# Green Supply Chain Practices and its Impact on Sustainability through the Role of Green Innovation Practices and Institutional Pressure

## Case Study: DHL in Egypt


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# Abstract

**Purpose** – The study mainly aimed to delve into the impact of the practices of green supply chain and their dimensions (Green Manufacturing, Global Collaborative Capability, Green Purchasing, Eco-Design, and Packaging, Systems of Green Information, and Green Logistics) on sustainability and dimensions of economic, Social, environmental) through the mediating effect of the practices of green innovation and the moderating influences of institutional pressure on DHL companies in Egypt.

**Design/methodology/approach** – The study employed the quantitative approach in data gathering and evaluation. The quantitative evaluation and deductive methodology were used to take a methodical and objective approach to data gathering and evaluation to achieve the primary goals of the investigation.

**Findings** – The outcomes indicated that there was a statistically significant association between Green Supply practices and Sustainability in DHL companies in Egypt, in addition, there was a statistically significant association between practices of Green Supply and Green Innovation Practices in DHL companies in Egypt. The inquiry also found that there was a statistically significant link between Green Innovation Practices and Sustainability in DHL companies in Egypt as well as institutional Pressure moderated the association between Green Supply practices and Sustainability in DHL companies in Egypt.


**Keywords** – Green Supply Practices, Global Collaborative Capability, and Green Logistics

# 1. Introduction

The imperative to address environmental concerns and foster sustainable business practices offered the emergence of Green Supply Chain Management (GSCM) as a pivotal paradigm within contemporary supply chain practices. GSCM involves fitting ecological considerations into every facet of the supply chain, aligning with the broader goals of sustainability. Since supply chains evolve according to dynamic market forces and technological advancements, the different associations between Green Supply Chain Management and contemporary supply chain practices becomes increasingly crucial.

Responding to the high client demand, corporations are decreasing to the center of the Red Ocean and attempting to build new enterprises or ways to attract customers. In recent years, businesses have demonstrated an enormous interest in adopting the strategies of environmentally friendly ways by providing goods and services that fit the standards of a safe environment (Weeratunge, Herath 2017). Through transitioning to ecological structures, firms may increase production efficiency, gain a competitive edge, and reduce the effect of detrimental environmental variables (Silva GM,2019).

Moreover, green innovation practices represent an essential element in developing sustainable business models. By investing in research and development for eco-friendly technologies and products, organizations can not merely diminish their ecological influence but likewise gain competitiveness in the market. Additionally, embracing green innovation allows companies to attract environmentally conscious consumers and investors who prioritize sustainability as a key factor in their decision-making process. The adoption of green innovation practices faces many challenges, including the high initial costs of implementing eco-friendly technologies and the need for extensive employee training. Organizations that successfully overcome these hurdles can gain long-term benefits such as reduced expenses via energy utilization and an increased brand recognition as a socially conscious corporation (Tseng et al., 2013).

Firms are also affected by the institutional pressure to adopt green innovation practices. Regulatory bodies and government policies are increasingly pushing for stricter environmental regulations, which puts pressure on organizations to reduce their carbon footprint and implement sustainable practices. Additionally, investors for instance clients, employees, and stockholders are becoming more vocal about their expectations for companies to be environmentally responsible, further increasing the institutional pressure on firms to adopt green innovation practices. Therefore, corporates are developing new frameworks to enhance the acceptance of green practices and to integrate them into their overall business strategies. This involves spending money on R&D to generate new and environmentally friendly goods, as well as collaborating with suppliers and partners who share the same environmental values (Li et al., 2017).

Accordingly, this study delves into the different effects of green supply chain practices on sustainability via the mediating influence of green innovation practices and the moderating effect of the institutional pressure on DHL companies in Egypt.

## 2. Research Problem

Green supply chain standards represent one of the most influential elements in nowadays manufacturing industry, as they promote sustainability and reduce environmental impact. The implementation of green practices in supply chain management systems may offer noteworthy cost savings for companies. By implementing green practices, companies can reduce energy consumption, minimize waste generation, and adopt more efficient transportation methods, resulting in lower operational costs and improved profitability. Additionally, incorporating green systems may advance the corporate’s standing and attract environmentally conscious customers, leading to increased market share and competitive advantage (Wungkana et al., 2023).

The global supply chain network refers to a major contributor to environmental degradation, accounting for around 20% of global $CO_2$ emissions. Transportation, particularly reliance on fossil-fuel-powered vehicles, is a significant culprit within this network, generating air pollution, noise, and resource depletion. This unsustainable reliance on traditional transportation methods poses a critical threat to the planet's health and well-being.

However, the urge to enhance the sustainability levels in the world in general and in developing countries, including Egypt in particular, is becoming increasingly urgent. The lack of green practices in developing countries like Egypt has led to severe environmental degradation and resource depletion. Companies in these regions must prioritize the operations regarding sustainable initiatives to mitigate the negative impacts on the ecological approaches. By adopting green practices, Egypt can not only improve its ecological footprint but also attract foreign investments and promote economic growth through sustainable development. Therefore, companies in Egypt must recognize the urgency of incorporating green practices and take immediate action towards a more sustainable future (Mamdouh et al., 2018).

While green supply chain management establishes a framework for incorporating values of the sustainability throughout the supply chain, the full potential of eco-friendly methods for ecological, financial, and social sustainability is often unexplored. This research gap illustrates the requirement for an in-depth inquiry into the different effects of green supply chain management practices on the triple bottom line of sustainability within the supply chain via the mediating impact of green innovation standards and the moderating effect of pressure at DHL in Egypt.

## 3. Literature Review

### Emerging of Green Supply Chain Management

GSCM stands as a transformative force, redefining the very purpose of supply chains. It moves beyond mere economics, embedding environmental and social considerations into every stage of the network, from raw material sourcing to product end-of-life management (Christopher, 2016). This holistic approach encompasses a diverse range of practices, each aimed at minimizing negative impacts and fostering positive change.

The historical trajectory of supply chains reveals a relentless focus on maximizing throughput and minimizing expenses. This led to the prioritization of short-term profitability over long-term environmental and social ramifications. Consequently, unsustainable practices became commonplace, ranging from rampant resource depletion and pollution to exploitative labor conditions (Genova et al., 2017; Beske, 2016). This "business as usual" approach yielded undeniable economic dividends, but at the cost of ecological degradation and social inequities, ultimately threatening the very foundations of global prosperity (Ghisellini & Ciradina, 2014).

However, amidst this seemingly inexorable march towards an unsustainable future, a tide of change began to rise. Growing public awareness concerning the ecological and social costs of traditional supply chains fueled a demand for a more responsible approach. Consumers, businesses, and even governments started advocating for an integrated, holistic approach to managing supply chains – one that prioritized sustainability alongside profitability. This marked the genesis of GSCM.

GSCM is not merely an extension of existing practices; it represents a paradigm shift. It redefines the very purpose of supply chains, embracing the fundamental principle that economic success is inextricably linked to environmental and social well-being. This philosophy translates into a diverse array of practices implemented across the total supply chain lifecycle, from raw material sourcing to product end-of-life management (Christopher, 2016).

**Benefits and advantages of green supply chain management**

Environmental responsibility evolved beginning by a case study to a core competency that effectively aids businesses in achieving their objectives. Over the past few years, supportability has been steadily and significantly shifting from the boundaries of business. Based on the acts and geologies under which they operate, associations understand endorsed activities for a wide range of goals. The rationale behind this is that GSCM entails "greening" an organization's structure to encourage environmental protection and inspire eco-pleasing green activities, collaborations, coordination of waste, and green purchasing. When the stock network is greened in this fashion, three market factors contribute to productivity. The solution to rising raw material costs is a key motivator for going green. The second is the result of the supplier's product or material being accessible as alternatives. Changes in the way suppliers contribute to the quality or organization of the business's products serve as the third business driver for this greening concept (Noor Aslinda Abu Seman et al., 2012).

