

“Environmental Collaboration with Suppliers and Customers: Implications for Supply Chain Cost and Competitive Performance”

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Abstract

The paper focuses on understanding the relationship between environmental alliance with suppliers and customers as it affects supply chain cost and competitive performance under the umbrella of Resource Dependence Theory (RDT). Using the research data on 186 Indian manufacturing MSMEs, the research study utilizes Partial Least Squares Structural Equation Modeling (PLS-SEM) to evaluate the anticipated relationship. The results indicate that environmental cooperation with the suppliers as well as customers would greatly minimize the supply chain expenses and increase in the performance competitiveness. Also, the supply chain cost is identified to mediate the correlation between the environmental collaboration and the competitive performance in a mixed way, which means that the cost efficiency is a major mechanism by which sustainability initiatives are converted into strategic advantage. The research will add value to the literature by incorporating an upstream and downstream collaboration into a single RDT framework and illuminating the two-fold operational and strategic strengths of environmental collaboration. The findings have important implications to managers and policy makers who would want to ensure that they have a sustainable and competitive supply chain.

Keywords: Environmental Collaboration; Green Supply Chain Management; Supply Chain Cost; Competitive Performance

1. Introduction

Over the past years, the issue of sustainability has become the focal point in international supply chains as degradation of the environment is becoming prominent, as is climate change and policy requirements. Economic performance is no longer considered as the sole benchmark in assessing organizations as it is also set that organizations would prove to be environmental responsible in their operations. The contribution of supply chains towards carbon emission, wastes, and depletion of resources is very high because supply chains involve activities of sourcing raw materials to the delivery of the final product. Consequently, businesses are increasingly being pressured by the government and stakeholders, as well as the society, to consider environmental aspects in their supply chain strategies (Ugrinov, et al., 2024; Borji et al., 2023). Due to this change, the concept of sustainability-based supply chain practices has developed to reduce the environmental impact and ensure the high efficiency of operations.

Green Supply Chain Management (GSCM) has been an issue which is received with great enthusiasm as a strategic response to such environmental issues. GSCM encompasses the aspect of applying environmental thinking on the activities within the supply chain such as product design, sourcing of materials, production cycle, distribution and end-of-life. The recent research notes that the GSCM practices also lead to the enhanced operational and financial performance based on the resource efficiency, waste minimization, and innovation ((Wang et al., 2026; García-Hurtado et al., 2026).) even beyond the environmental sustainability. In addition, organizations that embrace GSCM at a higher position have a better chance of attaining long-term competitiveness through the alignment of sustainability and the strategic goals. Nevertheless, GSCM can only be adopted in a complicated manner since it involves alignment of various supply chain participants as opposed to single firm-based interventions.

Environmental collaboration is also a critical aspect of GSCM that focuses on the collaboration of supply chain partners to attain collective sustainability objectives. The importance of upward engagement with suppliers should not be underrated as it helps to achieve eco-friendly sourcing, eco-design, and sustainable production. The engagement of suppliers is quite important in mitigating environmental effects at its origin because they usually have control over major inputs and production practices. According to empirical evidence, supplier collaboration promotes the transfer of information, innovation and improvement of processes which eventually culminates in cost efficiencies and an improved environmental performance (Shin et al., 2023; Qiao et al., 2022). Further, joint relations with suppliers can assist companies to deal with the dependency and uncertainty of resources, especially in a multifaceted global supply network.

Correspondently, downstream partnership with customers is gaining a higher significance as the powerhouse to the sustainable consumption and lifecycle management of a product. Customers determine demand trends, product designs, and sustainability demands and that is why it shapes the organizational strategies. Eco collaboration with customers involves endeavors like development of joint products, environmentally friendly packaging and other similar activities like re-cycling and re-use in the name of recycling. Research has shown that customer collaboration goes a long way in improving sustainability performance by facilitating green innovation and responsiveness to the market (Rizzo et al., 2023; Andalib et al., 2023). Moreover, through such cooperation the firms are able to learn more about the factors of the market that are changing and match their products with the requirements of environmentally conscious consumer needs, hence, consolidating their competitive stance.

Although there is an increasing amount of literature on GSCM, this has a number of gaps. First, a significant part of the available research is almost inclined to explore supplier collaboration and customer collaboration in isolation of each other, as opposed to considering two dimensions within the framework of each other. Nonetheless, the supply chains are interrelated systems and the upstream relationships and downstream relationships are mutually dependent. Overlook of this interconnectedness restricts the perception of how environmental collaboration as holistic constructs can have a bearing on the result of the organizational end. Secondly, the dual effect of environmental collaboration on the cost and competitiveness of supply chain is not clear. Some studies focus on cost reduction by efficiency, yet others on improving market performance and innovation, although rarely do the two outcomes of potential models coexist (Kalasua & Sahu 2026).

The other relevant research gap is the fact that little consideration of the theory of Resource Dependence Theory (RDT) has been done in interpreting environmental cooperation within the supply chains. RDT assumes that critical resources are supplied by outside parties, and organizations are in mutually relational type of relationships with that outsourced party to minimize uncertainty and gain access to the resource. Within the framework of GSCM, one can consider environmental collaboration as the tactical reaction to the resource dependencies, and firms may cooperate with suppliers and customers to have access to environmental knowledge and technologies, as well as capabilities. Even though collaboration is accepted to be one of the fundamental contributors to sustainability, there have been limited studies that explicitly incorporate RDT to elucidate how inter-organizational dependencies contribute to environmental cooperation and performance outcomes (García-Hurtado et al., 2026). Considering these gaps, this research has the following research questions, Does environmental cooperation with suppliers and clients lower the cost of supply chain? & Is there an increase in environmentally-based collaboration and competitive performance? Through these questions, the research will ensure that the overall knowledge of the effects of environmental collaboration to the operation efficiency and strategic competitiveness is given.

