



GRADUATE PROGRAM INSTITUTE

**GREEN SUPPLY CHAIN MANAGEMENT AND
OPERATIONAL PERFORMANCE IN PAKISTANI
MANUFACTURING: THE ROLE OF LOGISTIC
INTEGRATION AND GREEN INNOVATION**

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ÖZET

PAKİSTAN İMALATINDA YEŞİL TEDARİK ZİNCİRİ YÖNETİMİ VE OPERASYONEL PERFORMANS: LOJİSTİK ENTEGRASYONUN VE YEŞİL İNOVASYONUN ROLÜ

Küresel ısınma ve zehirli atıklar insan hayatını önemli ölçüde tehdit ediyor ve bilim insanları yeşil tedarik zinciri yönetimi çözümlerini uygulamaya teşvik ediliyor. Bu nedenle, bu çalışma yeşil satın Alma, iç çevre yönetimi, yeşil ürünler ve ambalajlama ve eko-tasarımın Pakistan imalat sektörünün operasyonel performansı üzerindeki etkisini araştırmaktadır. Ayrıca çalışma, lojistik entegrasyonun aracılık etkisini ve yeşil inovasyonun aracılık rolünü de araştırıyor. Araştırmada betimsel bir yöntem ve PLS-SEM tekniği kullanılarak beşli Likert ölçekli bir anket kullanılmaktadır. Çalışma, yeşil satın Alma, iç çevre yönetimi, yeşil ürün ve ambalajlama ve eko-tasarımın lojistik entegrasyon üzerinde olumlu ve istatistiksel olarak anlamlı bir etkisini ortaya koyuyor. Ayrıca yeşil satın Alma ve çevre yönetimi operasyonel performansı olumlu ve önemli ölçüde etkilerken, yeşil ürün ve ambalajın operasyonel performans üzerinde önemsiz bir etkisi var. Son olarak, lojistik entegrasyonun bağımsız değişkenler (yeşil satın Alma, iç çevre yönetimi, yeşil ürün ve paketleme ve eko-tasarım) ve Pakistan'daki imalat sektörünün operasyonel performansı üzerinde istatistiksel olarak anlamlı bir aracı etkisi vardır. Ayrıca çalışma, yeşil inovasyonun Bağımsız değişkenler ile Pakistan'daki imalat sektörünün operasyonel performansı arasındaki ilişki üzerindeki düzenleyici etkisine dair kanıtlar sunmaktadır.

Anahtar Kelimeler: Yeşil Satın Alma, İç Çevre Yönetimi, Yeşil Ürün ve Paketleme, Eko-Tasarım, Lojistik Entegrasyon, Yeşil İnovasyon.

ABSTRACT

GREEN SUPPLY CHAIN MANAGEMENT AND OPERATIONAL PERFORMANCE IN PAKISTANI MANUFACTURING: THE ROLE OF LOGISTIC INTEGRATION AND GREEN INNOVATION

Global warming and toxic waste threaten human life significantly, and scientists are prompted to implement green supply chain management solutions. Hence, this study investigates the impact of green purchasing, internal environmental management, green products and packaging, and eco-design on the operational performance of the Pakistani manufacturing sector. Furthermore, the study also investigates the mediating effect of logistic integration and the moderating role of green innovation. The research uses a descriptive method and a five-point Likert scale survey using the PLS-SEM technique. The study reveals a positive and statistically significant impact of green purchasing, internal environmental management, green product and packaging, and eco-design on logistic integration. Furthermore, green purchasing and environmental management positively and significantly impact operational performance, while green product and packaging have an insignificant impact on operational performance. Finally, logistic integration has a statistically significant mediating effect on independent variables (green purchasing, internal environmental management, green product and packaging, and eco-design) and the operational performance of the manufacturing sector in Pakistan. Moreover, the study provides evidence of the moderating effect of green innovation on the relationship between Independent variables and the operational performance of the manufacturing sector in Pakistan.

Keywords: Green Purchasing, Internal Environmental Management, Green Product and Packaging, Eco-Design, Logistic Integration, Green Innovation.

ABBREVIATIONS

GSCM	: Green Supply Chain Management
RBV	: Resource-Based Theory
IDT	: Innovation and Diffusion theory
GI	: Green Innovation
GP	: Green Purchasing
OP	: Operational Performance
PLS-SEM	: Partial least squares Structural Equation Modelling
KPI	: Key Performance Indicator



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1. INTRODUCTION

The detrimental environmental impact of global warming has caused concern worldwide (Abdullah et al., 2019). There has been an unexpected increase in pollution levels in the country, which could potentially affect productivity. The greatest threat to human life is posed by toxic waste. In response to these concerns, scientists are working on implementing solutions for green supply chain management. It is known that the industrial sector is responsible for around 20% of total pollution, highlighting the importance of ensuring environmental sustainability (Dasanayake and Amarasena, 2022). Green supply chain management, also referred to as GSCM, encompasses environmental design, data management, production, and procurement. For many companies, manufacturing performance is crucial, and understanding how to sustainably conduct operations is essential for profitability (Ga et al., 2011).

Green purchasing refers to environmentally conscious procedures designed to reduce the negative impact of commodities or raw materials on the environment. This includes recycling, reducing resource waste, utilizing cyclical resources, and substituting raw materials (Gikonyo, 2022). Many companies integrate environmental considerations into their purchasing policies and practices in order to become more environmentally friendly (Gupta, 2016). Green purchasing involves adopting policies that encourage the use of environmentally aware suppliers and the procurement of environmentally conscious raw materials and components. It aims to protect resources and reduce pollution (Hafeez et al., 2019). An increasing number of organizations are working to improve the efficiency of their purchasing processes and establish supplier panels that promote environmental sustainability. As part of this process, businesses must ensure that suppliers provide low-cost, high-quality goods and services with fair turnaround times (Jabbour et al., 2013).

Similarly, companies are increasingly implementing environmental management practices in response to rising environmental concerns. The term "green and competitive" originates from the assumption that these policies benefit businesses (Maccioni et al., 2019). Environmental management can improve performance by reducing production costs and other operational expenses. However, data from the specialist literature illustrates how environmental management can supplement other management practices in a business (Manajemen, 2022). According to the "Lean and Green" theory, lean manufacturing practices increase the likelihood that their operations

and manufacturing departments will support environmental management (Melnik et al., 2003). Several authors have investigated this relationship and determined that cleaner production facilities, less wasteful use of production resources, and better workplace organization all lead to improved environmental management and, eventually, competitive advantages (Moraczewski et al., 2020).

"Green packaging" refers to the efforts made by businesses or groups to reduce the environmental impact of packaging. This can include minimizing resource use, using reusable or refillable containers, and opting for biodegradable or recycled materials (Nugraha et al., 2022). Biodegradable materials, such as corrugated cardboard and certain types of plastic (Olusegun, 2023), can decompose and return to nature in a year or less, making the environment safer and healthier. Eliminating excessive packaging can lead to lower product pricing and better use of materials. Reusable shipping containers, like corrugated boxes and large steel boxes, provide durability during transit and storage across various transportation modes (Alan, 2020). By adopting green packaging practices, businesses can contribute to a safer, cleaner, and healthier environment.

Additionally, eco-design plays a crucial role in enhancing industrial efficiency by raising awareness among businesses about the environmental implications of their products. This knowledge gives them a sustainable competitive advantage in the long term. Considering environmental impact during the design phase is a key strategy in Green Supply Chain Management (Prajogo and Olhager, 2012). Eco-design enhances resource efficiency in supply chain partnerships, leading to improved green supply chain performance (Rahmat, 2019). To create eco-friendly products, it is necessary to assess the environmental impact at every stage of the product's life cycle, from raw material acquisition to disposal, while also factoring in product performance and cost. This approach significantly affects production feasibility and green supply chain efficiency (Wungkana et al., 2023).

Furthermore, integration helps to streamline industrial processes by coordinating the flow of resources from suppliers to consumers along the value chain, which ultimately saves time and space for firms. Integrating logistics functions across supply chain actors is a crucial step (Zailani et al., 2012). On the other hand, information integration utilizes IT to facilitate the exchange of essential data across the supply chain network, with the goal of processing and transmitting data necessary for real-time

supply chain decisions. Efficient information exchange leads to reduced stock on hand and fewer shortages, ultimately resulting in lower pricing (Huong et al., 2021).

1.1. PROBLEM STATEMENT

In response to growing environmental concerns, many businesses are adopting eco-friendly practices to reduce their carbon footprint. Environmental issues are a significant concern for Pakistan's manufacturing sector, impacting the country's economic growth and development. Due to the increasing focus on environmental sustainability, there is a growing interest in understanding the effectiveness of green practices. However, there is a lack of empirical data on how logistic integration and green innovation impact the relationship between green practices and operational performance in Pakistan. This study aims to examine how green supply chain management practices, such as eco-design, green purchasing, green packaging, and green internal environmental management, affect the operational performance of Pakistan's manufacturing firms. Additionally, it will explore the mediating role of logistic integration and the moderating effect of green innovation on the relationship between green practices and operational performance. The primary goal of this study is to enhance green practices within Pakistan's manufacturing sector, shed light on the benefits of green practices, and evaluate the function and impact of sustainable practices on firm operational performance and environmental sustainability.

1.2. OBJECTIVES OF THE STUDY

- To investigate the impact of green practices (GP) on the operational performance (OP) of the manufacturing firms in Pakistan.
- To explore the moderating effect of green innovation on the relationship between GP (Green Practices) and OP (Operational Performance).
- To investigate the mediating effect of logistic integration between green practices (GP) and operational performance (OP).

1.3. RESEARCH QUESTIONS

- Is there any relationship between GP and OP of the manufacturing firms in Pakistan?

- How does green innovation moderate the relationship between GP and the OP of the manufacturing firms in Pakistan?
- How does the logistic integration mediate the relationship between GP and the OP of the manufacturing firms in Pakistan?

1.4. SIGNIFICANCE

This research explores the influence of green supply chain management practices on operational performance in Pakistan's manufacturing industry. It also examines the role of logistic integration as a mediator and the impact of green innovation as a moderator. The study emphasizes the need to integrate green approaches into core activities to realize benefits such as cost reduction, efficient resource consumption, and enhanced brand recognition. The findings have implications for policy development in Pakistan, highlighting the importance of leveraging existing environmental regulations and providing additional incentives for sustainable practices. Furthermore, the research recommends specific green practices, such as green procurement, sustainable environmental management, green products and packaging, and eco-design, based on empirical evidence. These practices are identified as crucial elements of an effective green business strategy. The study also demonstrates that logistics and supply chain management practices mediate the relationship between green initiatives and a company's operational performance, leading to improved processes, reduced waste, and increased efficiency. Additionally, the research underscores the necessity of continuous innovation and adaptation to address environmental concerns, market competition, and regulatory conditions. The empirical data, including case studies from Pakistan's manufacturing industry, fills a significant gap in the literature by providing valuable insights into the Pakistani context.

2. LITERATURE REVIEW

Among the environmental issues highlighted in the global context are global warming and pollution, which have prompted the adoption of sustainable standards for running industries. Green supply chain management is one of the most strategic ways to improve environmental sensitivity and operating performance. GSCM may include practices such as green purchasing, internal environmental management, green product design, environmentally friendly packaging, and logistic integration. This chapter provides a literature review on GSCM practices within the context of Pakistan's manufacturing firms. It discusses and analyzes theoretical frameworks such as the resource-based view and the innovation diffusion theory, as well as literature reviews indicating the positive effects of GSCM on firm performance.

Table 2.1.1: Summary of Literature Reviews

Variables	Focus of study	References
Green Purchasing	Purchasing goods and services with a smaller negative impact on the environment and human health than comparable goods and services is known as "green purchasing. Like previous empirical studies, this research examines green purchasing and operational performance relationship.	(Banjarnahor et al., 2021), (Niswaty et al., 2022), (Tokarčíková & Kucharčíková, 2015), (Barney et al., 2021), (Hitt et al., 2016), (Kozlenkova et al., 2014), (Otley et al., 2014), (Alsmadi et al., 2019).
Internal Environmental Management	An organization's internal environment includes items like its present-day workforce, management, and corporate culture. Some things impact the entire business, while others are limited to the manager. Previous evidence shows a significant relation between Internal Environmental Management and the operational performance.	(Siddik et al., 2016), (Mohammed et al., 2014), (Li et al., 2021), (Mital et al., 2018), (Mohamed Abdullai et al., 2017), (Ileri & Kimutai et al., 2020), (C.A et al., 2014), (Auwal Musa et al., 2014).
Green Product and Packaging	Using recyclable, reusable, or biodegradable materials in green packaging, also known as sustainable packaging, reduces environmental impact and increases demand for environmental packaging. Previous evidence shows a significant relation between Green Product and Packaging and operational performance.	(Ling et al., 2016b), (Santouridis & Kyritsi, 2014b), (Rozhkova et al., 2021), (Nisar & Prabhakar et al., 2017), (Singh & Srivastava et al., 2020), (Nisar & Prabhakar et al., 2017).
Eco-Design	Ecological design is a product and service design mode that considers a product's environmental impact throughout its entire lifecycle. Previous evidence shows a positive relation between Eco-Design and operational performance.	(Khan & Alhumoudi et al., 2022), (Siddik et al., 2016), (Rozhkova et al., 2021), (Keramati et al., 2018), (Ling et al., 2016b)

Logistic Integration	Logistics integration refers to a client firm's strategic collaboration with its logistics service provider (LSP) to manage its internal and external processes effectively. Like previous empirical studies, this research examines the relationship between the logistic integration and operational performance.	(Keramati et al., 2018), (Oladejo et al., 2016), (Henseler et al., 2015), (Khan et al., 2021), (Mutai, Nelly Chellagat; Kiprop et al., 2022).
Operational Performance	Greene (2021) defines operational performance as the collective effort of all business units within an organization to achieve crucial business objectives. Like previous empirical studies, this research examines operational performance as dependent variable.	(Banjarnahor et al., 2021), (Niswaty et al., 2022), (Tokarčíková & Kucharčíková, 2015), (Barney et al., 2021), (Hitt et al., 2016), (Kozlenkova et al., 2014), (Otley et al., 2014), (Alsmadi et al., 2019).
Green Innovation	Eco-innovation is the commercial use of knowledge to improve ecological aspects in order to create goods and procedures that support sustainable development. Previous evidence shows a significant relation between green innovation and the operational performance of banking sector.	(Siddik et al., 2016), (Mohammed et al., 2014), (Li et al., 2021), (Mital et al., 2018), (Mohamed Abdullai et al., 2017), (Ileri & Kimutai et al., 2020), (C.A et al., 2014), (Auwal Musa et al., 2014).