It should be mentioned that it is difficult to estimate the cost of going green. For instance, only a small percentage of programs for ecologically friendly production have shown to be financially successful, according to research prepared by the Rotterdam School of Management. Additionally, research and practical experience indicate that significant environmental improvement can only be achieved through significant investments that have either no or negative financial returns (Whitehead & Fred 2015). Cost increases typically act as a barrier to the adoption of cleaner alternatives. Businesses should consider the price of sustainability initiatives as an investment and search for favorable environmental impacts and cost trade-offs.

As a result of GSCM processes, the business benefits of environmental improvement are becoming increasingly obvious. Gains will be larger the more seriously businesses and consumers consider environmental challenges. Business benefits come in two primary categories. The first is possible cost savings. Environmental transformation frequently comes down to improved resource efficiency, which therefore boosts the financial performance of businesses. The second benefit has to do with improving brand reputation and catering to customer preferences. Progress in this area can result in higher sales and marketing efforts as more companies and customers consider environmental considerations when making purchases (Wisner, 2011).

The GSCM initiatives make sure that all of the organizations' competitive resources are effectively utilized. As a result, organizations can start purchasing green information assets that will move to offer the desired green returns through the natural pleasant development technique by consolidating this idea in the process of fundamental business leadership. The tradition of lowering waste by increasing efficiency is at the core of this idea. Effective asset and supply management will save manufacturing costs and promote the reuse and recycling of raw resources (Sharabati, 2021). This further reduces the production of dangerous compounds, preventing associations from being punished for violating environmental regulations. The ability to utilize assets is improved while the appropriate operational costs are decreased comparably.

## DHL Egypt

DHL is one of the largest 3PL companies in the world founded in 1969 in San Francisco by Adrian Dalsey, Larry Hillblom, and Robert Lynn, and DHL is a member of the Deutsche Post DHL network. DHL is made up of DHL Express, DHL Global Forwarding, DHL Supply Chain, and DHL Mails. DHL staff has been more than 285,000 people since 1969 and offers service in 220 countries worldwide. DHL has been the regional champion of the International Express and Logistics industry for its efforts over the past 40 years (https://www.dhl.com).

Depending on its profound comprehension of the worldwide Internet and neighborhood advertising, DHL offers proficient types of assistance in express, airship cargo, sea dispatching, ground transportation universal postal help regions, and so on. What's more, flexible chain and undertaking data Solutions are two significant business issues that DHL manages in association with contract coordination and endeavor arrangement administrations.

## DHL Green practices and its sustainability impact

DHL is a global logistics company that has been actively working to develop and implement sustainable practices across its operations. Here are some examples of green practices that DHL has implemented and how it has developed its sustainability:

1. Carbon-neutral operations: DHL constructed a target of achieving net-zero carbon emissions by 2050. To achieve this, the company has implemented several carbon-reduction measures, such as switching to electric vehicles, investing in renewable energy, and improving the energy proficiency of its buildings.
2. Sustainable packaging: DHL has developed a range of sustainable packaging solutions, including reusable packaging and biodegradable materials. The company also encourages customers to use sustainable packaging and offers advice on how to reduce packaging waste.
3. Sustainable supply chain management: DHL works closely with its suppliers to ensure that sustainability is integrated into its supply chain. This includes setting sustainability standards for suppliers, auditing supplier performance, and promoting sustainable sourcing practices.

4. Green logistics solutions: DHL offers a range of green logistics solutions, such as carbon offsetting, green shipping options, and sustainable warehousing. The company also provides customers with advice on how to reduce their carbon footprint and improve their sustainability.
5. Employee engagement: DHL has implemented several initiatives to engage employees in sustainability, such as sustainability training programs, green team activities, and employee sustainability awards.

DHL has developed its sustainability through a combination of top-down leadership and bottom-up initiatives. The company has a dedicated sustainability team that works to develop and implement sustainability initiatives across the organization. DHL also engages with stakeholders, including customers, suppliers, and employees, to understand their sustainability needs and priorities. Additionally, the company has set ambitious sustainability targets and regularly reports on its progress towards these goals.

Overall, DHL's commitment to sustainability is evident in the range of green practices it has implemented across its operations. The company's sustainability activities not merely assist to decrease its ecological effect, additionally they also offer clients sustainable logistics options that might help them lower the amount of carbon they emit.

## Research Development Hypotheses

### The Relationship between Green Supply Chain Practices and Sustainability

Singh and Trivedi (2016) provided an up-to-date and systematic overview of the literature produced on sustainable green supply chain management. A literature review was conducted by methodically collecting existing literature over 10 years (2005-2014) and classifying it based on features such as supply chain stages, methodology, and industries/sectors of interest. Literature was also classified by geographic area and year of publication. The analysis finds that there is a need to address behavioral concerns such as human resource management and supplier relationship management. Furthermore, reverse logistics in addition to closed-loop supply chain management require specific attention to ensure ecological sustainability.

Green et al. (2019) experimentally evaluated the complementing effects of Just in Time policy, Total Quality Management, and green supply chain techniques on environmental performance. Accordingly, PLS-SEM was performed to examine statistics from 225 manufacturing managers in the United States. Just in Time and TQM were directly and favorably connected to green supply chain management methods. Just in Time, TQM, and green supply chain strategies were complimentary in that when coupled, they have a stronger influence on conservational performance than if applied alone.

Jum'a et al. (2024) assessed how green supply chains management in addition to total quality management (TQM) affect ecological sustainability, with eco-friendly management techniques acting as a moderator. A quantitative analysis was conducted utilizing management data from several industrial enterprises in Jordan. A complete set of 362 forms were gathered, and the presented hypotheses were assessed implementing a structural equation model. The investigation exposed that each of green supply chain management as well as TQM have a significant and positive impact on the preservation of the environment. Furthermore, no evidence was discovered regarding the moderating influence of environmental management approaches.

**The Relationship between Green Supply Chain Practices and Green Innovation Practices**

Wu (2013) evaluated the different associations among green supply chain integration as well as green innovation, as well as the moderating role of ecological uncertainty. The hierarchical moderated regression evaluation was carried out employing questionnaire responses from 211 Taiwanese technology companies. It was discovered that supplier, client, and internal integration increases both green product and process innovation. Demand uncertainty supports integration and innovation in the green supply chain.

Pham et al. (2022) studied the impact of the concept of transformational leadership skills and supply chain learning on green innovation in construction at the supply chain sector. A questionnaire survey was directed to gather information from Vietnamese construction companies. To achieve the study's objectives, a range of statistical analytic methods were employed, including the Shapiro-Wilk test, one-sample Wilcoxon signed-rank test, and the test of Kruskal-Wallis'. The findings revealed that the value of most transformational leadership qualities is regarded equally by various role clusters (directors or deputy directors, project managers, advisors, quantity surveyors, and designers).

Khan et al. (2023) assessed how the management of green supply chain techniques influence the impact of Industry 4.0 skills on green innovation performance. Data was gathered from 225 diverse industrial businesses in Pakistan. The collected statistics was utilized to evaluate the hypotheses with SmartPLS 3 program, which employed structural equation modeling. The outcomes demonstrated that using Industry 4.0 technology and green supply chain management methods has a direct influence on operational and green innovation performance. Furthermore, the management of green supply chain approaches improve operational in addition to green innovation performance.

**The Relationship between Green Innovation Practices and Sustainability**

Afum et al. (2021) explored the relationships among lean manufacturing, internal green practices, innovation regarding green products, as well as sustainability measures. The investigation also investigated the mediation impact regarding internal green practices in addition to the innovation regarding green products on the lean production in addition to sustainable performance characteristics. The questionnaire was used to collect information from 209 industrial businesses. The mediation study revealed that internal green practices mediate the association between lean production as well as sustainability characteristics, nonetheless green product innovation mediates solely the association between lean production and the performance of financial systems.