The main contribution of the study is that it builds a combined conceptualization based on the Resource Dependence Theory in explaining environmental collaboration between two supply chains. In contrast to the past researches which take a divided methodology, the current study investigates the upstream and downstream collaboration simultaneously considering the combined effect on cost and competitive performance. It also talks of the mediating effect of supply chain cost in the translation of environmental initiatives to competitive advantage. In the theoretical viewpoint, the study builds RDT by applying it to the green supply chain management field thus providing a new definition of inter-organizational environmental cooperation. Practically the findings

will assist managers to develop collaborative benefits that support sustainability goals and objectives of cost efficiency and competitiveness in the market.

All in all, this study addresses the increasing demand of integrated, theory-based approaches to sustainable supply chain management, and adds to the disseminating debate on the environmental collaboration and firm performance in the modern business setting.

2. Literature Review

2.1 Resource Dependence Theory (RDT)

The inter-organizational relationships in the supply chains have been analyzed through the resource dependence theory (RDT) as a form of background. According to the theory, firms are not independent, but in need of outside actors to provide them with essential resources when it comes to raw materials, technology, knowledge and capabilities. This reliance brings uncertainty and the vulnerability so that the firms have to form strategic partnerships to handle such dependencies (Pfeffer and Salancik, 1978; reinterpreted in recent circumstances by Liu et al., 2023). According to modern research, companies are actively formed alliances, partnerships, and networks in order to minimize uncertainty and gain towards access to valuable resources (Bhandari et al 2020).

When applied to the supply chains, it can be argued that RDT proposes that the major source of interaction both in knowledge and in the use of innovation of an environmental type are the suppliers upstream and the consumers downstream. Firms also work with these stakeholders not merely to find a means of accessing resources, but also to increase their flexibility to the evolving environmental regulations and market demands. Recent studies point out that environmental cooperation contributes to minimization of information asymmetry and development of mutual dependence, which brings better performance results (Hussain et al., 2019; Chen et al., 2022;). Additionally, RDT identifies the reason why environmental practices are becoming a type of strategic interdependence in firms. The environmental laws, shareholders pressure, and sustainability ensure that firms work harmoniously along the supply chain. This co-ordination converts the traditional transactional relations to collaborative partnerships towards mutual environmental objectives (Khan et al., 2024). This kind of interdependence allows firms to share values of creation, decrease risks, and increase robustness in uncertain environments (Miller et al., 2019; Razzaque, et al., 2024; Kalasua & sahu 2026).

In fact, recent empirical research also establishes that collaborations based on RDT are highly effective mechanisms that enhance environmental and operational performance. As an example, companies that enter into strategic partnership agreements with the members of the supply chain have a greater degree of innovation and efficiency (Arbelo et al., 2024; Babu et al., 2026). Accordingly, the article by RDT offers a sound theoretical basis to the study of environmental collaboration as the means of coping with dependencies and improving the performance of supply chains.

2.2 Environmental Cooperation with Suppliers

One of the upstream dimensions of green supply chain management is vital and is the environmental cooperation with suppliers. Suppliers are critical in shaping the environmental impact of products because they manage raw materials, manufacturing processes and design of components. This, therefore, leads companies to participate in joint activities, including green procurement, eco-design assimilation and supplier environmental audit so that the supply chain can remain sustainable (Wang et al., 2026; García-Hurtado et al., 2026). Green procurement refers to the process of choosing suppliers according to environmental parameters whereby the suppliers are environmentally certified, have sustainable sourcing practices and adhere to the environmental standards. It has been shown that green procurement does not solely lessen the environmental impact, but it also improves the efficiency of operation by decreasing waste and the use of resources (Zarei et al., 2023; Andalib et al., 2023). Moreover, the company that pursues the green procurement approach frequently can save costs by using the resources more effectively and minimizing the risks associated with regulatory requirements (Zeng et al., 2025).

The other important point of supplier cooperation is integration of eco-design where companies collaborate with suppliers to create products with environmental friendliness. These involve minimizing the amount of materials

used, designing to become recyclable and minimizing the amount of energy used in production. Empirical studies also indicate that the eco-design partnership results in innovation and cost-effectiveness, as they allow the companies to streamline the process of product design and manufacturing (Shin et al., 2023; Qiao et al., 2022).

Supplier environmental monitoring generally means providing assessments and enhancement of environmental performance of suppliers in terms of audit, certification, and performance indicators. The practice will help maintain the environmental standards, and ensure continuous improvement. As it has been studied, monitoring systems increase confidence and openness between companies and their vendors, helping them to establish enduring cooperation and enhance performance (Zhu et al., 2022).

All in all, a sustained partnership with the suppliers in terms of environmental changes has been consistently associated with better cost performance and environmental results. Through knowledge sharing and collaborative problem solving, companies will be able to cut down wastage, extrinsic efficiency and attain sustainable competitive advantages (Xiao et al., 2024; Zeng et al., 2025).

2.3 Environment Collaboration with the Customer

The benefits of downstream partnership with the customers are also very significant in sustainable supply chains. The customers determine the design of products, trends of demand and their sustainability requirements and thus their participation is a key ingredient in attaining the environmental objectives. Some of the activities involved in environmental collaboration with the customers are green product feedback, alignment to sustainable consumption, and involvement in reverse logistics systems (Rizzo et al., 2023; Andalib et al., 2023). Green product feedback entails the participation of customers in designing and development of eco-friendly products. This partnership enables companies to match their products to customer demands and legal standards and gain more acceptance and a rise of innovations on the market (Calza et al., 2023). Moreover, customer feedback helps firms to operate more product sustainability opportunities and environmental impact reduction.