2.1. THEORETICAL FOUNDATION

This study used three frameworks: the Resource-Based View (RBV), Innovation Diffusion Theory (IDT), and Resource Dependence Theory (RDT). The RBV shows how a company can gain a competitive edge by using unique resources that are valuable, rare, and hard to copy. The IDT, on the other hand, asks and answers questions about how green innovations spread in different situations, focusing on temporal sustainability and operational performance gains. The RDT calls for external resources in environmental management, with a special focus on depending on renewable resources via a green purchasing policy. It has been established that these theories offer a good conceptual foundation for enhancing the environmental performance of nations in the OECD region.

2.1.1. Resource-Based View (RBV)

The Resource-Based View (RBV) argues that a company's competitive advantage grows from managing resources and talents that are unusual, distinctive, limited, and durable (Barney et al., 2021). The RBV framework demonstrates how certain environmentally friendly activities may help a company gain a competitive advantage while focusing on environmental sustainability. Purchasing environmentally friendly goods and services, sometimes called "green purchasing," is a valuable resource demonstrating a company's commitment to sustainability and, if widely applied, can provide a competitive advantage in the market (Mahoney et al., 2001). Internal environmental management, a desirable and separate activity, may help companies save money and aid with laws by applying eco-friendly methods. Developing environmentally friendly goods and packaging is important because it helps the company meet client demands and position itself as a leader in the area, particularly if these abilities are unique and difficult to capture (Kozlenkova et al., 2014). Environmental Design products can help to reduce the environmental problems and is recognized for its specific knowledge and experience in implementing specific green practices deemed to be valuable and unique problems under the RBV framework to expand the company's environmental sustainability and potential can improve.

2.1.2. Innovation Diffusion Theory

The Innovation Diffusion Theory (IDT) provides valuable insight into how the adoption and transfer of green innovation impact operational dynamics, particularly regarding environmental sustainability (Chaipoo Pirutana et al., 2009). Innovation diffusion theory is the most important theory that provides valuable insight into how green adoption and transition affect organization dynamics, particularly in association with environmental sustainability (Tokarková & Kucharková, 2015). Innovation diffusion theory examined the different strategies that organization use to implement environmentally friendly technology and overall performance of the organization. The green innovation strategies are used to develop manage operations, technologies, and product with minimum environmental impact is defined by the invention nature, elasticity and communication network. According to S Cheng et al. (2004), a corporation's original or subsequent adoption status influences its operational performance and adoption rate. Green innovation enhances operational performance, adaptability, efficiency, customer loyalty, market share, and competitiveness by complying with environmental rules, saving firms money and ensuring compliance.

2.1.3. Resource Dependence Theory

The Resource Dependency Theory (RDT) highlights the interplay between an organization's environment and external resources, emphasizing the importance of internal environmental management and green buying to reduce nonrenewable resource reliance and expand an organization's resource collection. Internal environmental management reduces an organization's environmental impact by making it less adaptable to resource pricing and availability changes (M. A. Khan & Alhumoudi, 2022). An RDT-based solution necessitates the coordination and collaboration of numerous partners on logistics integration across the supply chain. This integration enhances the flow of materials, information, and resources, increasing productivity while decreasing reliance on external resources (Bell & Bellon, 2018). An eco-friendly supply chain strategy is built on appropriate transportation routes, waste minimization, sustainable sourcing, and logistic integration. It promotes sustainable resource utilization and efficiency while helping reduce nonrenewable resource use. This projected response to RDT principles demonstrates how resource-dependence

management may be accomplished in an era of increased environmental concerns (Hitt et al., 2016).

2.2. GREEN PURCHASING AND OPERATIONAL PERFORMANCE

According to Zhuang et al. (2021), green purchasing refers to an organization monitoring its suppliers' environmental performance and requiring them to implement measures to ensure environmental quality in their operational systems. Green purchasing is defined as an environmental strategy for an organization's long-term material, component, or system requirements (Gera et al., 2022).

However, Jabeen and Talwar (2023) emphasized the difficulty of doing so since inter-firm-level collaborations are based on the conflicting operational purposes and priorities of the various businesses, significantly when different members may not directly profit from the same outcomes. According to Jabeen and Talwar (2023), green purchasing is a communally complicated resource since it demands enterprises to constantly integrate their operations and communications in order to provide a dependable, ecologically collaborative supply chain. This is because reaching an agreement among supply chain stakeholders would require different teams and organizations.

Furthermore, it is imperative to establish regular communication, support, and information sharing among the company and its suppliers. For formalizing communication channels and protocols for interactions between functions, it is important to have strong cross-functional relationships with upper management and environmental experts (Y.-H. Li & Huang, 2017). Including ecological aspects in purchasing policies, programs, and actions to reduce waste and achieve Green Supply Chain Practices (GSCP) entails ecologically friendly, green purchasing (Park et al., 2022).

Basana et al. (2022) found that green purchasing and manufacturing methods affected operating performance. The researcher focused on 468 industrial enterprises in East Java, Indonesia. Green purchasing has a direct impact on manufacturing organizations' operational performance. This research improves supply chain management by focusing on how green manufacturing and procurement may mitigate the impact of top management commitments on operational performance. Wang et al. (2021) investigated the relationship between green purchasing and manufacturing,

innovation orientation, and corporate operational performance using a stakeholder and resource dependence model. The study, which involved 290 publicly listed manufacturing companies in Shenzhen and Shanghai, discovered that innovation orientation is encouraged by green purchasing methods, which serve as a partial mediator in the association between operational performance and green purchasing.

Meow Yee Foo et al. (2021) evaluated how green purchasing habits and skills affected operational performance. The findings demonstrated that green manufacturing, financial, intra-operational, and integration skills favor green purchasing habits. Innovation-related skills could be more valuable. On the other hand, green buying practices improve an organization's operational performance; the most significant importance have been demonstrated in green manufacturing, intra-operational skills, and integration.

Santos et al. (2019) argued that operational performance has been demonstrated to improve when Brazilian companies implement Green Supply Chain Management techniques. This results from balancing operational objectives and environmental regulations with dealing with suppliers and customers. The 115 participants in the survey found that companies could derive the positive effects of green purchasing by cooperating to share environmental data and implementing customers' and green consumers' perspectives in their production procedures. Managers may promote environmental practices that contribute to better operational performance and long-term growth with the help of this study. Chin et al. (2020) found a strong positive association between green purchasing techniques, operational performance, and environmental sustainability in Malaysian manufacturing firms. The findings provide a framework for future research and direction for adopting green purchasing in Malaysian enterprises. The research results may influence green purchasing policies in the business world.

2.3. INTERNAL ENVIRONMENTAL MANAGEMENT AND OPERATIONAL PERFORMANCE

Internal Environmental Management (IEM) Internal environmental management has recently developed as a new management concept worldwide, and the need for eco-friendly management is growing significantly (Lee and Lim et al., 2020). The entire implementation of the Paris Agreement in 2021 as well as management focusing on climate change and the environment, along with an international carbon-neutral attitude, place a strong emphasis on internal environmental management among the ESG

activities (Yu et al., 2021). Similarly, the COVID-19 outburst has emphasized the importance of corporate or business investment in an acceptable internal environmental management system. However, business's environmental issues, especially greenhouse gas emissions, water use, and air pollution, have gained the world's consideration of their global magnitude (Weeratunge and Herath et al., 2018). The study by Environmental et al. (2021) examined the effects of internal environmental management on operational performance in a sub-sector of the food and beverage industry in Indonesia. The results indicate that corporate internal environmental management significantly impacts operational performance. The survey also discussed that many businesses disregard waste management standards, resulting in environmental deterioration. Companies should focus on survival, nature preservation, and socioeconomic sustainability rather than profit-driven activities. The findings highlight the need for companies to prioritize environmental responsibility and waste management to mitigate environmental degradation and improve business performance.

According to the researcher Yu jin et al. (2021), environmental management has evolved into a key component of company strategy, with the end goals of enhanced operational performance, increased profitability, and long-term viability. Companies are abandoning a competing management ethos in favor of one that allows success and growth. Environmental management favors a company's performance, and the degree of competition in an industry affects that performance. The degree of competition tempers the relationship between environmental management and operational performance. This study demonstrates that a company's environmental policies can be strategically leveraged to obtain a competitive advantage and could be relevant for future research into strategic ESG initiatives. Businesses are increasingly adopting environmental management techniques due to various motivations, including legal requirements, pressure from investors, customers, NGOs, communities, and employees, and growing customer pressure (Saeed Amer et al., 2017).

According to the study Wisner et al. (2006), environmental performance is recognized as a key intangible driver of firm value, with environmental liabilities, awards, and toxic emissions all related to financial measures of corporate value. Major companies like Ford and GM mandate suppliers to obtain ISO 14001 certification for environmental management in the automotive industry. Managers recognize that better environmental performance leads to more positive internal outcomes, such as reduced

waste, improved efficiency, decreased energy and resource costs, reduced risk and liability, enhanced corporate reputation, and decreased compliance costs. A strategic environmental management plan can help to minimize operational performance indicators, including waste, discharges, and compliance costs.

Díaz et al. (2018) examined how internal GSCM techniques, such as EM and eco design, affect the environmental, economic and operational performance of Peruvian manufacturing enterprises. According to a poll of 211 respondents, internal environmental management has a beneficial impact on these dimensions, but eco-design solely impacts environmental and operational performance. According to the report, managers should apply GSCM's internal strategies to boost performance.

Claver et al. (2007) conducted structural equation modeling to investigate the link between environmental strategy, environmental management systems, environmental actions, and company performance. It classifies environmental tactics as passive or active and uses cluster analysis to create two study models. The findings indicate that active environmental strategies improve all elements of environmental management systems, activities, and company performance. Passive techniques improve systems and operations but have no significant effect on business performance. The study provides evidence that active environmental management leads to improved corporate performance.

According to Klassen and McLaughlin et al. (1996), internal environmental management has a significant influence on a company's operational success. While some claim that more significant manufacturing costs reduce profitability, others contend that they boost profitability. According to a theoretical model, successful environmental management improves future operational performance, similar to how the stock market does. This relationship was investigated using financial event methodology and archival data. The results demonstrated that good environmental management produced considerable positive returns, but inadequate environmental management produced negative returns. First-time wins were connected with higher market valuation improvements, but enterprises in environmentally filthy industries had smaller increases. This link may be used to assess the advantages and investment opportunities of industry leaders.

Lucas and Noordewier et al. (2016) looked at the link between a company's internal environmental management practices (EMPs) and operational performance. The

study included 941 publicly traded manufacturing US enterprises with 42 four-digit NAICS codes. The data set contained environmental ratings, financial data at the business level, and industry-specific information. The study discovered that engaging in EMPs has a positive marginal effect on business performance in unclean and non-proactive sectors. Implementing EMPs had a more significant impact on operational performance in somewhat unclean, non-proactive industry environments than in relatively clean, proactive situations. According to the study, the industry environment influences the EMP-FP interaction.

2.4. GREEN PRODUCT AND PACKAGING AND OPERATIONAL PERFORMANCE

Green packaging refers to environmentally friendly and sustainable packaging technologies that minimize the negative consequences of product packaging over time (Aslinda et al., 2012). This area includes using renewable and recyclable materials, reducing manufacturing energy consumption, and lobbying for ecologically friendly waste management techniques. The objective is to minimize the environmental effects of traditional packaging, waste production, and material usage (Trujillo-Gallego et al., 2021). However, according to Eltayeb et al. (2010), "green products" refer to manufactured and marketed items while considering their environmental impact. Eco-friendly materials, energy-efficient manufacturing processes, and little waste and pollution during use are frequent objectives (Alsuraihi et al., 2022).

Green products and packaging enable businesses to improve their operational performance. Sustainable practices are consistent with CSR because they may save money while improving the company's reputation (Mughal et al., 2023). Businesses prioritizing green products and packaging have an advantage in eliminating waste costs, supply chain resilience, and consumer loyalty (Balon et al., 2020). Moreover, green investing is a financial term used to describe financing activities that take into account the need to preserve the environment while ensuring a more active and accountable approach to economic activity. By introducing sustainable business practices, corporations are appealing to more mindful consumers who are seeking environmentally friendly products and services (John and Al., 2018). Through investing in green products and packaging, companies can achieve sustainable revenue growth

through reduced utility bills and landfill charges stemming from reduced energy consumption and waste.

Based on the Study by Ahmed and History's (2022) finding, it is necessary to understand sustainable supply chain management strategies to reduce the environmental impact. Research process is based on quantitative technique, as a close ended questionnaire is distributed amongst local managers related to supply chain department in Karachi, Lahore, and Islamabad. The results indicated that green packaging does not only influence the operational performance in a positive direct way but also in a significant indirect way. Ahmed and History (2022) investigated the link between operational performance (OP) and strategic flexibility (SF) in manufacturing companies, with an emphasis on green goods (GP). Data from 167 Malaysian businesses was analyzed using structural equation modeling. The findings revealed that SF partially mediates the association between OP and GP, hence aiding GP adoption. GP functions as a comprehensive mediator between SF and PCA, converting SF into a competitive advantage.

Chiu and Hsieh (2016) investigated the link between green product innovation, operational performance, and competitiveness across Turkish firms. It presents actual data and a model that connects these concepts. The SEM method was utilized to analyze data from 155 companies. The findings revealed that green product innovation considerably increases firm performance and competitive capabilities. However, management environmental concerns only moderate the link. The findings have consequences for managers and indicate new research avenues. According to Trivellas et al. (2020), green packaging is critical for supply chain sustainability, but organizations must first understand the problems they confront while looking for ecologically acceptable alternatives.

White et al. (2015) described a case study of a motorized component manufacturer, stressing customer requirements as well as regulatory, operational, and environmental challenges that influence package design. Despite improvements, operational issues remain the most crucial consideration in packaging design. External supply chain problems, such as customer pressure to use branding packaging systems and the inability to manage incoming goods and material packaging, can stymie attempts to improve packaging operations.

Albino et al. (2009) investigated the use of environmental strategy techniques by sustainability-driven businesses, especially green product creation. It creates a taxonomy of environmental strategies and establishes quantitative indicators for both methods and green product development. The research analyses the content of firms in the Dow Jones Sustainability World Index, as well as environmental and sustainability reports. The findings demonstrate that green product developers use more environmentally strategic methods than non-developers. Implementation varies by economic sector, whereas more consistent behavior is found regionally.