Khattak (2023) investigated the relationship between the ecological sustainability beliefs and ecological performance. Mediation through the innovation of social aspects, along with the moderating influence of green innovation, are tested. A quantitative study design was utilized to examine the personal experiences of 387 SMEs managers. Accordingly, statistics were acquired by a questionnaire from people who were doing their jobs, therefore it is current data. The findings demonstrated that firms may operate sustainably by adopting ecological sustainability principles and green innovation. Furthermore, innovation of social aspects took advantage of the interaction of ecological sustainability concepts and conservational performance.

Kiranantawat and Ahmad (2023) proposed a theoretical structure that connects green dynamic capability, green innovation, creative thinking within organizations, and organizational agility, all of which affect the sustainability performance of SMEs in Thailand's trade and services industries. The study searched the current literature on the sustainability performance of SMEs. A conceptual framework was developed that SMEs may employ to advance their performance, resulting in sustainable growth. A framework for SME sustainability was provided, demonstrating the link between green dynamic capability besides performance, with green innovation and organizational creativity serving as mediators and structural agility as a moderator.

Ullah et al. (2024) evaluated how readiness for the green innovation, knowledge integration, and the performance regarding green innovation impact the performance of exporting enterprises. The analysis focused on textile manufacturers that generated more than 25% of export revenues. The statistics gathered from 245 middle management personnel was verified for reliability and validity. Hypotheses were tested using structural equation modeling in AMOS 26. The readiness for green innovation has a beneficial impact on sustainability performance. Moreover, readiness for green innovation improves the performance of innovation and hence contributes to sustainability.

**Institutional Pressure and the Relationship between Green Supply Chain Practices and Sustainability**

Sayed et al. (2017) investigated the different influences of institutional pressure and the concept of complexity on environmentally friendly procurement practices in mixed public-private chains of supply. Accordingly, multi-case research results were gathered from three scopes of the food and catering supply chain: customers/clients, major public sector from UK institutions, and private sector. The data revealed that normative and mimetic limitations are more common in focal universities than in suppliers; there is seldom an individual dominating logic across these supply chains; and institutional logics differ. As a result, in the usual instance of institutional homogeneity, such as a dominating sustainability rationale all over the supply chain, drastic transformation in SSCM applications is promoted.

Kalyar et al. (2020) assessed how various elements of the management regarding green supply chain techniques influence businesses' performance both directly and indirectly through environmental performance. Furthermore, the study looked at the different influences of pressure on the direct relationship between the management regarding green supply chain techniques and ecological performance, as well as green supply chain management practices and financial performance. Data from 238 textile enterprises in Pakistan's Punjab province were acquired using a convenience sample approach. The findings showed that the management of green supply chain methods have a considerable direct effect on organizations' financial success, as well as their environmental performance. Furthermore, institutional forces greatly attenuate the link between green supply chain management methods.

In the same context, Vidal et al. (2023) reviewed the connection among supply chain demand from consumers and vendors to adopt socially and environmentally sustainable supply chain management procedures, while accounting for the concurrent conditional properties of both business and sustainability orientations. The study conducted a poll of US industries to determine their link with their top supplier or client based on expenditure. The investigation used conditional process examination to determine the association between variables. The findings demonstrated that both business orientation and sustainability orientation purpose as moderators of the influence of supply chain stakeholder pressure on the application of socially and ecologically responsible supply chain management strategies.

## 4. Research Methodology

The study employs the quantitative approach in information collection and examination. The quantitative investigation and deductive methodology were used to take a methodical and objective method to statistics gathering and evaluation to achieve the primary goals of the study. The variables of the research can be discussed as follows: **Dependent Variable:** Green Supply Chain Practices and their dimensions (Green Manufacturing, Global Collaborative

Capability, Green Purchasing, Eco-Design, and Packaging, Green Information System, and Green Logistics). **Independent Variable:** Sustainability and its dimensions (Economic, Social, Environment). **Mediator Variable:** Green Innovation Practices. **Moderator Variable:** Institutional Pressure.

Accordingly, the conceptual framework model was developed as follows:

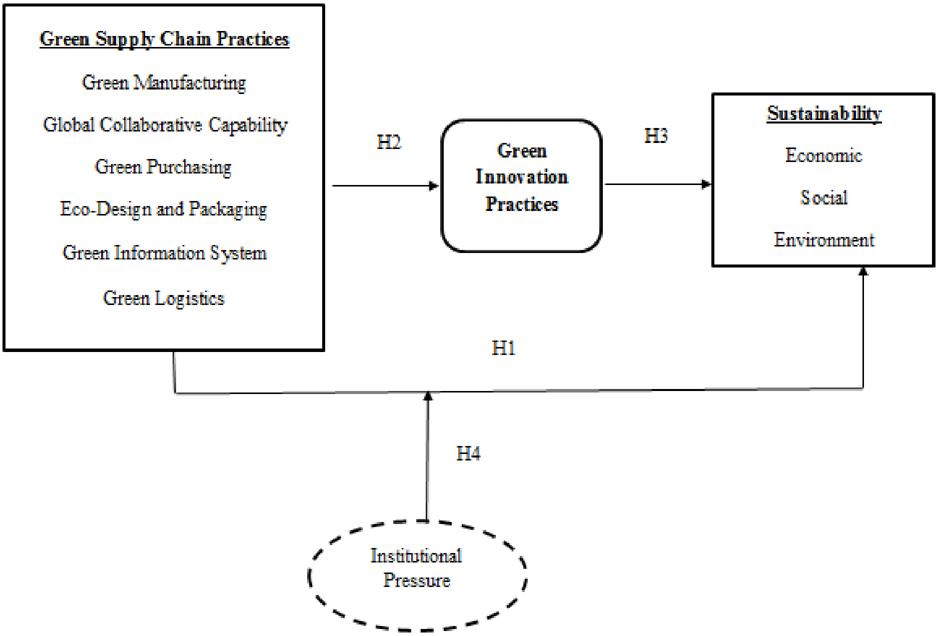


**Figure 1: Conceptual Framework**

The following research hypotheses are founded on both the factors and the inquiry's framework:

**$H_1$: There is a statistically significant relationship between Green Supply practices and Sustainability in DHL companies in Egypt.**

**$H_2$: There is a statistically significant relationship between Green Supply practices and Green Innovation Practices in DHL companies in Egypt.**

**$H_3$: There is a statistically significant relationship between Green Innovation Practices and Sustainability in DHL companies in Egypt.**

**$H_4$: Institutional Pressure moderates the relationship between Green Supply practices and Sustainability in DHL companies in Egypt.**

Data collection process collected from working in DHL the study also conducts questionnaire. The study sample included the employees who are responsible for DHL in Egypt.

Based on what was mentioned above regarding the variables and framework of the study, the study variables are measured by conducting a questionnaire as shown in Table 1. Data collection process collected from working in DHL the study also conducts questionnaire. The study sample included the employees who are responsible for DHL in Egypt.