Sustainable consumption alignment is the attempts to stimulate the customers to have environmentally friendly consumption patterns. Through the awareness campaigns, eco-labeling and sustainable buying incentives the firms are working with customers. Research demonstrates that these initiatives boost customer loyalty and brand reputation and also make the environment sustainable (Ndaguba et al., 2026; Ferrer-Estévez, & Chalmeta 2024). Another important aspect of collaboration with customers is participation in reverse logistics and recycling. Companies collaborate with clients in order to make products returnable and recycle and reuse them hence minimizing waste and encouraging the use of the circular economy. Studies show that the efficiency of resource usage and the environmental impact of the system are highly enhanced by the reverse logistics systems (Nguyen et al., 2026; Valentinov et al., 2023).

Moreover, sustainability innovation instigated by the customers has become a dominant source of competitive advantage. Through partnership of environmentally-conscience customers, companies will be able to innovate a new product and service that address the changing market needs. Empirical research emphasizes that customer collaboration increases the ability to innovate and be prompt to the market, resulting in better performance in the market (Cho et al., 2026)

2.4 Supply Chain Cost Performance

The key result of environmental cooperation is supply chain cost performance. Conventionally, sustainability programs were viewed as being expensive but current studies dispute the belief by proving that environmental practices can result in extensive cost reductions. The reduction in the operational costs is seen by means of efficient resource use, waste reduction, and process fine-tuning (Varriale et al., 2026; Wang et al., 2026).

Environmental collaboration has been found to be a major cost reduction mechanism which involves waste minimization. Recycling, reuse and eco-design are some of the practices that the firms can implement to reduce material waste and disposal costs. The research indicates that waste minimization can not only reduce the operation cost but also elevate the environmental performance (Aprilia et al., 2021; Unhelkar et al., 2023). Another factor that affects the cost performance is energy efficiency. Joint efforts with suppliers and consumers allow

companies to optimize the amount of energy used throughout the supply chain, which leads to cost reductions due to lowering energy prices and decreasing carbon emissions (Mohsen, et al., 2023; Gopal et al., Becattini, et al.,2022).

Efficiency in logistics is also important in minimizing the cost of supply chain. Greens and greens practices like optimal transportation routes, sustainable transportation, and effective inventory management are relevant in saving money and ensuring the environment remains sustainable (Kristanti,et al., 2024; Zhang et al., 2024 Uzozie et al.,2022).

All in all, the literature points out that environmental collaboration does increase cost performance, through increased efficiency, minimized waste, and better use of resources. Nevertheless, the degree in which these cost advantages can be transferred into competitive performance is still subject to research.

2.5 Competitive Performance

Competitive performance defines a firm performance in the market whereby the firm succeeds to produce excellent market results, such as market share, profits, innovation and brand names. The concept of environmental collaboration has become one of the primary contributors of competitive advantage in modern market (Firasat et al,2024; Kant et al., 2025). One of the main advantages of the environmental practices is market differentiation. The companies competing in a sustainable fashion will be able to distinguish their goods and service, attracting the attention of eco-conscious buyers and gaining a competitive advantage (Ugrinov,et al., 2024 ; Borji et al., 2023).

Another important aspect of competitive performance is brand reputation. Partnering with the environment contributes to a better corporate image and trustworthiness and results in a better brand equity and customer loyalty (Kant et al., 2025; Chakim et al., 2022). Companies that have good environmental images can easily attract investors, customers, and other partners. Environmental collaboration is also instrumental in innovation capacity. When the suppliers and customers work together, it becomes easier to share knowledge and co-create innovative products and processes (Opere et al, 2024; Agyabeng-Mensah et al., 2025). Such innovation improves long term survival and competitiveness.

Lastly, environmental collaboration is a contributor to long-term profitability as businesses are oriented on sustainability. Researchers show that companies that incorporate environmental excellence in their supply chains benefit better in financial terms and result in resilience in the dynamic business markets (Kant et al., 2022; Li et al., 2022).

2.6 Constructs and Research Gap Integration

Although the literature on environmental collaboration is quite comprehensive, there are still various gaps. Majority of the studies investigate either supplier or customer collaboration without the consideration of the cross effects of both dimensions. Also, little research has been conducted on the concurrent effects of environmental collaboration on cost and competitiveness of the supply chain. Moreover, we do not fully exploit the use of the Resource Dependence Theory in this area.

Table 1: Summary of Literature on Environmental Collaboration

Author (Year)	Focus	Variables	Findings	Gap
Touboulic et al. (2021)	Supplier collaboration	Green procurement, performance	Improves sustainability	No customer perspective
Jabbour et al. (2021)	Customer collaboration	Green innovation	Enhances innovation	Limited cost analysis
Khan et al. (2021)	GSCM practices	Environmental practices, cost	Cost reduction observed	No integration of both sides

Zhu et al. (2025)	Eco-design	Design, efficiency	Improves efficiency	Limited competitive analysis
Kazancoglu et al. (2021)	Reverse logistics	Recycling, cost	Cost savings	Narrow scope
Dubey et al. (2022)	Collaboration	Supply chain performance	Positive impact	No RDT application
Li et al. (2022)	Customer alignment	Sustainability, loyalty	Improves loyalty	No supplier linkage
Gong et al. (2023)	Supplier monitoring	Compliance, performance	Enhances trust	Lacks downstream view
Rahman et al. (2022)	Innovation	Collaboration, innovation	Boosts innovation	No cost linkage

Table 2: RDT-Based Collaboration Studies

Study	Theory Used	Key Insights	Limitations
Miller et al., 2019	RDT	Collaboration reduces uncertainty	Not environment-focused
Kalasua & sahu 2026	RDT	Resource sharing improves performance	Limited supply chain scope
Babuet al., 2026	RDT	Interdependence enhances coordination	No cost analysis
Razzaque, et al., 2024	RDT	Alliances improve innovation	Limited environmental context
Hussain et al., 2019;	RDT	Collaboration enhances resilience	No customer role
Chen et al., 2022	RDT	Dependency drives partnerships	Not integrated model
Bhandari et al 2020	RDT	Environmental collaboration emerging	Empirical gaps
Liu te al., 2023	RDT	Improves supply chain performance	No dual performance outcomes

It is evident in the literature that the strategic partnership with the environment in relation to suppliers and customers is a decisive contribution to improving sustainability, cost, and competition. Nevertheless, the current literature is not very coherent with only little interaction of upstream and downstream cooperation and theoretical lack of Resource Dependence Theory. This paper will fill these gaps because it suggests a combined RDT-backed model to explore the collaborative effects of the environment on the supply chain cost and competitive level.