Dangelico and Pujari (2010) explored green product innovation using a case study analysis of 12 small to medium-sized manufacturing enterprises in Italy and Canada. It presents a conceptual framework for comprehending three essential environmental aspects of green products: energy efficiency, material waste reduction, and pollution control. Furthermore, the study investigates the reasons behind the companies' motives, their green policies, and the problems they come across when it comes to production and supply. The research results are integrated into a collection of methods to tackle the issues and threats that hinder organizations.

2.5. ECO-DESIGN AND OPERATIONAL PERFORMANCE

Eco-design concentrates on the ecological consequences of a product or service all through its life cycle (Management et al., 2020). Likewise, it is an approach to making the place green for sustainability. Eco-design is a procedure that defines items in accordance with users' needs and wishes but has minimal environmental impact over the lifecycle (Bhatti et al., 2023). The term "eco-design," also known as "environmental design," "green design," or "the design that is sustainable," implies all the measures applied during the production phase for the reduction of the overall product's environmental footprint in its every life stage, from its manufacturing to its usage and final end-of-life. Only the eco-design or the green design ensures balance in the life of the product. Jermstipparsert et al. (2019) emphasize eco-design issues such as material management, reduced material consumption, recycling, long service life, and energy efficiency.

Businesses today realize the need to reconcile environmental concerns with industrial requirements. This study (Wungkana et al., 2023), focuses on the implications of becoming green in East Java's industrial sector. 116 permanent, upper-level

employees provided the data with at least two years of service. The findings showed that eco-design and green information systems may improve manufacturing operational performance by generating acceptable product quality. Green practices may impact the performance of industrial firms, and this study assists practitioners, particularly top management, in making that commitment. This study's theoretical contribution is to improve manufacturing enterprises' green supply chain management and long-term performance. According to research Subharaj et al. (2022), two environmentally friendly design improvement methodologies are used to improve manufacturing companies' operational performance. The results show that eco-design concepts improved the operational performance of the companies. These methodologies include Life Cycle Assessment (LCA) and Design for Environment (DfE). Implementing these methodologies reduced resource consumption, waste generation, and emissions, leading to improved operational efficiency and sustainability for manufacturing companies.

According to Singhal et al. (2024), sustainable manufacturing is underpinned by eco-design, a key strategy to decrease a product's or processes environmental impact from its cradle to its grave. LCA and DfE are the key principles, and environmental management systems (EMS) are one of the issues. Products and processes were designed to minimize environmental impact, and EMS is a framework for delivering environmental performance management within an organization. The challenges of implementing eco-design include collaboration within and across functions, data availability, and supply chain complexity. Life Cycle Assessment, eco-labeling, and Design for the Environment can be used by organizations to initiate or improve sustainable production practices, leading to a more sustainable future.

Eco-design is a strategy for environmentally responsible and efficient development (Bibi et al., 2022). However, few researches have examined what factors contribute to the success of eco-designed items in the marketplace. According to a study Vernier et al. (2022) European and Canadian firms that have adopted eco-design, regulation and market motives are critical for enterprises to achieve improved financial performance. Businesses that use eco-design tools see productivity increases. Regarding operational performance, eco-design's motives and qualities have a far larger impact in Europe than in Canada. This research aims to discover critical success elements for eco-designed goods and enhance their operational performance.

Le et al. (2024) investigated construction supply chains integrated into alliances with suppliers and where eco-design and digital transformation play a role. Survey data was analyzed using the PLS-SEM model, and expert evaluation of the results was validated. The study showed that these factors significantly impacted construction projects' sustainable supply chain performance. The study also showed that digital transformation can improve these aspects. First, construction managers improved the effectiveness of sustainable construction supply chains, thereby understanding the study of sustainable supply chain management within the construction sector. The study is unique because it has not examined the factors' roles in improving sustainable supply chain performance within the construction industry.

According to the researcher Fernando and Uu (2017), eco-design is a critical aspect of green supply chain management (GSCM), integrating it into product design and processing from extraction to disposal. This concept is applied to both upstream and downstream manufacturing processes. This study tested constructs using successful international manufacturers and a Malaysian survey on the impact of eco-design on environmental and operational performance. Results showed that eco-design's moderating effects strengthened the relationship between eco-design and operational performance. The report recommends that operational managers use eco-design metrics to predict future outcomes and suggests that future academics should develop techniques to educate industry counterparts on rigorous statistical modelling and structure creation. The research S. A. R. Khan et al. (2019), examined the impact of eco-design company procedures, including ecological design, green purchasing of materials, customer collaboration, and green practices in logistics operations, on operational performance. It found that these practices significantly influence operational performance.

According to the researcher Landeta-Manzano et al. (2017), the Spanish furniture industry has significantly benefited from adopting eco-design management guidelines, as the manufacturing process accounts for over 90% of the performance effects of three firms' goods. Standard management practices have also enabled businesses to promote product innovation, enhance public perception, reduce negative environmental effects, and adapt to stricter operational legislation, ultimately benefiting both the environment and the economy. According to the researcher Bersano et al. (2017), eco-design is a sustainable innovation integrating operational performance into development processes.

The design is being assessed for its potential to increase operational performance. It is also being researched for interchangeability characteristics, ensuring product lifecycles and repurposing used covers for new uses. The literature on sustainable manufacturing shows a strong correlation between eco-design use and the operational performance of manufacturing companies.

2.6. MEDIATION EFFECT

According to Micheli et al. (2020), logistics integration entails "environmental management practices of organizing, executing, and monitoring goods or services to the point where the consumer or customer is served." Integrating green supply chain management strategies with suppliers and customers to control information and material flow across the supply chain. According to Wong et al. (2020), "logistic integration" is within the scope of GSCM. Furthermore, logistics is defined as the process of transporting things or people from one point to another. However, when the flow of information is addressed, the entire process, from the moment water is pulled from its source until it reaches the consumer, is critical, as illustrated by a water bottle. Getting it to its destination on schedule and in excellent condition involves various obstacles (Africa et al., 2017). For green practices to be effective, all phases in the flow of materials and data must have little influence on the natural environment (Aamir and Raheem, 2020).

For managers to make sound judgments, operational performance management necessitates smooth communication across the supply chain (Chan et al., 2012). Supply chain performance and logistics have historically been centered on these three metrics: time, money, and precision (Shaw et al., 2010). When a supplier and a customer work together to integrate their logistics, everyone benefits in terms of saved time, money, and precision in data sharing (Alghababsheh et al., 2022). Logistical and technological integration is one of the key issues that may impede the organization's operational performance goals (Yildiz Çankaya and Sezen, 2019). By means of logistics, several organizations may achieve their operational performance objectives, provided that other participants in the green supply chain collaborate closely and cooperatively (Uddin et al., 2021). Al-awamleh et al. (2022) conducted a study and concluded that the use of green logistics management helps to achieve efficiency, reduce disposal, save resources and fulfil the society's expectations for conservation. "Green logistics," according to

Trivellas et al. (2020), is designed not just to be ecologically benign but also economically functional.

Esfahbodi et al. (2023) demonstrated that choosing the most effective transit routes might help us reduce our negative environmental impact while saving money. This notion explains how environmental conduct via logistics enhances the operational effectiveness of commercial organizations. Alam et al. conducted a multi-country survey in Brazil, Korea, and India to investigate how logistics-related elements such as supplier involvement, duration of relationship with providers, use of information technology, and integration of supply chain management influence operational effectiveness within businesses. The study analyses data from 177 organizations using partial least squares structural equation modeling. The results demonstrate that LI has a sizeable direct influence on SCP, but SI, LSR, and IT do not. LSR and IT have significant impacts on OP.

Rahmat et al. (2019) evaluated the link between supply chain capabilities and operational performance, with an emphasis on technology and logistic integration as mediators. The study uses smart PLS for structural equation modelling and data collection via mail and telephone questionnaires. The findings indicate that all hypotheses are valid, and the mediation impact of technology and logistic integration is considerable. Policymakers, practitioners, and operations managers can all benefit from a better understanding of the link between HRM and OM, as evidenced by the results. The outcomes of this study shed light on the relationship between operational performance and supply chain proficiency..

According to the researcher Ahmad and Saifudin (2019) the telecommunications market is becoming more competitive, so consumers are looking for higher-quality services at lower prices. As a result, telecommunications companies must work efficiently for supply chain management to obtain the best results. Most supply chain management research has focused on how it can boost a company's bottom line. This research aims to illustrate the structural link between supply chain management practice and supply chain performance in the telecommunications sector and examine whether or not this relationship is mediated by logistical integration. Data will be collected from telecommunications companies, and the proposed framework will be examined using the 21st version of the Statistical Package for the Social Sciences (SPSS) to assess the

measurement model. The study is primarily a review of the literature and finishes with some recommendations for additional research.

The research ultimately indicates the same core idea: Green logistics is an effective way for businesses to reduce adverse environmental effects while simultaneously increasing their operational efficiency. Effective green logistics management is largely determined by the degree of logistic integration between producers, suppliers, and customers (Stekelorum et al., 2021). The material and information flow coordination across supply chain partners can predict a company's operational performance.

2.7. GREEN INNOVATION AND OPERATIONAL PERFORMANCE

According to the researcher Shekari and Ghatari (2013) characterize green innovation as a transformation process involving creative methods (e.g., production manufacturing, construction, processes, systems, etc.) that bring direct and beneficial advantages to the environment. The term "green innovation" was used by (Stekelorum et al., 2021) to describe the creative application of technology in areas such as environmental protection and sustainability. The definitions' sig. lies in how stakeholders may use green technology to further the organization's aims without negatively impacting the environment. There is no denying the importance of green innovation in driving businesses toward long-term sustainability. Green innovation has been recognized by academics (Tan and Zailani 2016; Zhu et al., 2012) as a key component of a company's performance management strategy. To thrive in today's cutthroat business climate, companies must implement efficient green innovation strategies and actively connect with, construct, and create relationships with their stakeholder communities.

Xie et al. (2019) employed a study to establish the causality connection between green technology innovation and the financial performance of enterprises. The study deduced that green process innovation was constructively related to green product innovation, and the two may enhance a firm's operational performance. The study posits that green product innovation moderated the association between green process innovation and OP. In contrast, a company's green image, which is the company's perceived environmental image by consumers, can mitigate the relationship between green product innovation and FP. Accordingly, green subsidies were expected to

mediate between green product innovation and OP, but this study failed to capture evidence. The study's findings provide direction for managers and government agencies on how to harness green technology innovation. According to researcher Shuwaikh et al. (2023), Green innovation is critical for solving social and environmental concerns in the twenty-first century. Sustainability is broad, dynamic, and unexpected, necessitating incremental and radical changes in businesses, markets, consumer behavior, and public policy. Sustainable finance is a constantly developing method for making fiscal and investment decisions considering environmental, social, and governance factors. The systemic logic of green innovation is present in this industry.

The researcher Java and Java, (2023) set out to quantify the role of competitive advantage as a moderator between green innovation and firm performance. Purposive sampling was used to choose a sample of 369 firms from the proper database covering 2010-2018. The results of this study revealed that the positive effect of green innovation on competitive advantage, positive effect of competitive advantage on firm performance, no effect of green innovation on firm performance, and competitive advantage mediated the effect of green innovation on firm performance. To enhance competitive advantage and firm performance, businesses can implement green innovation to mitigate environmental issues.

According to study Rahman et al. (2023), green product innovation has a curvilinear influence on corporate growth. This study also implies that marketing intensity and sustainability disclosure strategy have a negative impact on this curvilinear relationship. However, a firm's proclivity for deviant corporate activities positively impacts it. This study uses an appropriate econometric modelling tool to demonstrate that green product innovation increases firm growth initially but after that, diminishes it. This research also demonstrates that a business's sustainability-disclosure strategy, marketing intensity, and deviant corporate behavior help attenuate the inverse U-shaped association between green product innovation and firm growth.

Nguyen et al. (2020) investigated the impact of green business initiatives implemented by Vietnamese enterprises on their operational performance. This study included both qualitative and quantitative methodologies. The findings of this study show that green initiatives improve corporate success in terms of operations, finances, marketing, and the environment. Businesses may boost sales, profitability, market share, and customer happiness by employing environmentally friendly techniques such as

green supply chain management, reverse logistics, logistics, marketing, advertising, eco-labelling, and green innovation. Furthermore, green business activities help organizations save money and have fewer adverse effects on the environment.

According to the researcher Huong et al. (2021), environmental management determines how green innovation affects an organization's success or failure. A-share businesses listed on the Shanghai Stock Exchange provided data for this analysis between 2014 and 2017. Innovations in green technology focus on reducing energy consumption and landfill waste, ultimately leading to environmentally friendly goods. The operational performance, public perception and long-term viability are all improved by this strategy. However, few studies have looked at this issue from a business standpoint. Environmental management is found to moderate the favorable correlation between green innovation and business success. Both researchers and professionals should consider the results.