**Table 1: Research Variables Measurement**

| Variables | Statements | References |
|---|---|---|
| **Green Supply Chain Practices** | | |
| Green Manufacturing | – Procurement of raw materials from suppliers that comply with environmental regulations and guidelines<br>– Make appropriate technology investments in product development and redesign<br>– Efficient use of resources in the production/manufacturing process | Wungkana et al. 2023 |
| Global Collaborative capability | – We depend on the partners' engineering expertise.<br>– The equipment and machines are tailored to our specifications.<br>– The partners devote substantial time and energy to our partnership.<br>– The understanding of methods, culture, and technological expertise is tough to replicate.<br>– The constant communication between our partners and engineers is critical.<br>– We communicate bilaterally instead of unilaterally.<br>– The engineers and sales personnel collaborate carefully with our partners.<br>– The firm offers our advanced engineering capabilities with them. | Nguyen and Le (2020) |
| Green Purchasing | – Buying environmentally friendly raw materials<br>– Establish criteria for the specification of environmentally friendly products produced<br>– Maintain adequate quality in the procurement of raw materials | Wungkana et al. 2023 |
| Eco-Design and Packaging | – Reduce the use of excessive materials used<br>– Using recyclable materials<br>– Using a minimal material variety<br>– Replacing parts with a new generation<br>– Energy use in the manufacturing process | Wungkana et al. 2023 |
| Green Information System | – Using information technology to reduce emissions<br>– Using paperless business processes<br>– Implementation of information technology in meeting product demand | Wungkana et al. 2023 |

| Variables | Statements | References |
|---|---|---|
| | – Implementation of information technology in production capacity planning | |
| Green Logistics | – Develop a renewable energy strategy for the firm.<br>– Measuring vehicle emissions<br>– Using recyclable packaging and logistical containers.<br>– Managing transportation waste recycling<br>– Obtaining ISO14000 environmental management accreditation. | Nguyen and Le (2020) |
| **Green Innovation Practices** | – The firm prioritizes ecologically safe materials that are low in pollution and toxic.<br>– Materials are easily recyclable, reused, and decomposable.<br>– The firm recovers end-of-life items and recycles them.<br>– The firm employs eco-labels.<br>– Refining products and services to satisfy new ecological standards or guidelines.<br>– Improved environmental efficiency by redesigning manufacturing and operational operations.<br>– Utilizing useful or renewable techniques to make savings (including energy, water, excess materials) | Wang et al. (2021) |
| **Institutional Pressure** | – The business follows ecological laws and standards to promote green production.<br>– Sanctions for ecosystem harm and resource waste are in place in Egypt.<br>– The ecological protection agency closely analyses firms' pollution levels on a regular basis. | Zeng et al. (2017) |
| **Sustainability** | | |
| Economic | – The company works on decreasing in charge of materials.<br>– The firm works on decreasing energy consumption<br>– The firm works on decreasing fees for waste discharge<br>– The corporate works on improvement in incomes per share<br>– The corporate works on improvement in return on investment<br>– The corporate achieves sales growth every year.<br>– The corporate achieves profit growth every year. | Yildiz Çankaya and Sezen (2019) |
| Social | – The corporate works on increasing customer satisfaction with fulfilment<br>– The company works on achieving compressed order lead time<br>– The company works on increasing customer service level<br>– The company works on enhancement in investments through social projects (education, culture, sports)<br>– The firm improves relationships with community stakeholders, including NGOs and campaigners.<br>– The company promotes knowledge and preservation of people's rights in community services.<br>– The company promotes staff training<br>– The organization prioritizes workplace health and | Mani et al. (2020)<br>Yildiz Çankaya and Sezen (2019) |

| Variables | Statements | References |
|---|---|---|
| | safety<br>– The organization prioritizes stakeholder welfare. | |
| Environment | – Company works on the enhancement of ecological standards<br>– The company works on decrease in waste materials.<br>– The corporate works on the reduction of air emission<br>– The company works on decreasing of usage of hazardous or toxic resources.<br>– The company works on decreasing of frequency environmental accidents | Yildiz Çankaya and Sezen (2019) |

The survey was distributed using probability sampling on the DHL employees. Upon collection of the surveys, the researchers encoded the survey's phrases within each dimension of the study and gave the weighting according to the 5-point Likert scale. After processing the data, 620 surveys were organized and ready for evaluation.

# 5. Results and Findings

The empirical study's key conclusions and outcomes following data analysis is presented in this section.

## Validity and Reliability Test

Data validation comprises assessing the quality and reliability of the data. The validity test is thought to be the most crucial requirement for the standards of an exam. Items on an examination with high validity are closely related to the test's objective. However, if a test's validity is poor, it means that its components have little bearing on a particular task. Factor Loading (FL) for each item, which should be bigger than 0.4 and if factor loading is less than 0.4, the statement should be dropped, and Average Variance Extracted (AVE), which would be larger than 0.5, are the two main components to take into account for high validity.

Verification of reliability is also a crucial part of assessing quality. It indicates the constancy of a metric. Higher reliability corresponds with greater test performance. The most common reliability test is to look at Cronbach's Alpha values. The range of Cronbach's Alpha coefficients is 0 to 1. The dependability increases with the coefficient's approach to one. It is deemed sufficiently reliable if the coefficient is more than 0.7.

# Table 2: Validity and Reliability Test

| Variables | KMO | AVE % | Cronbach's α | Items | Factor loading |
|---|---|---|---|---|---|
| Green Manufacturing | .783 | 94.621 | .972 | GM1 | .948 |
| | | | | GM2 | .952 |
| | | | | GM3 | .938 |
| Global Collaborative Capability | .919 | 85.762 | .958 | GCC1 | .857 |
| | | | | GCC2 | .846 |
| | | | | GCC3 | Deleted |
| | | | | GCC4 | Deleted |
| | | | | GCC5 | .870 |
| | | | | GCC6 | .862 |
| | | | | GCC7 | .853 |
| | | | | GCC8 | Deleted |
| Green Purchasing | .782 | 93.253 | .964 | GP1 | .930 |
| | | | | GP2 | .931 |
| | | | | GP3 | .936 |
| Eco-Design and Packaging | .917 | 85.106 | .956 | EDP1 | .857 |
| | | | | EDP2 | .856 |
| | | | | EDP3 | .843 |
| | | | | EDP4 | .849 |
| | | | | EDP5 | .851 |
| Green Information System | .890 | 96.613 | .988 | GIS1 | .955 |
| | | | | GIS2 | .967 |
| | | | | GIS3 | .968 |
| | | | | GIS4 | .975 |
| Green Logistics | .906 | 82.633 | .943 | GL1 | .916 |
| | | | | GL2 | .935 |
| | | | | GL3 | .930 |
| | | | | GL4 | .917 |
| | | | | GL5 | .434 |
| Green Innovation Practices | .921 | 86.755 | .962 | GIP1 | Deleted |
| | | | | GIP2 | Deleted |
| | | | | GIP3 | .873 |
| | | | | GIP4 | .853 |
| | | | | GIP5 | .866 |
| | | | | GIP6 | .874 |
| | | | | GIP7 | .871 |
| Economic | .961 | 85.065 | .971 | ECS1 | .854 |
| | | | | ECS2 | .839 |
| | | | | ECS3 | .850 |
| | | | | ECS4 | .852 |
| | | | | ECS5 | .846 |
| | | | | ECS6 | .858 |
| | | | | ECS7 | .856 |
| Social | .956 | 83.780 | .968 | SOS1 | .834 |

| Variables | KMO | AVE % | Cronbach's α | Items | Factor loading |
|---|---|---|---|---|---|
| | | | | SOS2 | .836 |
| | | | | SOS3 | .822 |
| | | | | SOS4 | .838 |
| | | | | SOS5 | .850 |
| | | | | SOS6 | .843 |
| | | | | SOS7 | .842 |
| Environment | .920 | 87.340 | .964 | ENS1 | .871 |
| | | | | ENS2 | .867 |
| | | | | ENS3 | .886 |
| | | | | ENS4 | .860 |
| | | | | ENS5 | .883 |
| Innovation Practices | .772 | 91.071 | .951 | IP1 | .897 |
| | | | | IP2 | .924 |
| | | | | IP3 | .911 |

## Confirmatory Factor Analysis

The results are shown graphically in Figure 1, which produces the following outcomes: After a thorough computation of the model fit statistics, a minimal discrepancy of 1.802 was found. This was expressed as the ratio of chi-square to degrees of freedom (CMIN/DF). The probability of generating a significant disparity in the current sample is indicated by the corresponding p-value of 0.000.

Additionally, the adjusted goodness of fit index (AGFI), which evaluates the model fit about the required number of estimated coefficients or degrees of freedom, was 0.876, and the goodness of fit (GFI) was determined to be 0.890. The Tucker-Lewis index (TLI), which registered at 0.979, showed an incremental fit of the model in comparison to a null model, while the Bentler-Bonett normed fit index (NFI) was reported at 0.958. It was found that the comparative fit index (CFI) was 0.981.