3. Objectives

- a. To analyze how cooperation with suppliers in relation to the environment affects the cost of the supply chain.
- b. To examine the effect of environmental partnership with customers on the performance of competition.

- c. To examine ways of supply chain cost to moderate competitive performance.
- d. To construct an RDT integrated model of environmental cooperation and firm performance.

4. Research Model (Conceptual Framework)

The research constructs a composite conceptual model to analyze the effects of environmental alliance on the performance results of the supply chain, based on the Resource Dependence Theory (RDT). The model describes the way in which firms will undertake to manage the external dependency in a more strategic way by collaborating with important supply chain participants- suppliers and customers in order to improve the efficiency of an organizational performance and also the competitive edge.

As the main independent variables of the model, Environmental Collaboration with Suppliers (ECS) and Environmental Collaboration with Customers (ECC) are placed. These constructs are upstream and downstream integration respectively, and they indicate the degree, to which firms are involved in integrating on joint environmental initiatives, including green procurement, eco-design, alignment between sustainable consumption, and reverse logistics. Through the lens of RDT, the firms depend on suppliers as a source of vital resources including raw materials and environmental technologies, and the customers act as the sources of market intelligence and demand feedback. Therefore, working together with these stakeholders will decrease the unpredictability and promote access to the useful environmental capabilities.

As one of the mediating variables, Supply Chain Cost (SCC) is introduced that reflects the benefits of environmental cooperation in terms of functioning. The existing literature indicates that joint environmental efforts enhance resource efficiency and minimize waste and maximize logistics which reduces operational expenses. In the context of the RDT, these cost efficiencies will arise when companies use collective resources and expertise to reduce the risk of dependency and better coordinate the supply chain system.

The dependent variable is Competitive Performance (CP), which is the strategic result of environmental collaboration. It covers aspects of market differentiation, innovation ability, brand image, and profitability in the long run. The model presupposes that direct and indirect channels lead to the association of environmental cooperation with competitiveness. However, even though collaboration can have a direct impact on competitiveness by improving innovativeness and gaining reputation, it can also have an indirect impact on the performance in terms of cost-efficiency realized in the supply chain.

In the proposed model, operational and strategic perspectives are therefore encompassed with the collaboration of the environment emphasized to both cost as well as competitive performance. It is also a step a further on current research as the issue of upstream and downstream cooperation is studied in a comprehensive framework. This two-facet approach gives a more in-depth answers to how the process of creating value by the firms using environmental initiatives occurs.

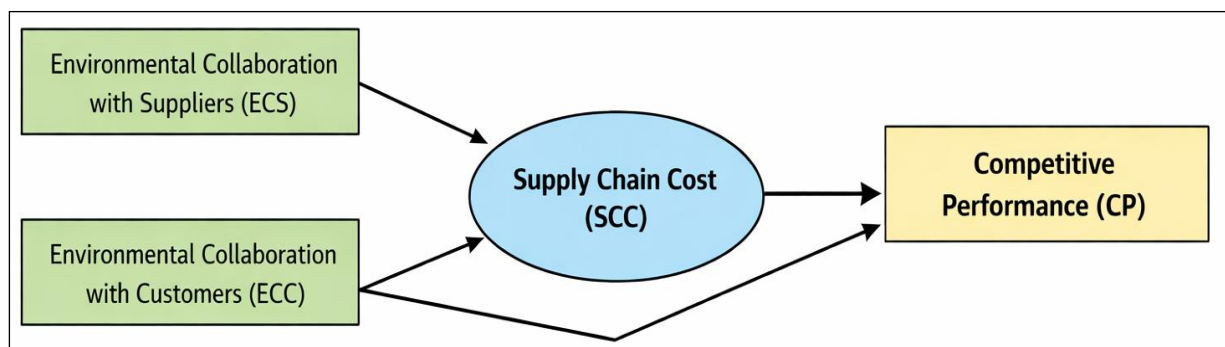


Figure 1: Conceptual Framework

5. Hypothesis Development

With reference to the Resource Dependence Theory (RDT), in this paper, the hypotheses are formulated to demonstrate how the environmental cooperation with its supply chain partners affects cost efficiency and competitiveness. According to RDT, companies rely on the external organizations on vital resources and attempt to reduce uncertainty by teaming up, coordinating efforts. Green supply chain management in relation to environmental cooperation is a strategic process that involves getting knowledge, technology, and capabilities that would be relevant in operating in a sustainable fashion.

H1: There is a significant decrease of supply chain cost through environmental collaboration with suppliers.

The suppliers also provide the important elements of materials, technologies and production processes that affect the environmental performance. RDT suggests that the companies make agreements with suppliers to gain access to such critical resources and minimize uncertainty (Andalib et al., 2023). Some of the environmental collaborations with suppliers, including green procurement and eco-design integration allows firms to maximize the use of resources, minimize wastes, enhance efficiency in production. The practices result into major aspects of saving costs such as ensuring that there is minimum material, energy and compliance costs. Moreover, common problem-solving and information transfer lead to an increase in efficiency of the processes, which leads to decreased operational expenses. Consequently, a closer partnership with the suppliers will ensure a decline in supply chain cost (Zarei et al., 2023;).