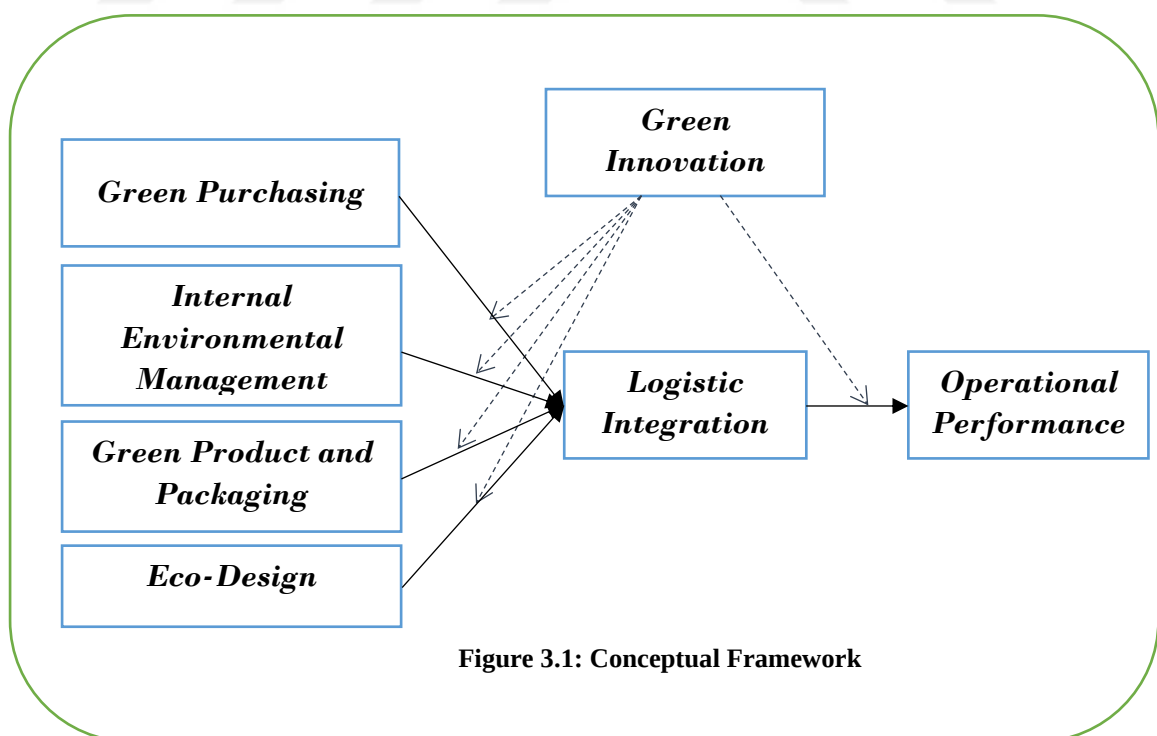
Becker et al. (2023) investigated the impact of green innovation strategies on a firm's innovation success and performance. It uses proclivity score and kernel matching to analyze a Spanish firm panel from 2008 to 2016. Results show that green innovation strategies increase turnover due to new-to-market or radical product innovation. However, these strategies do not significantly improve performance. Firms adopting general green innovation strategies show improved labor productivity, but no effects are observed for green product innovation strategies.

3. METHODOLOGY

This study explores the impact of green purchasing, internal environmental management, green product and packaging, and eco-design on the operational performance of the manufacturing sector in Pakistan. The investigation also examines the mediating role of logistic integration and the moderating effect of green innovation. The following sections outline the research framework, design, sample population, sampling techniques, data collection procedure, and data analysis methods employed in the study.

3.1. RESEARCH FRAMEWORK

The literature study established the framework for a research method to investigate the relationships between four independent variables—green purchasing, eco-design, green product and packaging, and internal environmental management—and one dependent variable—operational performance. The study also examines logistics integration's position as a mediator and green innovation's moderating effect.



3.2. HYPOTHESIS DEVELOPMENT

The study hypothesizes the following relationships:

H1: Green Purchasing has a positive impact on logistic integration.

H2: Green Purchasing has a positive impact on operational performance (OP).

H3: Internal Environmental Management (IEM) has a positive impact on logistic integration.

H4: IEM has a positive impact on OP.

H5: Green Product and Packaging (GPP) has a positive impact on logistic integration.

H6: Green Product and Packaging has a positive impact on OP.

H7: Eco-design has a positive impact on logistic integration.

H8: Eco-design has a positive impact on OP.

H9: Logistic Integration has a positive impact on OP.

H10: Logistic Integration significantly mediates the relationship between green purchasing and operational performance.

H11: Logistic Integration significantly mediates the relationship between internal environmental management and operational performance.

H12: Logistic Integration significantly mediates the relationship between green product and packaging and operational performance.

H13: Logistic Integration significantly mediates the relationship between eco-design and operational performance.

H14: Green Innovation significantly moderates the relationship between green purchasing and operational performance.

H15: Green Innovation significantly moderates the relationship between internal environmental management and operational performance.

H16: Green Innovation significantly moderates the relationship between green product and packaging and operational performance.

H17: Green Innovation significantly moderates the relationship between eco-design and operational performance.

H18: Green Innovation significantly moderates the relationship between Logistic Integration and operational performance.

3.3. RESEARCH DESIGN

This study adopts a quantitative research design to explore the relationships among variables. Descriptive research methods are employed to analyze the hypotheses and assess the empirical relationships between operational performance and the independent variables. The study utilizes PLS-SEM (Partial Least Squares Structural Equation Modeling) for data analysis, which is advantageous for handling complex models with multiple variables.

3.4. SAMPLE POPULATION AND SAMPLING TECHNIQUES

The target population for this study comprises employees of manufacturing companies in Pakistan, specifically in Punjab and Sindh regions (Lahore, Faisalabad, and Karachi). A sample of 240 employees from 50 manufacturing companies was selected using simple random sampling to ensure unbiased representation. The sample includes higher-level and middle-level managers.

3.5. DATA COLLECTION PROCEDURE

Data were collected through a self-administered survey using a five-point Likert scale. The survey was distributed via email to the selected participants. The survey aimed to gather insights on green supply chain management practices and their impact on operational performance. Initial communication was established through email and telephone to facilitate survey completion.

3.6. DATA COLLECTION TOOL

The questionnaire was chosen as the primary data collection tool due to its simplicity and effectiveness. It included items measured on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire was designed based on validated scales from previous research, ensuring reliability and validity.

3.7. DATA ANALYSIS

Data were analyzed using Smart PLS 4.0 for Partial Least Squares Structural Equation Modeling (PLS-SEM). This method was chosen for its flexibility and ability to handle complex models with multiple variables. The analysis aimed to determine the relationships among the studied variables and their impacts.

3.8. PILOT STUDY

The next step is to refine the instrument's questions after including the modified version of the instrument into the study design. Usually, a pilot study is conducted as part of the data collection procedure prior to the main survey. In order to make improvements, the pilot research is usually carried out to assess the validity and reliability of the instrument (Zikmund, 2003). Pilot studies are primarily conducted to rule out any potential weaknesses and defects in the device. In this regard, the questions' wording, sentence structure, sequence, and understanding level of the respondent are identified, along with the response rate, completion time, and analysis procedure. Luck & Rubin (1987) suggested that a sample of 10 to 50 respondents from the target demographic be used for the pilot study. Following was a presentation of the pilot study's results.

4. FINDING OF THE RESEARCH

4.1. PILOT STUDY

Prior to this, the current study emphasized the need of pilot studies and the essential procedure for modifying a reliable and valid instrument for the main survey study. This study conducted 50 surveys for this pilot study, and data was gathered for preliminary analysis. The primary aim of the pilot study is to determine the important requirements for purification, such as the wording of the questions, the composition of sentences, the sequence, the structure of sentences, the respondent's understanding level, the response percentage, the completion time, and the analysis procedure (Ticehurst & Veal, 2005). Moreover, the primary objective of a pilot study is to assess the validity and reliability of the instruments and make sure that the instructions, question phrasing, and instrument scale were all understandable (Zikmund, 2000; Sekaran, 2000). Table 4.1 demonstrates the finding of reliability and validity.

A reliability and validity analysis aims to determine whether the research scale items are valid and reliable. The researchers used the PLS approach to show validity. Henseler et al. (2014) and Hair et al. (2007) 0.80 for Cronbach's alpha (CA), and 0.70 for composite reliability (CR) and average variance extracted is not less than 0.50. The finding of the pilot study identified that Cronbach's alpha (CA) values for all variables are greater than 0.80, composite reliability (CR) values of all constructs are greater than 0.70 and average variance extracted (AVE) of all constructs also greater than 0.50. Therefore, present study provide evidence that the instrument of is valid and reliable. All of the structures studied had factor loadings greater than 0.60. Therefore, all HTMT values are less than 0.90 its indicates that conceptual model has validated.

Table 4.1: Results of Pilot study (Reliability and validity)

Constructs	Items	Factor loading	CA	CR	(AVE)
Eco-Design	(1) Reduce the use of excessive materials used.	0.836	0.934	0.937	0.865
	(2) Using recyclable materials.	0.850			
	(3) My organization seeks to minimize resource consumption (e.g., raw materials and energy) in our product designs.	0.840			

	(4) Design decisions are influenced by factors such as emissions reduction, waste minimization, and eco-friendly materials.	0.862				
Green Innovation	(1) My company has selected environmentally friendly raw materials in product development.	0.775	0.700	0.651	0.530	
	(2) My company has used energy-efficient raw materials in product development.	0.621				
	(3) My company has effectively recycled waste and emissions in the production process.	0.712				
Green Purchasing	(1) My organization prioritizes purchasing products and materials that are environmentally friendly.	0.71	0.752	0.751	0.567	
	(2) My organization actively seeks suppliers who demonstrate environmentally sustainable practices.	0.698				
	(3) We set environmental criteria that suppliers must meet.	0.782				
	(4) My organization encourages employees to consider environmental factors when making purchasing requests.	0.691				
Green Product and Packaging	(1) My organization collaborates with suppliers to source sustainable packaging materials that reduce waste and pollution.	0.721	0.839	0.881	0.696	
	(2) We communicate the environmental benefits of our green products and packaging to customers through labeling and marketing efforts.	0.826				
	(3) Our organization actively seeks feedback from customers and stakeholders regarding our green products and packaging.	0.842				
	(4) Our packaging designs are optimized to minimize material usage and waste generation.	0.797				
Internal Environment Management	(1) My organization has a dedicated environmental management team that implements green initiatives.	0.794	0.812	0.865	0.659	

	(2) Environmental sustainability goals and targets are integrated into our organization's strategic planning.	0.827			
	(3) My organization has clear policies and procedures to reduce energy consumption and promote energy efficiency.	0.721			
	(4) Our organization actively monitors and evaluates its environmental performance through key performance indicators (KPIs) such as waste reduction, water usage, and emissions.	0.749			
Logistic Integration	(1) Our organization has effectively integrated environmental considerations into our logistics planning and decision-making processes.	0.719	0.804	0.851	0.573
	(2) Our logistics operations include measures to minimize fuel consumption, emissions, and carbon footprint.	0.723			
	(3) Our logistics team is trained and equipped to implement sustainable logistics practices effectively.	0.825			
	(4) Our organization leverages technology such as GPS tracking, real-time monitoring, and data analytics to enhance the efficiency and sustainability of our logistics operations.	0.611			
	(5) Our logistics processes are flexible and adaptable, allowing for quick adjustments to meet changing environmental regulations and market demands.	0.872			
Operational Performance	(1) My organization consistently achieves high levels of product quality and reliability.	0.749	0.802	0.839	0.640
	(2) Our manufacturing processes are efficient, resulting in minimal waste and downtime.	0.776			

(3) Our organization maintains high levels of customer satisfaction regarding product delivery, lead times, and responsiveness. 0.804

(4) Our workforce is well-trained and motivated to support and implement green supply chain initiatives, enhancing our operational performance. 0.748

Table 4.2: Results of Pilot Study's Validity (HTMT)

	ED	GI	GP	GPP	IEM	LI	OP
ED							
GI	0.466						
GP	0.373	0.437					
GPP	0.473	0.373	0.500				
IEM	0.364	0.422	0.818	0.390			
LI	0.286	0.364	0.593	0.327	0.449		
OP	0.702	0.179	0.527	0.356	0.355	0.761	

4.2. DEMOGRAPHIC ANALYSIS

Table 4.3 demonstrated the findings of demographic analysis. Therefore, the demographic analysis facilitates to understand the characteristics of the target population's respondent. Total respondents of the sample were 240, in which 63.59% were male respondents and rest 38.50% respondents were female. Furthermore, the second classification on the basis of age group of the respondents, 27.08% were between the ages of 21 and 30, 31.67% were between 31 and 40, 28.75% were between 41 and 50, and 16.67% were between 51 and 60. Moreover, the 47.08% had bachelor's degrees, 40.83% had a master's degree, and 12.08% had done M.Phil. and rests 6.25% of respondents were doing doctorates (Ph.D.). Lastly, 11.25% respondent were related to high level management, 20.00% respondents were related to medium level management, 36.25% respondents were related to low level management and rest 32.50% belong to other employees of the organization.

Table 4.3: Respondent data

Variable	Frequency	Percentage
Gender		

Male	150	63.59%
Female	90	38.50%
Age		
21-30	65	27.08%
31-40	76	31.67%
41-50	69	28.75%
51 years above	40	16.67%
Academic Qualification		
Bachelors	113	47.08%
Master	98	40.83%
MS/M.Phil.	29	12.08%
PhD	15	6.25%
Management Level		
High Level	27	11.25%
Medium Level	48	20.00%
Lower Level	87	36.25%
Other Employee	78	32.50%

4.3. CONVERGENT RELIABILITY AND VALIDITY

Table 4.4 shows the results of the convergent reliability and validity checks. A convergent validity and reliability analysis aim to establish the validity and reliability of research scale items. The researchers demonstrated convergent validity by employing the PLS technique. Henseler et al. (2014) and Hair et al. (2007) set minimum norms for factor loadings of 0.60, Cronbach's alpha of 0.70, composite reliability of 0.70, and average variance extracted of 0.70. Cronbach's alpha values greater than 0.80 are found for all variables in Table 4.3. Factor loadings were more than 0.60 for each assessed structure. These composite reliability (CR) and average (AVE) values are more than 0.50. As a result, the current study's validity and reliability align.

Table 4.4: Results of Convergent Reliability and Validity

Constructs	Items	Factor Loading	CA	CR	AVE
Eco-Design	ED1	0.935	0.961	0.972	0.896
	ED2	0.949			
	ED3	0.939			
	ED4	0.963			
Green Innovation	GI1	0.874	0.616	0.788	0.561
	GI2	0.567			
	GI3	0.773			
Green Purchasing	GP1	0.794	0.769	0.854	0.598
	GP2	0.63			
	GP3	0.881			
	GP4	0.767			
Green Product and Packaging	GPP1	0.602	0.866	0.912	0.727
	GPP2	0.925			
	GPP3	0.941			
	GPP4	0.896			

Internal Environmental Management	IEM1	0.893	0.839	0.896	0.69
	IEM2	0.926			
	IEM3	0.554			
	IEM4	0.893			
Logistic Integration	LI1	0.757	0.821	0.879	0.604
	LI2	0.46			
	LI3	0.924			
	LI4	0.71			
	LI5	0.936			
Operational Performance	OP1	0.858	0.829	0.889	0.671
	OP2	0.875			
	OP3	0.903			
	OP4	0.608			

4.4. DISCRIMINANT VALIDITY

This study aims to establish a causal relationship between the constructs by assessing the discriminant validity of the scale's elements. Thus, the discriminant validity of the conceptual model proposed by Hair Jr. et al. (2020) was evaluated in this study using HTMT, the Fornell-Larcker criterion, and the cross-loading approach.