Additional fit indices were examined; the root mean square residual (RMR), which was measured at 0.037, showed how far sample variances and covariances deviated from estimates assuming that the model was correct. An essential criterion in covariance structure modelling, the root mean square of approximation (RMSEA), computed as 0.036, quantifies the intrinsic error in population estimation.

## Table 3: Thresholds and Fit Indices for the Measurement Model

| Measure | Results | Threshold |
|---|---|---|
| Chi-square/df | 1.802 | < 2 excellent; < 3 good; < 5 sometimes permissible |
| P-value | 0.000 | > 0.05 |
| GFI | 0.890 | > 0.90 |
| AGFI | 0.876 | > 0.90 |
| NFI | 0.958 | > 0.90 |
| TLI | 0.979 | > 0.95 |
| CFI | 0.981 | > 0.90 |
| RMR | 0.037 | < 0.08 |
| RMSEA | 0.036 | < 0.05 |

Figure 2 shows confirmatory factor analysis in action, with conspicuous arrows representing factor loadings. Strong factor loadings are shown by the arrows, which have values higher than the 0.4 cutoff. For a more in-depth analysis of the precise numerical values of these factor loadings, readers are referred to Table 5.

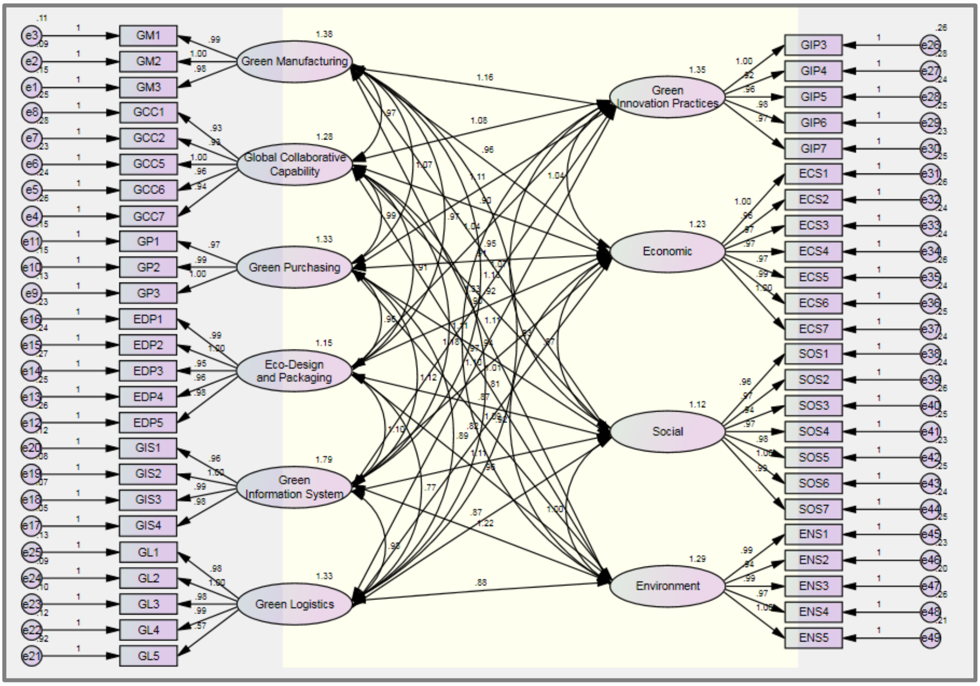


**Figure 1: CFA for the Measurement Model**

The factor loadings (FL), which show how strongly item loadings map to their associated variables, are shown in detail in Table 4. Interestingly, every factor loading regularly surpasses or equals the critical value of 0.40, confirming the strong validity of the structures under investigation. It is also important to emphasize that the corresponding p-values consistently fall below the predetermined cutoff point of 0.05, highlighting the statements' substantive significance in their relationship to the corresponding constructs.

**Table 4: Item Loading after Confirmatory Factor Analysis**

| | | | Estimate | S.E. | C.R. | P |
|---|---|---|---|---|---|---|
| GM3 | <--- | Green Manufacturing | .980 | .017 | 56.443 | *** |
| GM2 | <--- | Green Manufacturing | 1.000 | | | |
| GM1 | <--- | Green Manufacturing | .987 | .016 | 61.802 | *** |
| GCC7 | <--- | Global Collaborative Capability | .944 | .025 | 38.020 | *** |
| GCC6 | <--- | Global Collaborative Capability | .962 | .025 | 39.123 | *** |
| GCC5 | <--- | Global Collaborative Capability | 1.000 | | | |
| GCC2 | <--- | Global Collaborative Capability | .930 | .025 | 36.792 | *** |
| GCC1 | <--- | Global Collaborative Capability | .927 | .025 | 37.758 | *** |
| GP3 | <--- | Green Purchasing | 1.000 | | | |
| GP2 | <--- | Green Purchasing | .992 | .019 | 51.152 | *** |
| GP1 | <--- | Green Purchasing | .969 | .019 | 50.812 | *** |
| EDP5 | <--- | Eco-Design and Packaging | .984 | .027 | 36.248 | *** |
| EDP4 | <--- | Eco-Design and Packaging | .960 | .027 | 35.903 | *** |
| EDP3 | <--- | Eco-Design and Packaging | .953 | .027 | 35.163 | *** |
| EDP2 | <--- | Eco-Design and Packaging | 1.000 | | | |
| EDP1 | <--- | Eco-Design and Packaging | .988 | .027 | 37.259 | *** |
| GIS4 | <--- | Green Information System | .981 | .011 | 89.053 | *** |
| GIS3 | <--- | Green Information System | .993 | .012 | 82.786 | *** |
| GIS2 | <--- | Green Information System | 1.000 | | | |
| GIS1 | <--- | Green Information System | .958 | .013 | 71.770 | *** |
| GL5 | <--- | Green Logistics | .570 | .034 | 16.584 | *** |
| GL4 | <--- | Green Logistics | .985 | .016 | 60.357 | *** |
| GL3 | <--- | Green Logistics | .977 | .015 | 63.223 | *** |
| GL2 | <--- | Green Logistics | 1.000 | | | |
| GL1 | <--- | Green Logistics | .975 | .016 | 59.668 | *** |

| | | | Estimate | S.E. | C.R. | P |
|---|---|---|---|---|---|---|
| GIP3 | <--- | Green Innovation Practices | 1.000 | | | |
| GIP4 | <--- | Green Innovation Practices | .924 | .025 | 37.119 | *** |
| GIP5 | <--- | Green Innovation Practices | .955 | .024 | 39.336 | *** |
| GIP6 | <--- | Green Innovation Practices | .983 | .025 | 39.479 | *** |
| GIP7 | <--- | Green Innovation Practices | .966 | .024 | 39.632 | *** |
| ECS1 | <--- | Economic | 1.000 | | | |
| ECS2 | <--- | Economic | .956 | .026 | 36.976 | *** |
| ECS3 | <--- | Economic | .969 | .025 | 38.034 | *** |
| ECS4 | <--- | Economic | .973 | .026 | 38.153 | *** |
| ECS5 | <--- | Economic | .975 | .026 | 37.536 | *** |
| ECS6 | <--- | Economic | .993 | .026 | 38.550 | *** |
| ECS7 | <--- | Economic | .995 | .026 | 38.235 | *** |
| SOS1 | <--- | Social | .956 | .027 | 35.787 | *** |
| SOS2 | <--- | Social | .970 | .027 | 36.224 | *** |
| SOS3 | <--- | Social | .935 | .027 | 34.733 | *** |
| SOS4 | <--- | Social | .972 | .027 | 35.781 | *** |
| SOS5 | <--- | Social | .982 | .027 | 36.733 | *** |
| SOS6 | <--- | Social | 1.000 | | | |
| SOS7 | <--- | Social | .987 | .027 | 36.356 | *** |
| ENS1 | <--- | Environment | .994 | .025 | 40.530 | *** |
| ENS2 | <--- | Environment | .935 | .023 | 39.822 | *** |
| ENS3 | <--- | Environment | .988 | .023 | 42.578 | *** |
| ENS4 | <--- | Environment | .966 | .025 | 39.387 | *** |
| ENS5 | <--- | Environment | 1.000 | | | |

## Normality Test for the Research Variables

The range of -1 to 1 is required as an acceptable range for normality testing. According to the normality testing of the study variables, it is noted that all the values are within the range of -1 to 1. This indicates that the study variables exhibit a normal distribution, which is important for statistical examination. Therefore, the statistics can be considered reliable and suitable for further analysis and interpretation.