H2: Customer environmental cooperation plays a crucial role in lowering supply chain cost.

The customers will be significant in setting the demand trend and sustainability needs. Regarding an RDT, companies are reliant on clients to provide information about the market and earn income. Sustainable consumption orientation and involvement in reverse logistics provide the ability to environmental cooperation with the customers and facilitate the management of the product lifecycle; by-products minimize wastes. As an example, a customer participation in the recycling and reusing programs reduces the disposal expenses and enhances the recovery of the resources. Also, the customer response will assist companies to create effective and sustainable products that would minimize costs of production and operational expenses. In this way, cooperation with customers is projected to help reduce costs of supply chain (Rizzo et al., 2023; Andalib et al., 2023).

H3: Competitive performance has a positive relationship with the supply chain cost efficiency.

One of the issues that determine competitive performance is its cost efficiency. According to RDT, companies that serve a good handling of resource dependence and resource optimization deliver the best performance results. Lower costs of supply chains help companies to provide competitive prices, enhance their profit margins and allocate funds to innovations. In addition, the operations made cost efficient improve the flexibility and resiliency of organizations, which enables them to effectively react to the changes in the market. Thus, the enhanced cost efficiency of the supply chain is likely to have a positive impact on the competitive performance. (Li et al.,2022;

H4: Co-operation with the suppliers regarding the environment has a positive impact on the competitive performance.

Green cooperation with the suppliers improves the access to high-tech technologies, innovative techniques and long-lasting materials. As of RDT, these types of collaborations decrease the risks of dependence and increase the availability of resources, which improves the capabilities of an organization (Uzozie et al.,2022). The collaboration with suppliers promotes the innovation, enhances the quality of products and their environmental compliance, which are all part of competitive advantage. Also, companies that have sustainable supplier relations can butt exist among each other and upgrade their brands. Therefore, environmental cooperation with suppliers would have a favorable impact on the competitive performance. (Kristanti,et al., 2024; Zhang et al., 2024)

H5: Competitive performance is positively affected by environmental collaboration with customers.

The most important resource of market-oriented innovation and differentiation is customer collaboration. RDT lays emphasis on controlling customer dependency through alignment of organizational strategies to the market

needs. The cooperation with customers at the environmental level helps companies to create sustainable products that respond to the changing consumer preferences that can increase the competitiveness of the markets. It also enhances customer relations, loyalty and also brand image. Moreover, customer-led innovation leads to the profitability and success in the long-term. Thus, the collaboration with customers concerning the environment is likely to provide positive contribution to the performance competition. (Ugrinov, et al., 2024 ; Borji et al., 2023)

6. Research Methodology

The research follows a structured quantitative research approach in their effort to empirically determine how environmental collaboration, supply chain cost, and competitive performance are interrelated. The methodological design is consistent with the previous research on the topic of green supply chain management and is appropriate to test the complex relationships through structural equation modeling.

6.1 Research Design

The study adheres to a quantitative and cross-sectional approach, where a study is conducted at one time giving appropriate respondents in the industry. This is the right method to be used when analyzing causal relationships between constructs like the Environmental Collaboration with Suppliers (ECS) and Environmental Collaboration with Customers (ECC) with Supply Chain Cost (SCC) and Competitive Performance (CP). The quantitative design will allow conducting statistical tests of the hypothesis and improving the extrapolation of the results.

6.2 Industry Context

The research investigates the MSMEs (Micro, small, and medium enterprises) in the Indian manufacturing industry since these organizations are of great importance in the economic sector, and many are becoming environmentally sustainable. The constraint of resources is frequently observed among MSMEs and, therefore, they are very reliant on the supply chain partners, which is quite consistent with the Resource Dependence Theory (RDT) model. Moreover, the manufacturing industry is an ecologically consuming sphere and, thus, a perfect choice of a situation to examine the green supply chain practices and cooperation.

6.3 Sampling Technique

A stratified and convenience sampling method is used. The stratified sampling is to ensure coverage of the various manufacturing sub-sectors (e.g., automotive, textiles, electronics), whereas the convenience sampling will provide access to the respondents based on the practical consideration (e.g., access to respondents). This mixed method is common in research of supply chain because the sampling frames are not necessarily easy to access.

6.4 Sample Size

The research aims at interviewing 186 participants that is assumed sufficient in terms of Partial Least Squares Structural Equation Modeling (PLS-SEM). It is also stated that PLS-SEM indicates the adequate size of the sample by the methodological rules, whereas the complexity of the model and 186 respondents are enough to ensure the sufficient power of the system to guarantee the efficiency of estimation and hypothesis treatment.

6.5 Respondent Profile

The firm is a unit of analysis and data will be gathered through key informants that knew the supply chain and how the firm practices are affecting the environment. The respondents include:

- Supply Chain Managers
- Procurement Heads
- Sustainability/Environmental Officers

These workers have direct participation in decision making on cooperation with the suppliers, reaching to the customers and sustainability projects, which makes the reactions accurate and reliable.

6.6 Data Collection Method

A structured questionnaire is used to collect primary data based on other literature supported measurement scales. The questionnaire utilizes a five point Likert scale (1 = strongly disagree to 5 = strongly agree) in an attempt to assess how the respondents perceive the constructs.

The survey will be administered in various channels so as to increase response rates, which include:

- Industry databases
- The professional networking sites like LinkedIn.
- Associations and business networks.

Before arectual data gathering, a pilot study can be carried out in an attempt to verify the questionnaire items as clear, reliable and valid.

6.7 Measurement of Constructs

The measurement of all constructs in the study is done through multi-item scales derived through established research on the literature on green supply chain management and strategic management.

- ECS & ECC: Questions regarding the working partnerships, joint ventures and environmental strategies.
- SCC: Items which represent cost efficiency, waste reduction and operational savings.
- CP: Marketing performance, innovation, and competitiveness items.