4.4.1. Heterotrait-monotrait Ratio (HTMT)

The discriminant validity of the constructs associated with the conceptual model was evaluated using the HTMT approach, as indicated by Gold et al. (2001). Gold et al. (2001) state that HTMT levels should not exceed 0.90. All construct values are less than 0.90, as seen in Table 4.5, which contains the HTMT results. Thus, it demonstrates that the discriminant supports the conceptual mode.

Table 4.5: Results of HTMT

	ED	GI	GP	GPP	IEM	LI	OP
ED							
GI	0.656						
GP	0.563	0.560					
GPP	0.363	0.596	0.565				
IEM	0.654	0.345	0.883	0.614			
LI	0.676	0.587	0.658	0.451	0.650		
OP	0.592	0.402	0.592	0.280	0.556	0.651	

4.4.2. Fornell-Larcker Criterion

This study investigates the construct's discriminant validity to determine the weather model's validity. Table 4.6 displays the results of the Fornell-Larcker criterion,

which was used to assess the conceptual model's discriminant validity. The results show that the criteria have been favorably validated.

Table 4.6: Results of Fornell-Larcker Criterion

	ED	GI	GP	GPP	IEM	LI	OP
ED	0.746						
GI	0.821	0.749					
GP	0.849	0.8	0.773				
GPP	0.874	0.692	0.804	0.822			
IEM	0.727	0.822	0.898	0.816	0.831		
LI	0.578	0.777	0.523	0.583	0.576	0.777	
OP	0.793	0.809	0.803	0.828	0.742	0.551	0.819

4.4.3. Cross-Loading

The result of cross loading is displayed in Table 4.7. Therefore, the result shows that the scale items of constructs in the conceptual research model has absolutely validated.

Table 4.7: Results of Cross Loading

	ED	GI	GP	GPP	IEM	LI	OP
ED1	0.935	0.728	0.884	0.788	0.926	0.549	0.872
ED2	0.949	0.761	0.752	0.828	0.857	0.562	0.824
ED3	0.939	0.813	0.775	0.865	0.826	0.546	0.804
ED4	0.963	0.809	0.802	0.828	0.901	0.529	0.881
GI1	0.906	0.874	0.821	0.860	0.900	0.497	0.886
GI2	0.416	0.567	0.520	0.519	0.353	0.271	0.372
GI3	0.465	0.773	0.461	0.601	0.503	0.871	0.482
GP1	0.751	0.638	0.794	0.615	0.826	0.396	0.760
GP2	0.487	0.633	0.630	0.648	0.462	0.365	0.435
GP3	0.721	0.581	0.881	0.601	0.776	0.405	0.758
GP4	0.645	0.617	0.767	0.732	0.687	0.439	0.770
GPP1	0.453	0.609	0.606	0.602	0.421	0.337	0.443
GPP2	0.801	0.843	0.851	0.925	0.853	0.502	0.870
GPP3	0.815	0.844	0.733	0.941	0.797	0.543	0.790
GPP4	0.840	0.737	0.695	0.896	0.805	0.569	0.828
IEM1	0.827	0.778	0.752	0.853	0.893	0.529	0.872

IEM2	0.935	0.728	0.884	0.788	0.926	0.549	0.872
IEM3	0.381	0.327	0.384	0.321	0.554	0.296	0.385
IEM4	0.822	0.800	0.865	0.797	0.893	0.496	0.889
LI1	0.610	0.655	0.485	0.687	0.590	0.757	0.610
LI2	0.247	0.295	0.297	0.193	0.376	0.460	0.279
LI3	0.535	0.683	0.444	0.467	0.517	0.924	0.471
LI4	0.213	0.542	0.299	0.311	0.221	0.710	0.259
LI5	0.534	0.738	0.471	0.505	0.499	0.936	0.464
OP1	0.744	0.708	0.785	0.761	0.823	0.472	0.858
OP2	0.837	0.651	0.808	0.710	0.880	0.497	0.875
OP3	0.821	0.777	0.837	0.850	0.875	0.518	0.903
OP4	0.479	0.473	0.427	0.516	0.433	0.282	0.608

4.5. MULTICOLLINEARITY

Table 4.8 presents the VIF test results. The current analysis found no evidence of multicollinearity among the explanatory components. Table 4.6 shows that all VIF values are less than 5.

Table 4.8: Results of Multicollinearity (VIF)

	VIF	1/VIF
ED1	2.506	0.399
ED2	2.862	0.349
ED3	1.388	0.720
ED4	2.281	0.438
GI1	1.626	0.615
GI2	1.338	0.747
GI3	1.251	0.799
GP1	2.055	0.487
GP2	1.207	0.829
GP3	2.888	0.346
GP4	1.767	0.566
GPP1	1.272	0.786
GPP2	3.046	0.328
GPP3	2.215	0.451

GPP4	2.904	0.344
IEM1	2.942	0.340
IEM2	3.540	0.282
IEM3	1.218	0.821
IEM4	2.747	0.364
LI1	1.769	0.565
LI2	1.168	0.856
LI3	2.767	0.361
LI4	1.660	0.602
LI5	2.083	0.480
OP1	2.093	0.478
OP2	3.298	0.303
OP3	3.248	0.308
OP4	1.310	0.763
Average Value of VIF	2.159	

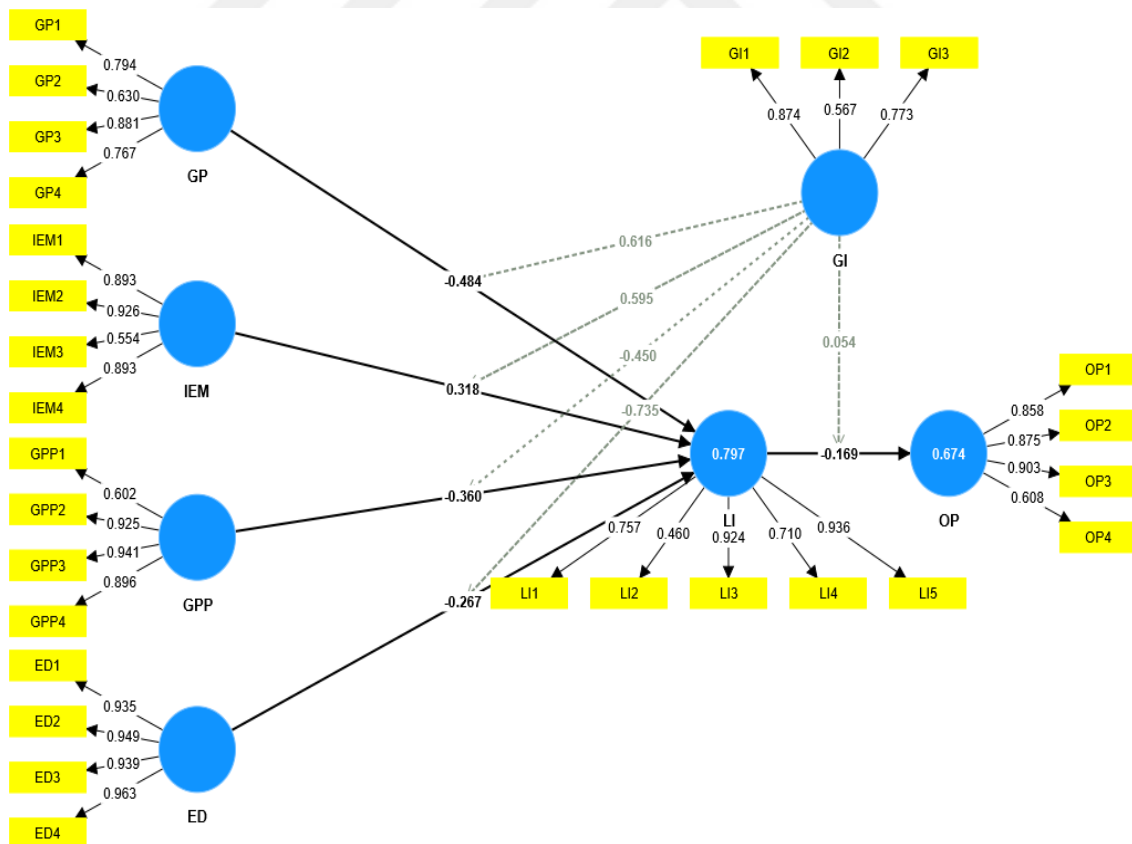


Figure 4.1: Measurement of Model

4.6. DIRECT RELATIONSHIP

Table 4.9 presents the model estimation parameters based on the computational data. PLS-SEM bootstrapping was used to determine the direct link between the constructs. The H1 was accepted at a 5% significance level and supported by the results (β Coeff = 0.483, t-statistic = 4.654, and $P < 0.05$). As a result, the findings reveal that green purchasing has a favorable and considerable impact on logistics integration. The current study's conclusions are based on prior researches (Ahmed & History, 2022; Gustavo et al., 2016; Wang et al., 2021). The H2 was accepted at the 5% significance level and supported by the results (β Coeff = 0.092, t-statistics = 2.190, and $P < 0.05$). Thus, the results show that green purchasing has a favorable and significant impact on operational performance. The finding of the present study follows by prior studies (Chin et al., 2020; Foo, n.d.; Santos et al., 2019).

Furthermore, the findings (β Coeff = 0.318, t-statistics = 2.163, and $P < 0.05$) support adopting the H3 at the 5% significance level. The findings show that internal environmental management significantly and positively influences logistics integration. The finding of the present study follows by prior studies (Lee and Lim et al., 2020; Yu et al., 2021). Additionally, the results (β Coeff = 0.094, t-statistics = 2.474, and $P < 0.05$) support adopting the H4 at the 5% significance level. The findings reveal that internal environmental management has a favorable and significant impact on operational performance. The finding of the present study follows by prior studies (Weeratunge and Herath et al., 2018; Environmental et al., 2021).

Moreover, the test results (β Coeff = 0.360, t-statistics = 2.571, and $P < 0.05$) support adopting the H5 at the 5% significance level. The findings show that environmentally friendly products and packaging have a favorable and considerable impact on logistical integration. The finding of the present study follows by prior studies (Pauer et al., 2019; Kaur et al., 2022; Majeed et al., 2022). Further, The H6 was rejected based on the results (β Coeff = 0.061, t-statistic = 1.488, and $P > 0.05$). Thus, the outcomes show that environmentally friendly products and packaging do not affect the organization's performance. The finding of the present study follows by prior studies (Bigliardi et al., 2020; Kaur et al., 2022; Liao et al., 2020; Majeed et al., 2022).

Moreover, The H7 was accepted at a 5% significance level and supported by the results (β Coeff = 0.297, t-statistics = 2.152, and $P < 0.05$). The findings show that eco-

design has a considerable and favorable influence on logistics integration. The finding of the present study follows by prior studies (Díaz, 2018; Lee & Lim, 2020). Furthermore, the results (β Coeff = 0.045, t-statistics = 1.250, and $P > 0.05$) show that the H8 is rejected. As a result, the data imply that eco-design does not substantially impact operational performance. The finding of the present study follows by prior studies (Alghababsheh et al., 2022; Sahoo & Vijayvargy, 2021). The H9 is accepted based on the results (β Coeff = 0.169, t-statistic = 2.167, and $P < 0.05$). As a result, the statistics show that logistic integration has little influence on operational performance. The finding of the present study follows by prior studies (Alam et al., 2014; Rahmat, 2019).

Table 4.9: Outcomes of Direct Relationship

	β Coeff.	Standard Deviation	T Stat.	P values	Decision
GP -> LI	0.484	0.104	4.654	0.000	Accepted
GP -> OP	0.092	0.042	2.190	0.041	Accepted
IEM -> LI	0.318	0.147	2.163	0.031	Accepted
IEM -> OP	0.094	0.038	2.474	0.029	Accepted
GPP -> LI	0.360	0.140	2.571	0.010	Accepted
GPP -> OP	0.061	0.041	1.488	0.142	Rejected
ED -> LI	0.297	0.138	2.152	0.053	Accepted
ED -> OP	0.045	0.036	1.250	0.216	Rejected
LI -> OP	0.169	0.078	2.167	0.030	Accepted

4.7. INDIRECT RELATIONSHIP/MEDIATION EFFECT

Table 4.10 shows the results of the indirect effect analysis and the use of PLS-SEM bootstrapping to identify the indirect relationship between the constructs. The results (β Coeff = 0.795, t-statistic = 3.412, and $P < 0.05$) support adopting the H10 at a 5% significant level. The findings show that logistics integration is key in mediating the association between green purchasing and operational performance. Furthermore, with a β coefficient of 0.451, t-statistic of 3.110, and $P < 0.05$, the H11 was validated at a 5% significance level. The findings show that logistic integration is key in mediating the association between environmental management and operational performance.

Additionally, the results show that the H12 is accepted at a 5% significance level (β Coeff = 0.735, t-statistics = 6.050, and $P < 0.05$). The findings show that logistics integration is key in mediating the association between green products and packaging and operational performance. The results show that the H13 is accepted at the 5% significance level (β Coeff = 0.084, t-statistic = 3.360, and $P < 0.05$). Thus, the data show that logistical integration is key in mediating the association between eco-design and operational performance.

Table 4.10: Outcomes Mediating Effect

	β Coeff.	Standard deviation	T Stat.	P values	Decision
GP -> LI -> OP	0.795	0.233	3.412	0.000	Accepted
IEM -> LI -> OP	0.451	0.145	3.110	0.002	Accepted
GPP -> LI -> OP	0.735	0.122	6.025	0.000	Accepted
ED -> LI -> OP	0.084	0.025	3.360	0.000	Accepted

4.8. MODERATING EFFECT

Table 4.11 displays the results of the PLS-SEM bootstrapping used to determine the moderating impact. The results indicate acceptance of the H14 at the 5% significance level (β Coeff = 0.416, t-statistic = 4.245, and $P < 0.05$). Thus, the results show that green innovation substantially moderates the impacts of the link between green purchasing and operational performance. The data (β Coeff = 0.618, t-statistics = 2.652, and $P < 0.05$) validate the H15 at a 5% significance level. Thus, the data suggest that green innovation substantially moderates the impacts of the link between IEM and operational performance.