**Table 5: Normality Test for Research Variables**

| | Skewness | | Kurtosis | |
|---|---|---|---|---|
| | **Statistic** | **Std. Error** | **Statistic** | **Std. Error** |
| Green Manufacturing | -.288 | .098 | -.885 | .196 |
| Global Collaborative Capability | -.353 | .098 | -.795 | .196 |
| Green Purchasing | -.251 | .098 | -.822 | .196 |
| Eco-Design and Packaging | -.387 | .098 | -.758 | .196 |
| Green Information System | -.405 | .098 | -1.102 | .196 |
| Green Logistics | .010 | .098 | -.560 | .196 |
| Green Innovation Practices | -.127 | .098 | -1.278 | .196 |
| Economic | -.208 | .098 | -1.339 | .196 |
| Social | -.327 | .098 | -.756 | .196 |
| Environment | -.163 | .098 | -1.449 | .196 |
| Innovation Practices | .557 | .098 | -.475 | .196 |

## Descriptive Analysis for the Research Variables

Descriptive statistics were used to analyze the research variables. The data was summarized using mean, standard deviation, and frequency distributions from the maximum to the minimum value. According to the descriptive analysis of the research variables, the variables Green Manufacturing, Global Collaborative capability, Green Purchasing, Eco-Design and Packaging, Green Information System, Green Logistics, Green Innovation Practices, Institutional Pressure, Economic, Social, and Environment have a range from 1.0 to 5.0.

Accordingly, the mean values for these variables range from 2.3548 to 3.6355, indicating a moderate level of overall agreement among participants. The standard deviations range from 1.20240 to 1.36245, as the standard deviation for Green Manufacturing is 1.20240, Global Collaborative capability is 1.19383, Green Purchasing is 1.17322, Eco-Design and Packaging is 1.16875, Green Information System is 1.36245, Green Logistics is 1.16576, Green Innovation Practices is 1.20913, Economic is 1.21243, Social is 1.14279, and Environment is 1.17707. These findings provide valuable insights into the distribution and overall perception of these research variables among the participants in the survey.

## Table 6: Descriptive Analysis of the Research Variables

| Research Variable | Mean | Std. Deviation | Frequency | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 |
| Green Manufacturing | 3.2274 | 1.20240 | 61 | 121 | 143 | 206 | 89 |
| Global Collaborative Capability | 3.2435 | 1.19383 | 64 | 106 | 151 | 213 | 86 |
| Green Purchasing | 3.2306 | 1.17322 | 54 | 121 | 161 | 196 | 88 |
| Eco-Design and Packaging | 3.1903 | 1.16875 | 68 | 105 | 154 | 227 | 66 |
| Green Information System | 3.1839 | 1.36245 | 119 | 70 | 110 | 220 | 101 |
| Green Logistics | 2.8355 | 1.16576 | 111 | 87 | 275 | 87 | 60 |
| Green Innovation Practices | 3.4194 | 1.20913 | 18 | 174 | 107 | 172 | 149 |
| Economic | 3.6210 | 1.21243 | 10 | 137 | 146 | 112 | 215 |
| Social | 3.6032 | 1.14279 | 25 | 76 | 198 | 142 | 179 |
| Environment | 3.6355 | 1.17707 | 1 | 147 | 136 | 129 | 207 |
| Innovation Practices | 2.3548 | 1.14529 | 169 | 196 | 153 | 70 | 32 |

## Testing Research Hypotheses

Table 7 shows the correlation matrix which indicates that there is a positive significant influence of green manufacturing on economic sustainability practices as the p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.796). A positive significant influence of global collaborative capability on economic sustainability was seen as the p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.796). A positive significant effect of green purchasing on economic sustainability was seen as the p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.779). There is a positive significant impact of eco-design and packaging on economic sustainability as the p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.829).

Moreover, a positive significant impact of green information system on economic sustainability was detected as the p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r= .814). There is a positive significant impact of green logistics on economic sustainability as the p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.685). A positive significant influence of green manufacturing on social sustainability practices was seen as the p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.832). There is a positive significant impact of global collaborative capability on social sustainability as the p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.843). A positive significant inference of green purchasing on social sustainability was detected as the p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.830). There is a positive significant impact of eco-design and packaging on social sustainability as the p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.845).

A positive significant impact of green information system on social sustainability was detected as the p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.874). Furthermore, a positive significant impact of green logistics on social sustainability was seen as p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.748). There is a positive significant impact of green manufacturing on environmental sustainability practices as p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.867). A positive significant impact of global collaborative capability on environmental sustainability was detected as p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.852). A positive significant influence of green purchasing on environmental sustainability was stated as p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.852).

There is a positive significant influence of eco-design and packaging on environmental sustainability as p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.856). A positive significant effect of green information systems on environmental sustainability was found as p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.836). Finally, a positive significant effect of green logistics on environmental sustainability was detected as p-value is less than 0.05 (p-value= 0.000) and the correlation coefficient is more than zero (r=.698).

## Table 7: Correlation Matrix of Research Variables

| | | | GM | GC | GP | EDP | GIS | GL | GIP | ECS | SOS | ENS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spearman's rho | Green Manufacturing | R | 1.000 | | | | | | | | | |
| | | Sig. | . | | | | | | | | | |
| | | N | 620 | | | | | | | | | |
| | Global Collaborative Capability | R | .793** | 1.000 | | | | | | | | |
| | | Sig. | .000 | . | | | | | | | | |
| | | N | 620 | 620 | | | | | | | | |
| | Green Purchasing | R | .814** | .801** | 1.000 | | | | | | | |
| | | Sig. | .000 | .000 | . | | | | | | | |
| | | N | 620 | 620 | 620 | | | | | | | |
| | Eco-Design and Packaging | R | .817** | .824** | .822** | 1.000 | | | | | | |
| | | Sig. | .000 | .000 | .000 | . | | | | | | |
| | | N | 620 | 620 | 620 | 620 | | | | | | |
| | Green Information System | R | .796** | .813** | .782** | .821** | 1.000 | | | | | |
| | | Sig. | .000 | .000 | .000 | .000 | . | | | | | |
| | | N | 620 | 620 | 620 | 620 | 620 | | | | | |
| | Green Logistics | R | .674** | .665** | .690** | .672** | .700** | 1.000 | | | | |
| | | Sig. | .000 | .000 | .000 | .000 | .000 | . | | | | |
| | | N | 620 | 620 | 620 | 620 | 620 | 620 | | | | |
| | Green Innovation Practices | R | .859** | .852** | .847** | .874** | .905** | .736** | 1.000 | | | |
| | | Sig. | .000 | .000 | .000 | .000 | .000 | .000 | . | | | |
| | | N | 620 | 620 | 620 | 620 | 620 | 620 | 620 | | | |
| | Economic | R | .796** | .796** | .779** | .829** | .814** | .685** | .856** | 1.000 | | |
| | | Sig. | .000 | .000 | .000 | .000 | .000 | .000 | .000 | . | | |
| | | N | 620 | 620 | 620 | 620 | 620 | 620 | 620 | 620 | | |
| | Social | R | .832** | .843** | .830** | .845** | .874** | .748** | .911** | .827** | 1.000 | |
| | | Sig. | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | . | |
| | | N | 620 | 620 | 620 | 620 | 620 | 620 | 620 | 620 | 620 | |
| | Environment | R | .867** | .852** | .852** | .856** | .836** | .698** | .893** | .837** | .874** | 1.000 |
| | | Sig. | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | . |
| | | N | 620 | 620 | 620 | 620 | 620 | 620 | 620 | 620 | 620 | 620 |

**. Correlation is significant at the 0.01 level (2-tailed).

The structural equation modeling (SEM) is conducted. The (SEM) examination for the effect of the studied variables is shown in the following table; it is possible to observe that:

For $H_1$, green manufactoring (Estimate = .294, $p < 0.001$) has a significant positive effect on economic sustaniability as the P-values are less than 0.05, while, global collaborative capability (Estimate = .156, p = .129), green purchasing (Estimate = .118, p = .384), eco-design and packaging (Estimate

= .012, p = .906), green information system (Estimate = .027, p = .723), and green logidtics Estimate = .078, p = .277) have a significant positive effect on economic sustaniability as the P-values are more than 0.05.