Implementing verifiable scales is an improvement of construct reliability and content validity.

6.8 Data Analysis Technique

The analysis utilizes Partial Least Squares Structural Equation Modeling (PLS-SEM) on such software like SmartPLS. PLS-SEM is most applicable concerning this study because:

- Its capability to deal with multi-construct, multi-modeling.
- Eligibility in predictive and exploratory research.
- Strength using rather small sample sizes.

The analysis will take place in two phases:

- Assessment of measurement model.
- Structural Model Assessment.

6.9 Reliability and Validity Testing

As a way to ascertain the strength of the model, a number of reliability and validity tests are made:

- i. Cronbach's Alpha: To test internal consistency of reliability (threshold > 0.70)
- ii. Composite Reliability (CR): To assess construct reliability (> 0.70)
- iii. Average Variance Extracted (AVE): To measure convergent validity (> 0.50)
- iv. Heterotrait-Monotrait Ratio (HTMT): To assess discriminant validity (< 0.85 or 0.90)

The tests also confirm the reliability and validity of the measurement model, then the hypothesis testing is carried out.

Table 3: Summary of Research Methodology

Component	Description
Research Design	Quantitative, cross-sectional
Industry	Indian MSMEs (Manufacturing Sector)
Sampling Technique	Stratified + Convenience Sampling
Sample Size	186 respondents
Respondents	Supply chain managers, procurement heads, sustainability officers
Data Collection	Structured questionnaire (Likert scale 1–5)
Data Sources	LinkedIn, industry databases, associations
Measurement Scales	Adapted from validated studies
Analysis Technique	PLS-SEM (SmartPLS)
Reliability Tests	Cronbach’s Alpha, Composite Reliability
Validity Tests	AVE, HTMT

7. Analysis and Interpretation

This is where the empirical findings of the study have been given using Partial Least Squares Structural Equation Modeling (PLS-SEM). The analysis is done in three phases: (1) measurement model analysis, (2) structural model analysis, and (3) mediation analysis.

7.1 Measurement Model

The measurement model had been evaluated to determine the reliability and validity of the constructs; Environment collaboration with supplier (ECS), Environment collaboration with Customers (ECC), Supply Chain Cost (SCC), and Competitive Performance (CP).

Cronbach’s Alpha and Composite Reliability (CR) were the tests of internal consistency reliability. Constructs were all above the desired value of 0.70 signifying a high level of reliability. Average Variance Extracted was used to determine convergent validity. All the AVE values were higher than 0.50 and the constructs explain adequate percentage of variance in the indicators. HTMT ratio was used in the determination of discriminant validity. The values of all HTMT have fallen below the mark of 0.85 meaning that the constructs are not similar to one another.

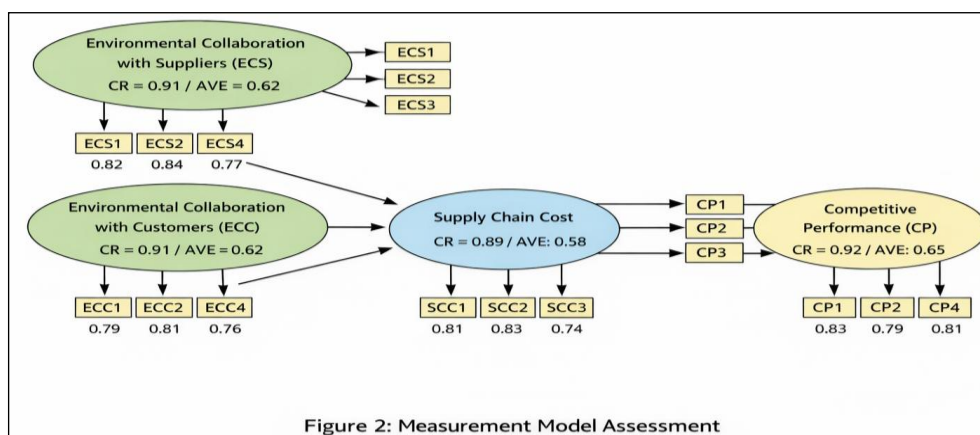


Table 4: Reliability and Convergent Validity Results

Construct	Cronbach's Alpha	Composite Reliability	AVE
ECS	0.88	0.91	0.62
ECC	0.86	0.90	0.60
SCC	0.84	0.89	0.58
CP	0.89	0.92	0.65

Table 5: Discriminant Validity (HTMT Ratio)

Constructs	ECS	ECC	SCC	CP
ECS	—			
ECC	0.72	—		
SCC	0.68	0.70	—	
CP	0.75	0.73	0.69	—

7.2 Structural Model

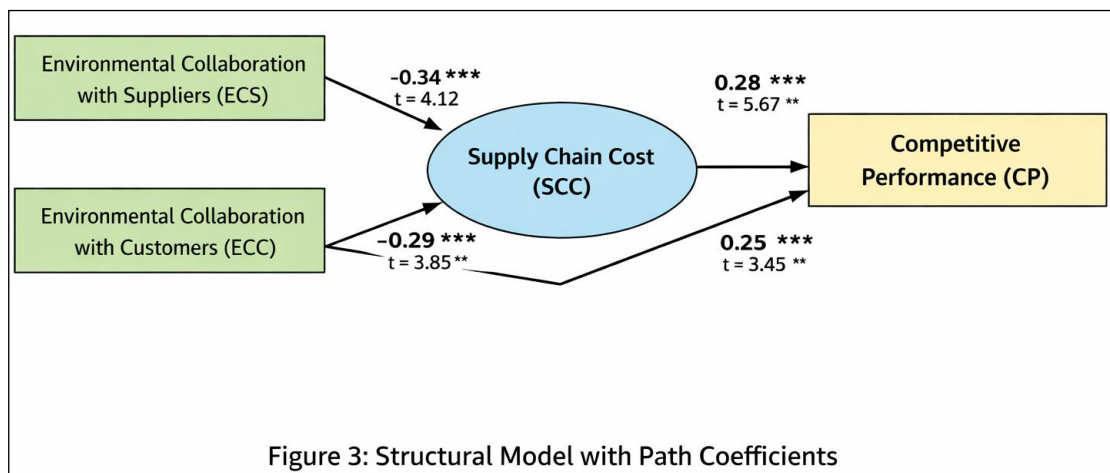
The relationships among constructs were tested by assessing the hypothesis of the structural model. Bootstrapping procedures were used to obtain path coefficients, t-values and levels of significance.