Additionally, the results (β Coeff = 0.625, t-statistics = 3.788, and $P < 0.05$) support the acceptance of the H16 at a 5% significant level. The findings show that green innovation substantially moderates the impacts on the association between environmentally friendly products and packaging and operational success. The H17 was rejected based on the results (β Coeff = 0.098, t-statistic = 0.538, and $P > 0.05$). The data show that green innovation does not mediate the connection between IEM and operational success. The results (β Coeff = 0.054, t-statistics = 2.160, and $P < 0.05$) support adopting the H18 at the 5% significance level. Thus, the results show that green

innovation substantially moderates the impact link between eco-design and operational success.

Table 4.11: Outcomes of Moderating Effect

	β Coeff.	Standard Deviation	T Stat.	P values	Decision
GI x GP -> LI	0.416	0.098	4.245	0.000	Accepted
GI x IEM -> LI	0.618	0.233	2.652	0.011	Accepted
GI x GPP -> LI	0.625	0.165	3.788	0.000	Accepted
GI x ED -> LI	0.098	0.182	0.538	0.653	Rejected
GI x LI -> OP	0.054	0.025	2.160	0.032	Accepted

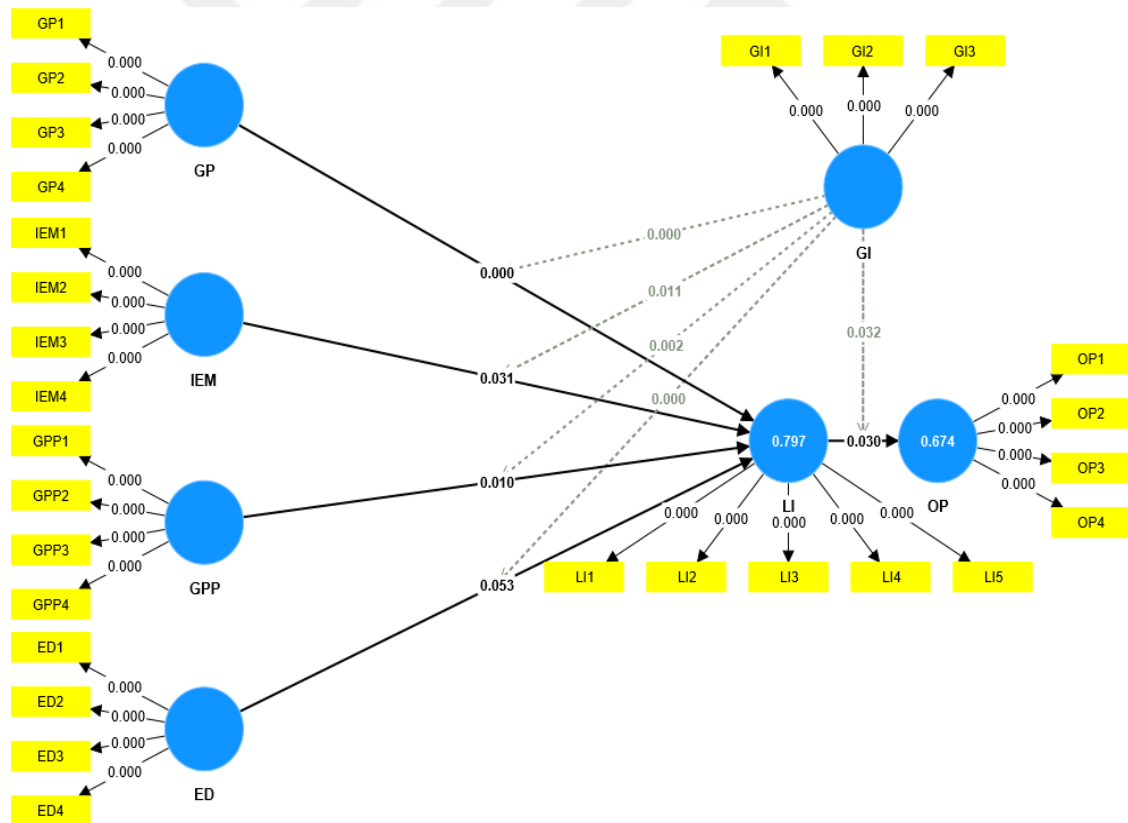


Figure 4.2: PLS-SEM Model

4.9. FINDINGS

The study findings discussed that green purchasing positively impacts both logistic integration and operational performance. Another indicator of internal environmental management also influences the levels of logistic integration and operational performance. However, HP's green product and packaging appeared to have a significant effect only on logistic integration. At the same time, the practice of eco-design did not have a significant impact on operational performance. Moreover, the research evidence also shows that the mediation role of logistic integration influenced the positive impact of green purchasing, internal environmental management, and green product and packaging on operational performance. Additionally, green innovation significantly moderates these relationships, which enhances the positive effects of green practices on operational performance.

5. DISCUSSION AND CONCLUSION

5.1. DISCUSSION

Bootstrapping in PLS-SEM was used to determine the direct relationship between the components. The results show that the H1 was accepted at the 5% significance level. The statistics show that green purchasing has a considerable and favorable influence on logistical integration. Green purchase also known as sustainable purchase refers to the acquisition of goods and services while being mindful of the harm its purchase will cause to the environment. It leads to the better supply chain management as it increases coordination, information exchange and sharing, reengineering, supplier partnering and compliance to regulatory requirements. Knowledge of the project affects communication for the better, minimizes unnecessary spending on extra resources, enhances efficient means of transport, and fosters energy conservation measures. Furthermore, the use of environmental policies creates an environment that leads to adherence to the legal compliances along with the potential impact on supply chain.

Further, at the 5% significance level, the findings support the H2. Thus, the results show that green purchasing has a favorable and significant impact on business outcomes. Therefore, the green purchasing enhances the operational performance in specifically in the areas of costs, legal requirements, brand reputation, aspects of risk such as supply chain disruptions, innovation, and the engagement of the employees, new markets, efficiency, and customers in the organization. Through procuring more efficient, longer lasting, or reusable products needed, firms are cut down electricity charges, disposal expenses and frequent replacement costs. Green purchasing also ensures that organizations adhere to various environmental laws, thus avoiding legal consequences that would make the organization's image degraded. It also encourages creativity or better still it attracts consumers and investors who are environmentally sensitive and at the same time it helps in cutting down the use of non-renewable sources. In this manner, every organization which integrates green purchasing in strategic management can be in a good start for success and sustainability in future.

The findings also support the acceptance of the H3 at the 5% significance level. The findings show that internal environmental management significantly and positively influences logistics integration. Thus, internal environmental management has played a

significant role in enhancing the effectiveness of the logistics integration. Internal environmental management has control and facilitate effective processes, reduce or eliminate discrepancies, adopt better resources, enforce regulations, incorporate use of technology, encourage sustainability, increase operational visibility, save costs, motivate employees, and meet customer and stakeholders' needs and expectations. Meanwhile internal environmental management simplifies the processes of waste reduction and efficient use of resources, it results in lower expenditures, increased transparency, and the creation of sustainability-oriented values. This leads to better performance at every aspect in the network and much better interaction among the logistic levels.

Furthermore, the results validate the H4 at the 5% significance level. The findings reveal that internal environmental management has a favorable and significant impact on operational performance. Therefore, internal environmental management has an important role in the performance of an organization, with a direct influence on supply chain resilience, cost management, legal compliance, operational image, business effectiveness, creativity and innovation, staff motivation and commitment, resource utilization, clients' satisfaction, strategic positioning, procurement and purchasing, overall financial performance, and sustainability. These improvements reduce costs that are not necessary and help to increase the efficiency in the use of resources; they can also spread awareness about sustainability and ensure a stronger supply chain, there will improve the financial performance and sustainability of internal environmental management thus increasing its overall success.

The findings also support accepting of H5 at a 5% significance level. The findings show that environmentally friendly commodities and packaging have a favorable and considerable impact on logistical integration. Therefore, the green products and packaging offers ways to enhance logistic integration through waste reduction, efficient packaging, better compliance, sound relation with supplier, meeting the customer needs and demands encouraging innovation in support of logistic goals, better achievements in sustainable logistics solutions, better data and tracking, reduced carbon foot prints and complexities arising from proliferation of packaging materials, bolted corporate social responsibility and better brand value. Such practices help to reach objectives of reduction of costs, optimizing cooperation with suppliers, customer satisfaction, and better supply chain management.

Furthermore, the data refutes the H6. Thus, the data show that environmentally friendly products and packaging do not affect the organization's efficiency. Thus, the green product and packaging have not significant effects towards enhancing the operational performances thereby having factors such as high initial cost, fluctuating market demands, number chain logistics, short term objectives, inconsistent implementation, a limited number of measures, disadvantageous position, competitors, regulatory and economic factors, consumer awareness, and resistance from insiders as possible reasons. They can also lower the perceived value of such measures and slow down the impact on performance.

Moreover, the H7 was accepted with a significance level of 5%. As a result, the eco-design has a favorable and considerable impact on logistics integration. Thus, the eco-design impacts logistics integration in a positive way due to optimization of packaging and product design, hence cutting down on the cost of transportation, high resource utilization in the supply chain, better coordination of suppliers, and most importantly compliance to the current environmental laws, increased flexibility, better tracking of data, efficiency in the use of resources, better customer satisfaction, innovation, improved lifecycle, and company's reputation. From this aspect, when organizations choose to implement the eco-design principles, there is a possibility that its logistic operations will be improved overall in terms of efficiency, of being cohesiveness, and integrated.

Further, the results indicate that the H8 is rejected. Thus, as a result, the data imply that eco-design does not substantially impact corporate efficiency. Therefore, the eco-design has insignificant impact on operational performance due to reasons such as high Initial costs , volatility in market demand, complex Implementation, focus short term, lack of awareness, limited matrices, low complete measures, high external pressures, regulatory and economic environment, stringent, Internal resistance, significant trade-offs, often perceived between eco and business values and Increment effect. These factors may culminate into situations where by organizations will endeavor to work towards achieving short-term benefit and entirely contempt the extended benefits of eco-design and also disregard the effects of progressive accumulation of little sustainable effect on operational performance.

The findings indicate that the H9 is accepted at 55 level of significance. The results show that logistic integration has a substantial impact on operational

performance. Thus, the finding of the present study shows that the arrangements of logistics integration enhancing operational performance is more possible, actual effects may be considered trivial due to such concerns as high implementation costs, high coupling, domain restrictiveness, externality, and assessment difficulties. Perhaps by implementing the ideas and researching the effects of the subject factors, extensive patterned and tested approaches may be instrumental in enabling organizations to optimize for effective integrated logistics.

PLS-SEM bootstrapping was used to create a direct relationship between the constructs. Based on the results, the H10 was accepted at the 5% significance level. The data show that logistic integration has a strong mediation effect on green purchasing and operational performance. Therefore, the findings of the present study indicate that logistics integration acts the mediating variable and plays role where green purchasing is positively affecting the operational performance because of the subsequent factors which include coordination, supplier relationships, resources and risk optimization, data visibility and customer satisfaction, and innovation. Data also shows that organizations which adopt integrated logistics in their green purchasing can significantly improve operational performance.

Furthermore, the findings also support the H11 at the 5% significance level. The outcomes show that logistic integration has a strong mediation effect on environmental management and operational performance. Meanwhile, the role of logistics integration is to act as a mediator between internal environmental management and operational performance by improving resource supply, supporting supply chain management, enabling compliance and managing risk, providing data visibility, customer and stakeholder interaction, and innovation, and most importantly competitive advantage. Thus, the organizations that have been able to align logistics operations with internal environmental management programs are better placed to record steady growth as well as improvement in performance.

Additionally, at the 5% level of significance, the findings support the H12. The outcomes show that logistic integration strongly mediates green product and packaging and operational performance. Therefore, the role of the logistics integration as a mediator permits indirect direct relationship between green product and packaging initiatives and operational performance by adding values like supply chain optimization, effective supplier relations, compliance measured, accurate data analysis, customer

satisfaction, spearheading innovation and by supporting long-term concepts and goals. Managing the supply chain in a way that ensures sustainable supply of material through embracing green product and packaging and co-coordinating it with logistics can work wonders and provide sustainable competitive advantages to the concerned organization and the overall performance outcome can be optimized even in a fluctuating business environment.

Further, The H13 was validated at a 5% level of significance. Thus, the outcomes show that logistic integration strongly mediates eco-design and operational performance. Thus, the logistics integration plays an important intermediary role between green eco-design strategies and operational outcomes; in operational resource efficiency, supply chain management, compliance, analytical and visualization tools, customer satisfaction, innovation, and growth plans. The study established that firms that can incorporate logistics with eco-design concepts endure attain sustainable competitive edges and optimize overall performance benefits in a fluid environment.

PLS-SEM bootstrapping was used to determine the moderating impact. The findings support the H14 at the 5% level of significance. Thus, the results show that green innovation substantially moderates the link between green purchasing and operational performance. Thus, the mediating role of green innovation on the green purchasing and operational performance relationship shows that innovation is pivotal in increasing the benefits of sustainability activities. It is a study of how green purchasing strategies can create competitive edge, better operational effectiveness, enhance brand equity, and increase operational sustainability which translates into increased operational performance in terms of various parameters.

Furthermore, the findings supported the H15 at the 5% significance level. Thus, the data suggest that green innovation substantially moderates the link between IEM and operational performance. The moderating role of green innovation shows how powerful innovative practices are in changing sustainability results through the interaction between internal environmental management and operational performance. Through the concept of green innovation in environmental management, it is clear that organizations can secure competitive advantages, achieve operational efficiencies, strengthen stakeholder relations, and generate sustainable value adding for investors and other stakeholders, thus, boosting sustainable growth and competitive performance in the market.

Additionally, the findings support the H16 at the 5% level of significance. The findings show that green innovation considerably moderates the association between environmentally friendly products and packaging and operational performance. In the current study, green innovation provides a moderating effect on the relationship between green products and packaging and organizations' performance. It also contributes to improvement of product value, cutting on expenses, compliance to the law as well as customer loyalty and a way of creating a competitive niche within the market. Investigations can be done by borrowing measures such as the rate of uptake, customers' response, and implementation expense. Working level implications are: promoting green innovation, efficient resource management, and stakeholder management. Thus, it can be concluded that green innovation greatly contributes to the performance increase within the organization by increasing the efficiency and desirability of the green projects.

