Syst. Appl.*, vol. 42, no. 20, pp. 7207–7220, Jun. 2015, doi: 10.1016/j.eswa.2015.04.030.
41. S. Kumar, S. Luthra, and A. Haleem, "Customer involvement in greening the supply chain: an interpretive structural modeling methodology," 2013. [Online]. Available: <http://www.jieit-sb.com/content/9/1/6>
42. Chen-Lung Yang, "The effects of environmental regulations on green supply chains," *Afr. J. Bus. Manag.*, vol. 5, no. 26, Oct. 2011, doi: 10.5897/ajbm11.518.
43. M. Björklund, U. Martinsen, and M. Abrahamsson, "Performance measurements in the greening of supply chains," *Supply Chain Manag.*, vol. 17, no. 1, pp. 29–39, Jan. 2012, doi: 10.1108/13598541211212186.
44. C. A. Geffen and S. Rothenberg, "Suppliers and environmental innovation The automotive paint process," # MCB University Press, 2000. [Online]. Available: <http://www.emerald-library.com>
45. S. K. Srivastava, "Green supply-chain management: A state-of-the-art literature review," *Int. J. Manag. Rev.*, vol. 9, no. 1, pp. 53–80, Mar. 2007, doi: 10.1111/j.1468-2370.2007.00202.x.
46. S. G. Azevedo, H. Carvalho, S. Duarte, and V. Cruz-Machado, "Influence of green and lean upstream supply chain management practices on business sustainability," *IEEE Trans. Eng. Manag.*, vol. 59, no. 4, pp. 753–765, 2012, doi: 10.1109/TEM.2012.2189108.
47. A. S. Kohli and E. Hawkins, "Motivators to adopt green supply chain initiatives," *Int. J. Inf. Syst. Supply Chain Manag.*, vol. 8, no. 4, pp. 1–13, Oct. 2015, doi: 10.4018/ijisscm.2015100101.
48. P. R. Murphy and R. F. Poist, "Green perspectives and practices: A 'comparative logistics' study," *Supply Chain Manag.*, vol. 8, no. 2, pp. 122–131, 2003, doi: 10.1108/13598540310468724.
49. B. M. Beamon, "Sustainability and the Future of Supply Chain Management," 2008.
50. Q. Zhu and J. Sarkis, "Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises," *J. Oper. Manag.*, vol. 22, no. 3, pp. 265–289, Jun. 2004, doi: 10.1016/j.jom.2004.01.005.
51. Q. Zhu, Y. Geng, T. Fujita, and S. Hashimoto, "Green supply chain management in leading manufacturers: Case studies in Japanese large companies," *Manag. Res. Rev.*, vol. 33, no. 4, pp. 380–392, Mar. 2010, doi: 10.1108/01409171011030471.

52. K. W. Green, P. J. Zelbst, J. Meacham, and V. S. Bhadauria, "Green supply chain management practices: Impact on performance," *Supply Chain Manag.*, vol. 17, no. 3, pp. 290–305, Apr. 2012, doi: 10.1108/13598541211227126.
53. H. Walker, L. D. Sisto, and D. Mcbain, "Drivers of environmental supply chain practices: lessons from the public and private sectors."
54. E. Olugu and K. Wong, "A Study on the Validation of Green Supply Chain Performance Measures in the Automotive Industry," *Commun. IBIMA*, pp. 1–14, Feb. 2011, doi: 10.5171/2011.911153.
55. S. Seuring, "A Review of Modeling Approaches for Sustainable Supply Chain Management." [Online]. Available: <http://www.uni-kassel.de/go/scm>
56. N. Darnall, G. J. Jolley, and R. Handfield, "Environmental management systems and green supply chain management: Complements for sustainability?," *Bus. Strategy Environ.*, vol. 17, no. 1, pp. 30–45, Jan. 2008, doi: 10.1002/bse.557.
57. T. Al Khidir, S. Hanim, and M. Zailani, "Greening of the Supply Chain Through Supply Chain Initiatives Towards Environmental Sustainability."
58. A. B. L. S. Jabbour and C. J. C. Jabbour, "Are supplier selection criteria going green? Case studies of companies in Brazil," *Ind. Manag. Data Syst.*, vol. 109, no. 4, pp. 477–495, Apr. 2009, doi: 10.1108/02635570910948623.
59. A. Diabat and K. Govindan, "An analysis of the drivers affecting the implementation of green supply chain management," *Resour. Conserv. Recycl.*, vol. 55, no. 6, pp. 659–667, Apr. 2011, doi: 10.1016/j.resconrec.2010.12.002.
60. R. Dubey, S. Bag, and S. S. Ali, "Green supply chain practices and its impact on organisational performance: An insight from Indian rubber industry," *Int. J. Logist. Syst. Manag.*, vol. 19, no. 1, pp. 20–42, 2014, doi: 10.1504/IJLSM.2014.064029.
61. N. Dheeraj and N. Vishal, "An Overview of Green Supply Chain Management in India," 2012. [Online]. Available: [www.isca.in](http://www.isca.in)
62. Q. Zhu, J. Sarkis, and K. hung Lai, "Confirmation of a measurement model for green supply chain management practices implementation," *Int. J. Prod. Econ.*, vol. 111, no. 2, pp. 261–273, Feb. 2008, doi: 10.1016/j.ijpe.2006.11.029.
63. M. D. Hanna, W. R. Newman, and P. Johnson, "Linking operational and environmental improvement through employee involvement," # MCB University Press, 2000. [Online]. Available: <http://www.emerald-library.com>
64. Hejazi, M.T.; Al Batati, B.; Bahurmuz, A., "The Influence of Green Supply Chain Management Practices on Corporate Sustainability Performance". *Sustainability* 2023,vol. 15,no.6 (2023). <https://doi.org/10.3390/su15065459>.
65. Simarnjit Singh, Mohit Sajwan, Gurbhej Singh, Anil Kumar Dixit, Amrinder Mehta, "Efficient surface detection for assisting Collaborative Robots" *Robotics and Autonomous Systems*, Vol.61(2023] doi:10.1016/j.robot.2022.104339
66. Gurbhej Singh, Hitesh Vasudev, Amit Bansal and Sachit Vardhan, "Influence of heat treatment on the microstructure and corrosion properties of the Inconel-625 clad deposited by microwave heating" *Surface Topography: Metrology and Properties*, Vol.9 no.2. DOI 10.1088/2051-672X/abfc61.
67. Deepa Mishra, Angappa Gunasekaran, Tanos Papadopoulos, Benjamin Hazen, "Green supply chain performance measures: A review and bibliometric analysis" *Sustainable production and consumption*, vol.10, 2017, pp.85-99. <https://doi.org/10.1016/j.spc.2017.01.003>.