For $H_1$, green manufactoring (Estimate = .070, p = .466), global collaborative capability (Estimate = .153, p = .068), green purchasing (Estimate = .094, p = .394), green information system (Estimate = .098, p = .111), and green logidtics Estimate = .073, p = .212) have a significant positive effect on social sustaniability as the P-values are more than 0.05. While, eco-design and packaging (Estimate = -.002, p = .984), have an insignificant negative effect on social sustaniability as the P-values are more than 0.05.

For $H_1$, green manufactoring (Estimate = .206, $p < 0.001$) and green purchasing (Estimate = .330, $p < 0.001$) have as a significant positive effect on enviromental sustaniability as the P-values are less than 0.05, while, eco-design and packaging (Estimate = .031, p = .708), green information system (Estimate = .039, p = .516), and green logidtics (Estimate = .055, p = .331) have an insignificant positive effect on enviromental sustaniability as the P-values are more than 0.05. however, global collaborative capability (Estimate = -.060, p = .461) has a negative insignificant effect on enviromental sustaniabilty as p-value is more than 0.05.

For $H_2$, green manufactoring (Estimate = .270, $p < 0.001$), global collaborative capability (Estimate = .178, $p < 0.001$), green purchasing (Estimate = .085, $p < 0.001$), eco-design and packaging (Estimate = .136, $p < 0.001$), green information system (Estimate = .253, $p < 0.001$), and green logidtics Estimate = .129, $p < 0.001$) have a significant positive effect on social sustaniability as the P-values are less than 0.05.

For $H_3$, green innovation practices (Estimate = .379, $p < 0.001$) had a significant positive effect on economic sustaniability as the P-values are less than 0.05. green innovation practices (Estimate = .377, $p < 0.001$) had a significant positive effect on social sustaniability as the P-values are less than 0.05. green innovation practices (Estimate = .186, $p < 0.001$) had a significant positive effect on enviromental sustaniability as the P-values are less than 0.05.

For $H_4$: Institutional pressure moderates the relationship between green supply practices and sustainability. Based on the previous results it could be observed that there is a insignificant effect of insitiutional pressure on sustaniabilty, which means that there is no direct effect of insitiutional pressure on sustaniabilty.

## Table 7: SEM Analysis for the Research Variables

| | | | Estimate | P | $R^2$ |
|---|---|---|---|---|---|
| Green Innovation Practices | <--- | Green Manufacturing | .270 | *** | .888 |
| Green Innovation Practices | <--- | Global Collaborative Capability | .178 | *** | |
| Green Innovation Practices | <--- | Green Purchasing | .085 | .011 | |
| Green Innovation Practices | <--- | Eco-Design and Packaging | .136 | *** | |
| Green Innovation Practices | <--- | Green Information System | .253 | *** | |
| Green Innovation Practices | <--- | Green Logistics | .129 | *** | |
| Economic | <--- | Green Manufacturing | .294 | .012 | .697 |
| Economic | <--- | Global Collaborative Capability | .156 | .129 | |
| Economic | <--- | Green Purchasing | .118 | .384 | |
| Economic | <--- | Eco-Design and Packaging | .012 | .906 | |
| Economic | <--- | Green Information System | .027 | .723 | |
| Economic | <--- | Green Logistics | .078 | .277 | |
| Economic | <--- | Green Innovation Practices | .186 | .018 | |
| Economic | <--- | GM*IP | -.055 | .115 | |
| Economic | <--- | GCC*IP | -.024 | .412 | |
| Economic | <--- | GP*IP | -.047 | .248 | |
| Economic | <--- | EDP*IP | .066 | .025 | |
| Economic | <--- | GIS*IP | .045 | .069 | |
| Economic | <--- | GL*IP | .013 | .552 | |
| Social | <--- | Green Manufacturing | .070 | .466 | .791 |
| Social | <--- | Global Collaborative Capability | .153 | .068 | |
| Social | <--- | Green Purchasing | .094 | .394 | |
| Social | <--- | Eco-Design and Packaging | -.002 | .984 | |
| Social | <--- | Green Information System | .098 | .111 | |
| Social | <--- | Green Logistics | .073 | .212 | |
| Social | <--- | Green Innovation Practices | .377 | *** | |
| Social | <--- | GM*IP | -.011 | .707 | |
| Social | <--- | GCC*IP | -.016 | .511 | |
| Social | <--- | GP*IP | -.016 | .624 | |
| Social | <--- | EDP*IP | .017 | .479 | |
| Social | <--- | GIS*IP | .002 | .905 | |
| Social | <--- | GL*IP | .030 | .105 | |

| | | | Estimate | P | $R^2$ |
|---|---|---|---|---|---|
| Environment | <--- | Green Manufacturing | .206 | .026 | |
| Environment | <--- | Global Collaborative Capability | -.060 | .461 | |
| Environment | <--- | Green Purchasing | .330 | .002 | |
| Environment | <--- | Eco-Design and Packaging | .031 | .708 | |
| Environment | <--- | Green Information System | .039 | .516 | |
| Environment | <--- | Green Logistics | .055 | .331 | |
| Environment | <--- | Green Innovation Practices | .379 | *** | .847 |
| Environment | <--- | GM*IP | -.013 | .630 | |
| Environment | <--- | GCC*IP | .047 | .045 | |
| Environment | <--- | GP*IP | -.044 | .173 | |
| Environment | <--- | EDP*IP | -.005 | .837 | |
| Environment | <--- | GIS*IP | .018 | .363 | |
| Environment | <--- | GL*IP | -.015 | .402 | |

Following the structural equation modeling (SEM), the final research model is evaluated, demonstrating that the model fit indices are completely within suitable limits and thresholds. GFI was calculated to be 0.907, CMIN/DF, was found to be 1.322, AGFI was 0.886, CFI of Bentler-Bonett was 0.989, RMSEA was 0.028.

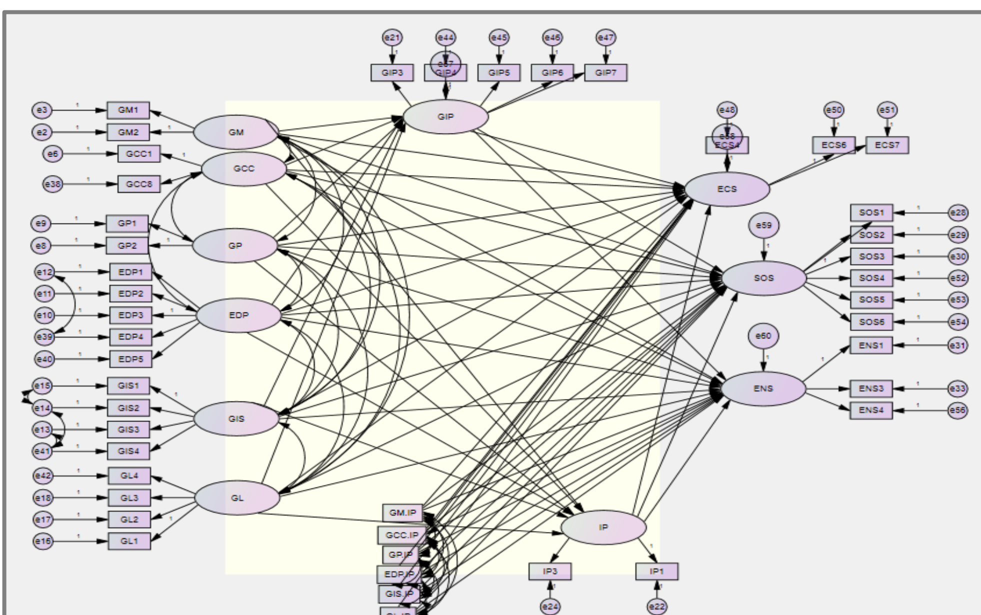


**Figure 2: SEM for the Research Variables**

## 6. Discussion and Conclusion

Depending on the above, the following results can be derived;