Further, the results refute the H17. Thus, as a result, the data suggest that green innovation has no moderating effect on the association between eco-design and operational performance. Finally, the results support adopting the H18 at the 5% significance level. The findings show that green innovation substantially moderates the relationship between logistic integrations and operational performance. Innovation plays a significant moderating role on the relationship between logistic integrations and operational performance in the green context. It improves productivity, sets a company aside from competitors, conserves funds, moderate hazards, and fosters a favorable image. This can be done through researching on green technologies for investment, employee training, stakeholder engagement, as well as assessing the relationship between green innovations and logistics performance and operational performance. Hence, integration of green innovation initiatives with logistics initiatives, embracing green truths through investment in sustainable technologies, sustainability consciousness can move operational performance to another level.

5.2. CONCLUSION

This study investigates the impact of green purchases, internal environmental management, green products and packaging, and eco-design on operational performance. It also examines logistic integration as mediating and moderating effects on green innovation. Causal research is used to analyze the

relationship between these variables. The study uses PLS-SEM and various statistical methods to analyze the relationships between variables in the population. Statistical measures like frequencies, percentages, and averages are used to present data, making it useful for preliminary investigations of a geographic region. The study reveals that green purchasing, internal environmental management, green product and packaging, and green product and packaging positively impact logistic integration. Green purchasing enhances supply chain management by increasing coordination, information exchange, and promoting energy conservation. It also improves operational performance by reducing costs, legal requirements, brand reputation, risk, innovation, employee engagement, and market penetration. Internal environmental management improves supply chain resilience, cost management, legal compliance, and financial performance.

Green products and packaging reduce waste, improve compliance, and promote innovation, contributing to cost reduction, supplier cooperation, customer satisfaction, and better supply chain management. However, due to high initial costs, fluctuating market demands, and competition, green products and packaging do not significantly affect operational performance. Eco-design positively impacts logistics integration by optimizing packaging and product design, cutting transportation costs, and improving supply chain efficiency. Aligning logistics operations with internal environmental management programs can lead to steady growth and improved performance. Logistic integration significantly mediates the relationship between green product and packaging initiatives and operational performance, optimizing the supply chain, supplier relations, compliance, customer satisfaction, innovation, and long-term goals. Green innovation also plays a moderating role, improving product value, reducing costs, and fostering customer loyalty.

5.3. IMPLICATIONS

5.3.1. Implications

Based on the results obtained in this research, the following policy recommendations implications for the improvement of GSCM in the manufacturing sector can be deemed pertinent:

5.3.2. Practical Implications:

- Adopting green supply chain practices helps Pakistani manufacturers eliminate waste, conserve energy, and use environmentally friendly materials. This will do much to improve their brand image, thus standing a better chance of attracting customers who are aware of the plight of the environment
- It is possible to eradicate wastage, thus improving the efficient use of resources, hence enabling the companies to gain in the long run. Little expenses on waste disposal and conserved energy can translate to great savings.
- It was also identified that Pakistan has been recently experiencing emerging environmental concerns. Implementing green practices enables the organization's compliance with the local and international standards to access new and larger markets pale of the environment.
- Manufacturers with green practices enjoy competitive advantages because consumers and other stakeholders are pro-environmental. This creates a gateway for affiliation with other global-based companies and market penetration.

5.3.3. Methodological Implications:

- Green supply chain management research should propose methodologies for developing indices in terms of environmental and operational performance results. These may consist of Carbon footprints, energy consumption, waste, and resource generation, recycle ratios, and productivity, among others.
- Logistics integration and green innovation should be considered as separate antecedents affecting green supply chain performance. This entails establishing methods to measure the extent to which operational logistics systems (supply chain management, inventory control, transportation, and supplier integration) and

environmental innovation processes (eco designs and cleaner production processes) factor impact performance.

- Logically, subsequent research endeavors can undertake a system-based approach to analyze the relationship between green supply chain practices, logistics, and innovation. It might offer an understanding of how those ever-present components make their contributions to the achievement of sustainability objectives.

5.3.4. Managerial Implications:

- Pakistani manufacturing managers should enhance their awareness about environmental management with reference to materials, technologies, and practices and make new investments in renewable energy, recyclable materials, and energy-efficient manufacturing equipment. This will decrease long-term costs and achieve environmental performance at the same time.
- This means companies implementing a green supply chain may need to develop special sensitization for their employees. Staff training on sustainability issues and green technology best practices is essential in determining the best ways of disseminating such knowledge.
- Managers must also pay attention to developing better associations with suppliers and logistic providers that adhere to green principles. Good relations with environmental-driven partners are useful for green logistics fit and sustainability initiatives.
- It is therefore important to support green innovation in order to promote research and development of environment-friendly products, packaging, and processes. In this case, it is the responsibility of managers to ensure that the organizations develop cultures that support innovation and creativity since it will propel the organizations to a level of functional specificity so that they can achieve a sustainable competitive advantage.
- Logistics can be synchronized with environmentally sustainable activities; hence, the flow of materials and products through the supply chain is environmentally friendly. This involves enhancing the flow of materials, products, and people to and from supply chain members and within the organization; increasing efficiency in receiving, warehousing, storing, and issuing of goods; and promoting 'green' activities where the firm deals with other supply chain partners.

- Stressing green innovation helps firms create new and improved protocols or services that minimize their effects on the environment. Green innovation could be essential in dealing with the peculiar issues of the Pakistani manufacturing sector, hence bringing fresh technologies and thinking that are more environmentally friendly.

5.4. CONTRIBUTION OF RESEARCH

The study on Green Supply Chain Management (GSCM) and Operational Performance in Pakistani Manufacturing: The Role of Logistic Integration and Green Innovation has some relevant supporting data on the effect of green supply chains on operational performance within a developing country environment. The paper focuses on the application of logistics integration into the concept of GSCM while pointing out how efficient management of logistics systems can enhance the impact of the concept on operational performance. Self-implemented green innovation is also considered an important moderating factor in the context of the GSCM–operational performance relationship, stressing the importance of green product development, environmentally friendly production, and energy-saving technologies. The study produces actionable recommendations for Pakistan-based manufacturing companies interested in practicing sustainable manufacturing by reducing waste and minimizing costs while enhancing their productivity. When implemented, the practices make companies environmentally sustainable, place the company in a competitive advantage vis-à-vis rivals both locally and internationally, and may result in increased customer loyalty and market share. The research results can help policymakers in Pakistan to foster industries to embrace sustainable practices. The study proposes a model for assessing the impact of GSCM with two variables: logistics integration and green innovation. This study can be valuable for future researchers and practitioners interested in further examination of methods to measure and analyze the effect of GSCM on operational performance. The study also contributes to the construction of a model for emerging economies, which will stand as a reference model for researchers and firms in emergent economic settings. The results support the operational revolution in the Pakistani manufacturing industry to promote GSCM as a means for enhanced profitability and operational efficiency, addressing environmental accountability proactively. Therefore, the present study presents managerial and theoretical implications alongside stressing the importance of

both the integration of logistics and green innovation for improving operational performance through GSCM practices.

5.5. LIMITATIONS

These are the limitations of this research. First, the sample includes only manufacturing organizations within the two regions of Pakistan, Punjab and Sindh. This may affect the generalization of the research findings to the organizations operating in different regions or belonging to different industries. Secondly, due to the cross-sectional study design, it is difficult to demonstrate causality between green supply chain management implementations and organizations' operational performance.



REFERENCES

- [1] Aamir, S., & Raheem, F. (2020). The Influence of Green Supply Chain on Environment Performance of Government Organization in Turkey : Mediating Role of Operational Support. 1(2), 63–73.
- [2] Abdullah, R., Mohamad, M. N., & Thurasamy, R. (2019). Towards Sustainable Performance : Promoting Eco-Design in Green Supply Chain Management Practices. 7399, 609–616.
- [3] Africa, I. S. (2017). Green supply chain management in small and medium enterprises : Further empirical thoughts from South Africa. 1–12.
- [4] Ahmad, N., & Saifudin, A. M. (n.d.). Supply Chain Management in Telecommunication Industry : The Mediating Role of Logistics Integration. 648–653.
- [5] Ahmed, A., & History, A. (2022). South Asian Journal of Operations and Logistics Influence of Green Purchasing and Green Packaging on Sustainability and Operational Performance : A Case Study from E-Commerce Industry Influence of Green Purchasing and Green Packaging on Sustainability and. 1(2), 16–29. <https://doi.org/10.57044/SAJOL.2022.1.2.2207>
- [6] Al-awamleh, H. K., Izzat, M., Ahmad, Z., & Saraireh, S. (2022). Uncertain Supply Chain Management The effect of green supply chain on sustainability : Evidence from the pharmaceutical industry. 10, 1261–1270. <https://doi.org/10.5267/j.uscm.2022.8.002>
- [7] Albino, V., Balice, A., Dangelico, R. M., Meccanica, I., & Bari, P. (2009). Environmental Strategies and Green Product Development: an Overview on Sustainability-Driven Companies. 96, 83–96.
- [8] Alghababsheh, M., Abu khader, D. E., Butt, A. S., & Muktadir, M. A. (2022). Business strategy, green supply chain management practices, and financial performance: A

- nuanced empirical examination. *Journal of Cleaner Production*, 380, 134865.
<https://doi.org/https://doi.org/10.1016/j.jclepro.2022.134865>
- [9] Aslinda, N., Seman, A., Zakuan, N., Jusoh, A., Shoki, M., Zameri, M., & Saman, M. (2012). Noor Aslinda Abu Seman 1 , Norhayati Zakuan 1 , Ahmad Jusoh 1 and Mohd Shoki Md Arif 1. 3(1), 1–18. <https://doi.org/10.5121/ijmvsc.2012.3101>
- [10] Authors, F. (2018). Green supply chain management and export performance. <https://doi.org/10.1108/JMTM-03-2018-0079>
- [11] Becker, B. (2023). Green Innovation Strategies , Innovation Success , and Firm Performance — Evidence from a Panel of Spanish Firms.
- [12] Bell, M. M., & Bellon, S. (2018). Generalization without universalization : Towards an agroecology theory. *Agroecology and Sustainable Food Systems*, 42(6), 605–611. <https://doi.org/10.1080/21683565.2018.1432003>
- [13] Bersano, G., Fayemi, P.-E., Schoefer, M., & Spreafico, C. (2017). An Eco-Design Methodology Based on a-LCA and TRIZ BT - Sustainable Design and Manufacturing 2017 (G. Campana, R. J. Howlett, R. Setchi, & B. Cimatti (Eds.); pp. 919–928). Springer International Publishing.
- [14] Bhatti, S. H., Rashid, M., Arslan, A., Tarba, S., & Liu, Y. (2023). Servitized SMEs' performance and the influences of sustainable procurement, packaging, and distribution: The mediating role of eco-innovation. *Technovation*, 127, 102831. <https://doi.org/https://doi.org/10.1016/j.technovation.2023.102831>
- [15] Bibi, R. (2022). The effect of Financial Development on Economic Growth : Evidence from South Asian Developing Countries. 1–17.
- [16] Chan, R. Y. K., He, H., Kai, H., & Wang, W. Y. C. (2012). Industrial Marketing Management Environmental orientation and corporate performance : The mediation mechanism of green supply chain management and moderating effect of competitive intensity. *Industrial Marketing Management*, 41(4), 621–630. <https://doi.org/10.1016/j.indmarman.2012.04.009>
- [17] Chiu, J., & Hsieh, C. (2016). The Impact of Restaurants ' Green Supply Chain Practices on Firm Performance. 1–14. <https://doi.org/10.3390/su8010042>

citation (1). (n.d.).

- [18] Claver, E., López, M. D., Molina, J. F., & Tarí, J. J. (2007). Environmental management and firm performance: A case study. *Journal of Environmental Management*, 84(4), 606–619. <https://doi.org/10.1016/j.jenvman.2006.09.012>
- [19] Dangelico, R. M., & Pujari, D. (2010). Mainstreaming Green Product Innovation: Why and How Companies Integrate Environmental Sustainability. *Journal of Business Ethics*, 95(3), 471–486. <https://doi.org/10.1007/s10551-010-0434-0>
- [20] Dasanayake, M. D. M. S. M., & Amarasena, P. T. S. M. (2022). Impact of Green Procurement on Purchasing Performance (Special reference to the Apparel Manufacturing Industry in Sri Lanka). 2, 18–33.
- [21] Díaz, A. E. J. (2018). Internal Green Supply Chain Management Practices Influence on Firm Performance. 2013, 23–29.
- [22] Environmental, T. H. E., Application, M., & Business, O. N. (2021). International Journal of Research in Commerce and Management Studies. 3(03), 104–123.
- [23] Fernando, Y., & Uu, N. C. R. (2017). An empirical analysis of eco-design of electronic products on operational performance: does environmental performance play role as a mediator? *International Journal of Business Innovation and Research*, 14(2), 188–205. <https://doi.org/10.1504/IJBIR.2017.086285>
- [24] Ga, M., Yang, M., Hong, P., & Modi, S. B. (2011). Int . J . Production Economics Impact of lean manufacturing and environmental management on business performance : An empirical study of manufacturing firms. *Intern. Journal of Production Economics*, 129(2), 251–261. <https://doi.org/10.1016/j.ijpe.2010.10.017>
- [25] Gikonyo, P. K. (2022). Influence of Green Packaging on Performance of Building and Construction Manufacturing Firms in Kenya. 12(9), 137–144. <https://doi.org/10.29322/IJSRP.12.09.2022.p12917>
- [26] Gupta, M. C. (2016). Environmental management and its impact on the. May. <https://doi.org/10.1108/01443579510094071>
- [27] Hafeez, M., Wahab, A. A., Ismail, M., & Muhayiddin, M. (2019). The Effect of Internal Environmental Factors on Operational Excellence of Manufacturing Industry : A Pilot Study Mohd Hafeez Al-Amin Abdul Wahab , Mohammad Ismail and Mohd Nazri. June. <https://doi.org/10.6007/IJARBS/v9-i2/5666>

- [28] Hitt, M. A., Xu, K., & Carnes, C. M. (2016). Resource based theory in operations management research. *Journal of Operations Management*, 41, 77–94. <https://doi.org/10.1016/j.jom.2015.11.002>
- [29] Huong, P. T., Cherian, J., Hien, N. T., Sial, M. S., Samad, S., & Tuan, B. A. (2021). Environmental Management, Green Innovation, and Social–Open Innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, 7(1), 89. <https://doi.org/https://doi.org/10.3390/joitmc7010089>
- [30] Jabbour, C. J. C., Jabbour, A. B. L. de S., Govindan, K., Teixeira, A. A., & Freitas, W. R. de S. (2013). Environmental management and operational performance in automotive companies in Brazil: the role of human resource management and lean manufacturing. *Journal of Cleaner Production*, 47, 129–140. <https://doi.org/https://doi.org/10.1016/j.jclepro.2012.07.010>
- [31] Java, E., & Java, E. (2023). COMPETITIVE ADVANTAGE AS A MEDIATING EFFECT IN THE IMPACT. 24(1), 216–226.
- [32] Jermisittiparsert, K., Namdej, P., & Somjai, S. (2019). Green Supply Chain Practices and Sustainable Performance : Moderating Role of Total Quality Management Practices in Electronic Industry of Thailand. June.
- [33] Khan, M. A., & Alhumoudi, H. A. (2022). Performance of E-Banking and the Mediating Effect of Customer Satisfaction: A Structural Equation Model Approach. *Sustainability (Switzerland)*, 14(12). <https://doi.org/10.3390/su14127224>
- [34] Khan, S. A. R., Jian, C., Yu, Z., Golpîra, H., & Kumar, A. (2019). Impact of Green Practices on Pakistani Manufacturing Firm Performance: A Path Analysis Using Structural Equation Modeling BT - Computational Intelligence and Sustainable Systems: Intelligence and Sustainable Computing (H. Anandakumar, R. Arulmurugan, & C. C. Onn (Eds.); pp. 87–97). Springer International Publishing. https://doi.org/10.1007/978-3-030-02674-5_6
- [35] Klassen, R. D., & McLaughlin, C. P. (1996). The Impact of Environmental Management on Firm Performance. *Management Science*, 42(8), 1199–1214. <https://doi.org/10.1287/mnsc.42.8.1199>
- [36] Landeta-Manzano, B., Arana-Landín, G., RuizdeArbulo, P., & DíazdeBasurto, P.