The outcomes point to the fact that Environmental Collaboration with Suppliers (ECS) and Environmental Collaboration with Customers (ECC) produce substantial adverse impacts on Supply Chain Cost (SCC), which proves the cost reduction advantages. Moreover, SCC poses a positive but significant impact on Competitive Performance (CP) which means that a cost efficiency improves competitiveness.

Both ECS and ECC also have a direct positive impact on CP, indicating that environmental collaboration has competitive advantage even in terms of other than cost-saving. The values of the coefficient of determination (R²) show that the model captures a high percentage of variance in endogenous constructs. Particularly, the R² of SCC is 0.48, the R² of CP is 0.62 which signify a moderate or strong value of explanatory power. The ECS and ECC analysis demonstrate that ECS and ECC strongly affect SCC with a medium effect, whereas the effects of SCC on CP are strong.

Table 6: Structural Model Results and Hypothesis Testing

Hypothesis	Path	β	t-value	Result
H1	ECS → SCC	-0.34	4.12	Supported
H2	ECC → SCC	-0.29	3.85	Supported
H3	SCC → CP	0.41	5.26	Supported
H4	ECS → CP	0.28	3.67	Supported
H5	ECC → CP	0.25	3.45	Supported

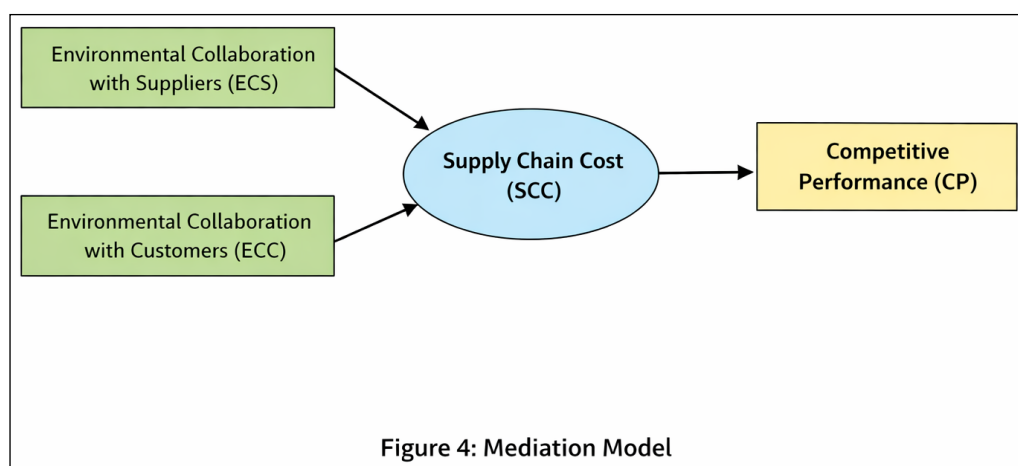


7.3 Mediation Analysis

In order to investigate the mediating effect of Supply Chain Cost (SCC), a bootstrapping regression procedure was performed (5,000 resamples). The findings show that SCC partially mediates between environmental collaboration (ECS and ECC) on the one hand and competitive performance (CP) on the other hand.

Indirect effects of ECS-SCC-CP and ECC-SCC-CP are equally important showing that cost efficiency is a relevant tool by which the environmental collaboration can boost competitiveness. Nevertheless, as the direct impact of ECS and ECC on CP in question is still remarkable, partial mediation is proved.

Coherence of significant indirect effects is further supported by bootstrapping confidence interval because the null value is out of the confidence interval.



The results give high empirical significance to the model proposed. Eco-collaboration with the suppliers as well as customers helps a lot in lowering supply chain expenses and competitive performance. The findings further show the mediating position of cost efficiency as it is the underline that operational gains are one of the major channels via which sustainability initiatives would lead to strategic gains.

In general, the discussion supports the applicability of Resource Dependence Theory in defining the value of inter-organizational collaboration in terms of firms to manage the situations of dependence, lessen the state of uncertainty, and acquire better results regarding the performance outcomes.

8. Discussion

This study gives empirical evidence in regard to the given model since the application of environmental collaboration is critical in improving operational performance and strategic performance outcomes. In particular, the findings demonstrate that the existence of environmental collaboration with suppliers (ECS) and customers (ECC) can save a lot of costs incurred in the supply chain at the same time increasing the competition performance. The findings contribute to the continuously increasing belief in the green supply chain management literature that sustainability-based partnership is not only a compliance level but a performance facilitator (Zhu et al., 2023; Khan et al., 2025).

Relative to the Resource Dependence Theory (RDT), the findings can be explained by the fact that companies are actively involved in collaboration with the environment to deal with the external matters of dependence and minimize uncertainty. The suppliers or customers are very important sources of environmental knowledge, technology and market intelligence. Through these stakeholders, firms can get access to good resources which otherwise cannot be developed without their assistance. This is consistent with the essence of the RDT idea that organizations establish inter-organizational connections to ensure the necessary resources and reduce the environmental uncertainty (Drees & Heugens, 2021; Chen et al., 2024).