For $H_1$: There is a statistically significant association between Green Supply practices and Sustainability in DHL companies in Egypt is partially supported. Regarding the results, some of the previous studies are consistent with these results, such as (Çankaya and Sezen, 2019; Mitra and Datta, 2014; Zaidet al., 2018; Hammouet al., 2022; Chinet al., 2015). While these previous studies are inconsistent in their methodologies with the current research. The current research focused on collecting data by developing a questionnaire that was distributed to 620 DHL employees in Egypt. Çankaya and Sezen (2019) was built upon cross-sectional face-to-face and e-mail surveys collected from Turkish manufacturing firms. Otherwise, Mitra and Datta (2014) gathered the data through surveys on GSCM practices in Indian manufacturing firms. On the other hand, Zaidet et al. conducted study in 2018, relied on a survey involving 121 companies operating within the most environmentally impactful manufacturing sectors, namely the food, chemical, and pharmaceutical sectors, in Palestine. Hammouet et al. (2022) collected data from 23 research articles dealing with GSCP and its effect on sustainability. However, Chinet et al. (2015) built on collecting data from Malaysian manufacturing companies through a structural questionnaire.

For $H_2$: There is a statistically significant association between Green Supply practices and Green Innovation Practices in DHL companies in Egypt is partially supported. some of the previous studies are consistent with these results as (Seman et al., 2019; Cherrafi et al., 2018; Burki, 2018; Shafique et al., 2017). Otherwise, the results of (Lisi et al., 2020; Wu, 2013) are inconsistent in their results with the current research, as they proved that there is in significant impact of green supply practices and green innovation practices. Although most of these studies are consistent with the current research in their results, they are inconsistent in their methodologies with the current research. Seman et al. (2019) collected data from 123 manufacturing organisations with ISO 14001 certification. However, Shafique et al. (2017) was built upon a structural questionnaire that distributed to electronic industry firms in Pakistan.

For $H_3$: There is a statistically significant link between Green Innovation Practices and Sustainability in DHL companies in Egypt is fully supported. Regarding the results, some of the previous studies are consistent with these results, as (Wang and Yang, 2021; Ullah et al., 2022; Li et al., 2021; Asadi et al., 2020; Jum'a et al., 2022). Although these studies are consistent with the current study in their results, they are inconsistent in their methodologies. Wang and Yang (2021) examined to examine how the manufacturing sector's sustainability performance is impacted by green innovation. For China's manufacturing sector, the study defined six green innovation aspects (criteria), twenty-four sub-aspects (sub-criteria), and three sustainability performance indicators (alternatives). While, Ullah et al. (2022) The study determined the forces behind green innovation in the manufacturing sector in Pakistan. A unique framework for examining the drivers of green innovation was created using a hybrid methodology that combined the fuzzy Delphi method (FDM), interpretive structural modelling (ISM), and cross-impact matrix multiplication applied to classification (MICMAC). Li et al. (2021) used a structural questionnaire to gather data from 229 Chinese managers to analyse green innovation on sustainability in China's energy-intensive industry. Otherwise, Asadi et al. (2020) built on 183 hotels in Malaysia that were inspected to gather data. Jum'a et al. (2022) depended on 392 managers' data from various industrial organizations in Jordan were gathered using a well-designed questionnaire.

For $H_4$: Institutional Pressure moderates the link between Green Supply practices and Sustainability in DHL companies in Egypt is partially supported. According to the previous results, some of the previous studies are consistent with these results as (Hashmi and Akram, 2021; Shahzad et al., 2022; Prachayapipat et al., 2020), these studies proved that there is a moderation role of institutional pressure on the relationship between green supply practises and sustainability. Furthermore, these studies are inconsistent in their methodologies with the current research although they are consistent with their results. Hashmi and Akram (2021) collected data from 277 executives employed in various Pakistani companies where GSCM techniques are used. Shahzad et al. (2022) depended on structured questionnaire from 347 supply chain employees. While, Prachayapipat et al. (2020) used A survey questionnaire with a Likert scale to gather primary data and the sample consisted of 369 managers and employees from manufacturing enterprises in Malaysia.

## 7. Research Recommendations

**A**ccording to the results of the current study, a set of recommendations was developed to enhance future research and adaptation practices of green supply chains in addition to sustainability in firms, these recommendations are as follows:

- DHL companies in Egypt should prioritize the operation of green innovation standards to achieve sustainability goals. This can include adopting renewable energy sources, reducing carbon emissions, and implementing waste management strategies.
- It is crucial for DHL companies in Egypt to recognize the function of institutional pressure in mediating the different associations between green supply practices and sustainability. This can involve collaborating with regulatory bodies, industry associations, and other stakeholders to ensure compliance with environmental standards and promote sustainable practices throughout the supply chain.
- Additionally, DHL companies in Egypt can also benefit from research and development to explore innovative knowledge and solutions that further enhance their environmental sustainability efforts. This can involve finding new ways to optimize logistics operations, minimize packaging waste, and promote the use of eco-friendly materials.
- DHL may educate and train staff on environmental sustainability, equipping them with devices and assets to help achieve the company's green goals. Workshops, training programs, and frequent communication channels may all help to guarantee that the business has a sustainable culture.
- Firms in general and firms in developing countries, in particular, are recommended to partner with local environmental organizations and government agencies to further enhance their sustainability efforts. By collaborating with these entities, companies can gain access to valuable resources, expertise, and funding opportunities that can help them implement more impactful and innovative green initiatives.
- Additionally, engaging in community outreach programs and public awareness campaigns can help raise awareness about the importance of environmental sustainability among customers, suppliers, and other stakeholders, encouraging them to adopt more eco-friendly practices as well.
- Controlling the institutional pressure to develop effective supply chain practices is also recommended by environmental sustainability goals. By ensuring that

suppliers and partners adhere to sustainable practices, companies can reduce their carbon footprint and promote a more sustainable supply chain.

- By controlling institutional pressure and promoting sustainable supply chain practices, companies can further enhance their environmental sustainability efforts and contribute to a greener future.

## 8. Research Limitations and Direction for Future Research

This study offers several research limits, despite its positive findings. These limitations will be discussed in this section along with recommendations for future researchers to help overcome the limitations of the current study. The current investigation’s limitations included a small sample size, limited geographical scope, and reliance on self-reported data. The current study used DHL companies in Egypt as the main population of the investigation regarding the studied variables, which limited the study scope to a limited economic and geographical scope.

Moreover, the spatial limitation of the current study did not include a long period to investigate the rapid changes in the chains of supplying and sustainability sectors. Furthermore, the study did not consider the potential impact of external factors such as government policies or technological advancements on the variables under investigation. Future researchers could expand the scope of their study by including a larger sample size from different regions and industries to ensure the generalizability of the findings. Furthermore, incorporating a longitudinal approach would provide a more comprehensive understanding of how supply chain and sustainability practices evolve. Future researchers should consider expanding the sample size to increase the wide usage of the inquiry’s outcomes. Additionally, conducting the study in multiple regions or countries would provide a more comprehensive understanding of sustainable supply chain practices. Finally, future studies could incorporate objective measures of sustainability performance to complement self-reported data and ensure greater accuracy in assessing the effect of sustainable standards on carbon usage reduction.

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