- (2017). Longitudinal Analysis of the Eco-Design Management Standardization Process in Furniture Companies. *Journal of Industrial Ecology*, 21(5), 1356–1369. <https://doi.org/https://doi.org/10.1111/jiec.12479>
- [37] Lee, C., & Lim, S. (2020). Impact of Environmental Concern on Image of Internal GSCM Practices and Consumer Purchasing Behavior. 7(6), 241–254. <https://doi.org/10.13106/jafeb.2020.vol7.no6.241>
- [38] Lucas, M. T., & Noordewier, T. G. (2016). Environmental management practices and firm financial performance: The moderating effect of industry pollution-related factors. *International Journal of Production Economics*, 175, 24–34. <https://doi.org/https://doi.org/10.1016/j.ijpe.2016.02.003>
- [39] Maccioni, L., Borgianni, Y., & Pigosso, D. C. A. (2019). Can the choice of eco-design principles affect products' success? *Skerlos* 2015, 1–31. <https://doi.org/10.1017/dsj.2019.24>
- [40] Management, S. A., Kalyar, M. N., & Shoukat, A. (2020). Enhancing firms' environmental performance and financial performance through green supply chain management practices and institutional pressures. September. <https://doi.org/10.1108/SAMPJ-02-2019-0047>
- [41] Manajemen, J. (2022). Green Product Innovation , Green Process Innovation , and its Impact on Green Performance of Batik SMEs. 7, 1–8.
- [42] Melnyk, S. A., Sroufe, R. P., & Calantone, R. (2003). Assessing the impact of environmental management systems on corporate and environmental performance. 21, 329–351.
- [43] Micheli, G. J. L., Cagno, E., Mustillo, G., & Trianni, A. (n.d.). Green supply chain management drivers, practices and performance: A comprehensive study on the moderators. *Journal of Cleaner Production*, 121024. <https://doi.org/10.1016/j.jclepro.2020.121024>
- [44] Moraczewski, K., Pawłowska, A., Karasiewicz, T., & Rytlewski, P. (2020). Impact of Accelerated Aging on the Performance Characteristics of “ Green ” Packaging Material of Polylactide. 14(4), 1–10.
- [45] Nguyen, Q. Do, Thi, H., & Nguyen, T. (2020). Do Green Business Initiatives Enhance

Firm Performance ? Evidence from an Emerging Market. 06, 278–291.

- [46] Nugraha, A. T., Fawzi, A. M., & Wahyudi, R. (2022). Jurnal Manajemen Indonesia Eco Design , Internal Environment Management , Just In Time And Operational Performance : Examining Moderating Role Of Trust. 22(3), 396–405. <https://doi.org/10.25124/jmi.v22i3.3673>
- [47] Olusegun, A. H. (2023). Effect of Eco-Design on the Performance of Nigerian Bottling Company. January.
- [48] Performance, E. (2020). A Short Review on Green Supply Chain Management Practices The Impact on Operational and Environmental Performance. 10(2), 5367–5370.
- [49] Prajogo, D., & Olhager, J. (2012). Int . J . Production Economics Supply chain integration and performance : The effects of long-term relationships , information technology and sharing , and logistics integration. 135, 514–522. <https://doi.org/10.1016/j.ijpe.2011.09.001>
- [50] Rahman, M. (2023). Does Green Product Innovation Help or Hinder Firm Performance ? 1(1), 51300.
- [51] Rahmat, A. (2019). Uncertain Supply Chain Management. 7, 553–566. <https://doi.org/10.5267/j.uscm.2018.11.001>
- [52] Shekari, H., & Ghatari, A. R. (2013). Promoting Corporate Image : A Reflection on Green Supply Chain Management Approach. 3(4), 311–324.
- [53] Shuwaikh, F., Benkraiem, R., & Dubocage, E. (2023). No Title. Journal of Innovation Economics & Management, 41(2), 107–149. <https://doi.org/10.3917/jie.pr1.0137>
- [54] Stekelorum, R., Laguir, I., Gupta, S., & Kumar, S. (2021). Green supply chain management practices and third-party logistics providers' performances: A fuzzy-set approach. International Journal of Production Economics, 235, 108093. <https://doi.org/https://doi.org/10.1016/j.ijpe.2021.108093>
- [55] Subharaj, C., Jerin Leno, I., Shivashankara, Vivek, S., Joe Patrick Gnanaraj, S., & Appadurai, M. (2022). Sustainable manufacturing system applying on eco-design products. Materials Today: Proceedings, 68, 1528–1535. <https://doi.org/https://doi.org/10.1016/j.matpr.2022.07.169>

- [56] Tan, C. L., & Zailani, S. (2016). The impact of green supply chain management practices on firm competitiveness The impact of green supply chain management practices on firm competitiveness Cheng Ling Tan Suhaiza Hanim Mohd . Zailani * Sieow Chin Tan Mohd Rizaimy Shaharudin. August. <https://doi.org/10.1504/IJBIR.2016.079507>
- [57] Trivellas, P., Malindretos, G., & Reklitis, P. (2020). Implications of Green Logistics Management on Sustainable Business and Supply Chain Performance : Evidence from a Survey in the Greek Agri-Food Sector.
- [58] Trujillo-Gallego, M., Sarache, W., & Sellitto, M. A. (2021). Identification of practices that facilitate manufacturing companies' environmental collaboration and their influence on sustainable production. *Sustainable Production and Consumption*, 27, 1372–1391. <https://doi.org/https://doi.org/10.1016/j.spc.2021.03.009>
- [59] Uddin, M. (2021). Exploring Environmental Performance and the Competitive Advantage of Manufacturing Firms : A Green Supply Chain Management Perspective. 15(October 2020), 219–239.
- [60] Vernier, M.-F., Arfaoui, N., Challita, S., Lanoie, P., & Plouffe, S. (2022). No Title. *Journal of Innovation Economics & Management*, 39(3), 141–172. <https://doi.org/10.3917/jie.pr1.0117>
- [61] White, G. R. T., Wang, X., & Li, D. (2015). Inter-organisational green packaging design: a case study of influencing factors and constraints in the automotive supply chain. *International Journal of Production Research*, 53(21), 6551–6566. <https://doi.org/10.1080/00207543.2014.975854>
- [62] Wisner, P. S., Epstein, M. J., & Bagozzi, R. P. (2006). Operational Antecedents and Consequences of Environmental Performance. In M. Freedman & B. Jaggi (Eds.), *Environmental Accounting* (Vol. 3, pp. 143–167). Emerald Group Publishing Limited. [https://doi.org/10.1016/S1479-3598\(06\)03005-6](https://doi.org/10.1016/S1479-3598(06)03005-6)
- [63] Wong, C. Y., Wong, C. W. Y., & Boon-itt, S. (2020). Effects of green supply chain integration and green innovation on environmental and cost performance. *International Journal of Production Research*, 58(15), 4589–4609. <https://doi.org/10.1080/00207543.2020.1756510>

- [64] Wungkana, F. A., Siagian, H., Jiwa, Z., & Tarigan, H. (2023). International Journal of Data and Network Science. 7, 1045–1058. <https://doi.org/10.5267/j.ijdns.2023.6.001>
- [65] Xie, X., Huo, J., & Zou, H. (2019). Green process innovation, green product innovation, and corporate financial performance: A content analysis method. Journal of Business Research, 101, 697–706. <https://doi.org/https://doi.org/10.1016/j.jbusres.2019.01.010>
- [66] Yildiz Çankaya, S., & Sezen, B. (2019). Effects of green supply chain management practices on sustainability performance. Journal of Manufacturing Technology Management, 30(1), 98–121. <https://doi.org/10.1108/JMTM-03-2018-0099>
- [67] Yu, Y., Zhang, M., & Huo, B. (2021). The impact of relational capital on green supply chain management and financial performance. Production Planning & Control, 32(10), 861–874. <https://doi.org/10.1080/09537287.2020.1774675>
- [68] Zailani, S., Eltayeb, T., Tan, K., & Vegas, L. (2012). International Journal of Operations & Production Management strategy on environmental performance. May. <https://doi.org/10.1108/01443571211230943>
- [69] Zhu, Q., Sarkis, J., & Lai, K. (2012). Examining the Effects of Green Supply Chain Management Practices and Their Mediations on Performance Improvements Examining the effects of green supply chain management practices and their mediations on performance improvements (Issue March). <https://doi.org/10.1080/00207543.2011.571937>
- [70] Zhuang, W., Luo, X., & Riaz, M. U. (2021). On the Factors Influencing Green Purchase Intention: A Meta-Analysis Approach. Frontiers in Psychology, 12(April), 1–15. <https://doi.org/10.3389/fpsyg.2021.644020>

Appendix

QUESTIONNAIRE

This questionnaire is designed to conduct **research**. Your opinion matters a lot in the completion of the study. Please be honest in completing the questionnaire. Answer all the questions by putting one tick against the option of your choice. The information provided by you will be kept confidential and used for research purpose only.

Demographic Part

- | | | |
|---------------------------|-------------------|--------------------|
| 1. Gender | a) Male | b) Female |
| 2. Age | a) 21 – 30 years | b) 31 to 40 years |
| | C) 41 to 50 years | d) 51 years above |
| 3. Academic Qualification | a) Bachelors | b) Masters |
| | c) MS/MPhil | d) PhD |
| 4. Management Level | a) High Level | b) Middle Level |
| | c) Lower Level | d) Other Employees |

Please tick the option by values as given under on the need based priority of the statement.

1=strongly disagree, 2=Disagree, 4= neither agree or disagree, 4= agree and 5= strongly agree

	1	2	3	4	5
	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
i. This section includes statements about the Green Purchasing.					
(1) My organization prioritizes purchasing products and materials that are environmentally friendly.					
(2) My organization actively seeks suppliers who demonstrate environmentally sustainable practices.					
(3) We set environmental criteria that suppliers must meet.					
(4) My organization encourages employees to consider environmental factors when making purchasing requests.					
This section includes statements about the Internal Environmental Management	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
(1) My organization has a dedicated environmental management team that implements green initiatives.					
(2) Environmental sustainability goals and targets are integrated into our organization's strategic planning.					
(3) My organization has clear policies and procedures to reduce energy consumption and promote energy efficiency.					
(4) Our organization actively monitors and evaluates its environmental performance through key performance indicators (KPIs) such as waste reduction, water usage, and emissions.					
This section includes statements about the Green Product and Packaging	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
(1) My organization collaborates with suppliers to source sustainable packaging materials that reduce waste and pollution.					
(2) We communicate the environmental benefits of our green products and packaging to customers through labeling and marketing efforts.					
(3) Our organization actively seeks feedback from customers and stakeholders regarding our green products and packaging.					
(4) Our packaging designs are optimized to minimize material usage and waste generation.					

This section includes statements about the Eco-Design	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
(1) Reduce the use of excessive materials used.					
(2) Using recyclable materials.					
(3) My organization seeks to minimize resource consumption (e.g., raw materials and energy) in our product designs.					
(4) Design decisions are influenced by factors such as emissions reduction, waste minimization, and eco-friendly materials.					
This section includes statements about the Operational Performance	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
(1) My organization consistently achieves high levels of product quality and reliability.					
(2) Our manufacturing processes are efficient, resulting in minimal waste and downtime.					
(3) Our organization maintains high levels of customer satisfaction regarding product delivery, lead times, and responsiveness.					
(4) Our workforce is well-trained and motivated to support and implement green supply chain initiatives, enhancing our operational performance.					
This section includes statements about the Logistic Integration	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
(1) Our organization has effectively integrated environmental considerations into our logistics planning and decision-making processes.					
(2) Our logistics operations include measures to minimize fuel consumption, emissions, and carbon footprint.					
(3) Our logistics team is trained and equipped to implement sustainable logistics practices effectively.					
(4) Our organization leverages technology such as GPS tracking, real-time monitoring, and data analytics to enhance the efficiency and sustainability of our logistics operations.					

(5) Our logistics processes are flexible and adaptable, allowing for quick adjustments to meet changing environmental regulations and market demands.					
This section includes statements about the Green Innovation	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
(1) My company has selected environmentally friendly raw materials in product development.					
(2) My company has used energy-efficient raw materials in product development.					
(3) My company has effectively recycled waste and emissions in the production process.					



BIOGRAPHY

My name is Sardar Moazam Ali Khan, and I hail from a prominent and respected family in Bahawalpur, in the Punjab province of Pakistan. My father, Sardar Ghazanfar Ali Khan, has significantly influenced my life, guiding our family with wisdom and integrity. Our family has a long-standing history as landlords and is deeply rooted in the business sector, contributing to the local economy and community development. The legacy of our family's endeavors in agriculture and business has been passed down through generations, shaping our identity and reputation in the region.