The high negative correlation between the environmental collaboration with the supply chain cost substantiates the position that collaboration helps to improve resource efficiency. By collaborating in such activities like eco-design, green procurement, and reverse logistics, companies may optimize the use of materials, minimize wastes, and become more energy efficient. These results translate into the reduced costs of operation, which proves previous researchers who accentuate the cost-saving prospects of the green supply chain practices (Agyabeng-Mensah et al., 2020; Centobelli et al., 2021).

Moreover, the correlation between the operational excellence and the competitive performance as also stated by the positive relationship between supply chain cost efficiency and the competitive performance is strategically important. The cost-efficient companies will be in a position to provide competitive pricing, enhance profitability, and invest in innovation. This observation is aligned with recent studies showing that the cost benefits, which are based on sustainability, can result in the achievement of the best results in the market (Balsalobre-Lorente et al., 2022; Gupta et al., 2024).

The positive direct effects of ECS and ECC on the competitive performance imply that the collaboration with the environment has more than cost-saving competitive advantage. Teamwork is good because it contributes to innovation, improvement of product quality and brand recognition, which help firms to stand out within the market. This is in line with the literature that emphasizes stakeholder collaboration in sustainable innovation and competitive differences (Jabbour et al., 2021; Leonis et al., 2022).

Notably, it can be seen that mediation analysis of the relationship between environmental collaboration and competitive performance portrays that supply chain cost mediates relationship to some extent. This shows that cost efficiency is another important avenue, although there are other processes like innovation and reputation that result in improved competitiveness. This discovery is a follow-up on past studies that offer a more subtle interpretation of environmental collaboration and its impact on performance (Dubey et al., 2022).

This study provides a more coordinated view as compared to the previous studies since both the upstream and downstream collaboration are analyzed together in an RDT framework. Although previous research tended to look at the supplier or customer, the current research shows the confluence of the two dimensions hence filling a major gap in the research.

No significant surprising findings were identified, but the proportionality of Supplier collaboration in reducing costs on the proportion of Customer collaboration was rather higher, which could indicate a direct effect of supplier on the production processes and use of resources. This is hinting at a higher benefit of upstream collaboration on the immediate operations and downstream collaboration with respect to market-oriented outcomes.

On the whole, the results support the relevance of environmental collaboration as a strategic tool of resource dependency management, minimization of uncertainty, and superior productivity of sustainable supply chains.

9. Implications

9.1 Theoretical Implications

This research has a number of theoretical implications to existing literature of green supply chain management and inter-organizational relationships. First, it expands the applicability of postulation of Resource Dependence Theory (RDT) into the environment supply chain field as it reveals how companies can use cooperation with suppliers and buyers to control resource dependencies and increase performance results. Although RDT has been used traditionally to explain general inter-organizational relationships, the study airs its importance in the explanation of sustainability-oriented collaboration. Next, the paper incorporates both of the upstream (supplier) and downstream (customer) environmental cooperation in the same framework. Previous studies have studied these aspects to a large extent in singular cases, which restricts the perception on the interplay of these aspects. This is more holistic because the research considers both sides of the argument of environmental collaboration and its effects on supply chain performance. In addition to that the current study paves the way to the clear relationship between cost effectiveness and competitive advantage as it proves that environmental collaboration is able to lower costs but improve strategic performance. The fact that supply chain cost was used as a mediating variable adds to the body of literature because it explains the related mechanisms by which sustainability initiatives will ultimately lead to competitive outcomes.

9.2 Practical Implications

The research results of this study can be useful to managers, policymakers, and companies that are interested in improving sustainability and performance levels in supply chains.

Both suppliers and customers should also be invested by managers who endeavor to ensure that robust environmental relations are developed. Geo-design can be exchanged individually with others, green procurement and reverse logistics, can substantially enhance resource efficiency and lower costs. Knowledge sharing and long-term relationship building should also be considered by the managers to increase the advantages of collaboration.

The policymakers also play a key role in strategic development of sustainability of supply chains through establishment of enabling regulatory frameworks and motivation towards environmental partnerships. The policy that promotes information transfer, innovative thinking, and cooperation between partners in the supply chain can promptly contribute to green practices adoption and improve the overall level of sustainability.

Firms ought to aim at balancing sustainability goal and cost efficiency by becoming environmental conscious within their core business strategies. Instead of considering sustainability as an expense center, companies need to see it as a possible source of competitive advantages with innovative products, efficiency, and improved brand name.

10. Conclusion, Limitations & Future Scope

This experiment explored how supply chain cost and competitive performance can be affected by environmental cooperation with suppliers and customers as a form of the Resource Dependence Theory. The results show the supply chain costs and competitive performance are greatly decreased through environmental collaboration.

Further, supply chain cost is to some extent intervening the relationship between performance and collaboration, representing the significance of efficiency in operations as a means towards strategic advantage. The findings highlight the importance of environmental collaboration being not only a sustainability process but also a strategic requirement that companies in dynamic and competitive environments need to have. Through the successful management of resource dependencies and additional inter-organizational relationships, firms may benefit in terms of both economic and environmental.

The work has some shortcomings regardless of its contributions. One, the study design adopted is cross-sectional, and as such the research does not yield dynamics to be observed across time. Second, the manufacturing industry and Indian MSMEs considered could limit the applicability of the results to other industries or regions. Third, there is a risk of biases of self-reports introduced, e.g. common method bias.

The limitations can be resolved in the future research through application of longitudinal research designs in exploring the development of environmental collaboration with time. Comparison of various works in different industries across various countries would give a greater insight into the contextual variability. It should be noted, as well, that another opportunity to engage in research in the future is the integration of digital technologies into supply chain partnership, including Artificial Intelligence (AI) and Internet of Things (IoT). The data sharing, transparency, and decision-making can be improved with the use of these technologies and can contribute to the effort to work on environmental collaboration.

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