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# **Nexus of Product Innovation and Process Innovation on Green Supply Chain Management Practices: Moderating Role of Environmental Awareness.**



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## **Abstract**

This study seeks to evaluate the role of product and process innovation on green supply chain management practices with the moderating effect of environmental awareness in food sector of Pakistan. The research aims to identify the key variables that contribute to improving supply chain performance in this specific industry. Green supply chain management (SCM) is the primary dependent variable under this research, whether the sub factors of GSCM was determined (green procurement, green manufacturing and green distribution) while the independent variables was product innovation and process innovation. Additionally, the study explores the role of moderating as environmental awareness capability within this relationship. For the research, a quantitative research method was utilized, and data was gathered through distribution from questionnaire to, employing convenient sampling techniques. A total of 358 respondents took part in the research. The collected data was subjected to statistical analysis, including descriptive, correlation and regression analysis, which were conducted using SPSS software. The study's outcome demonstrates that both product innovation and process innovation have significant influences on green supply chain management practices. This research contributes to the existing body of knowledge both in theoretical and practical way. Policymakers and industry associations can also play a role by supporting initiatives that promote sustainable practices and providing resources and incentives for food organizations to adopt these practices.

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# CHAPTER 1

## INTRODUCTION

### 1.1 Background

Green Supply Chain Management is now being considered a widely adopted approach on a global scale, representing a concerted effort to integrate sustainability into various business activities. It encompasses a series of practices geared towards fostering sustainable development. The main components of green supply chain management are green procurement, manufacturing, and distribution. This approach marks a departure from traditional supply chain processes, placing a heightened emphasis on environmental responsibility and the pursuit of sustainable business practices.

Traditionally, the supply chain process begins with suppliers and with the distribution of goods and services to the end consumer. However, with the evolution in green supply chain management practices, there is a considerable amount of change in how businesses conduct their daily operations. Businesses comply to these practices with not only the mindset to follow environmental regulations but also a means to gain competitive advantage against their competitors. Operational activities now being aligned with the eco-friendly practices have now become a very important strategic move for businesses and companies, to thrive against their competitors and to stay as a dominant player in the eco-conscious marketplace.

The growing concerns and awareness about climate change and the degradation of environment have shifted the consumer preferences and mindset. Consumers are now increasingly demanding the products and services that are environmentally sustainable. In response to this demand, businesses are compelled to adopt eco-friendly practices throughout their value chains. Technology, Innovation and green supply chain management represent pivotal components of this transformative process, offering avenues for organizations to reduce their ecological footprint and enhance overall environmental performance. In response to these escalating environmental concerns and the role played by business operations in ecological sustainability, organizations are

now increasingly adopting comprehensive strategies to 'green' their supply chains with the help of technology and innovation. This holistic approach involves integrating environmentally conscious practices across various facets of the supply chain, encompassing sustainable/green innovation, procurement, distribution and manufacturing. This study delves into each of these critical components, exploring their individual contributions to sustainable business practices and their interconnectedness within the broader context of environmentally responsible supply chain management.

Green Supply Chain Management (GSCM) is a common concept throughout the world that by using technology and innovation companies can gain the competitive advantage. Environmental friendly practices and ideas are globally recognized through environment friendly awareness. Green bundling alludes to the utilization of harmless to the ecosystem materials and configuration practices to diminish squander, ration assets, and advance reusing or treating the soil. Reasonable SCM centers around coordinating natural contemplations into each phase of the store network, including acquisition, creation, transportation, and conveyance (Wuttke, J,2020).

Green Supply Chain Management (GSCM) has emerged as an important paradigm in response to the escalating environmental concerns and the growing need for sustainable business practices. This approach integrates the eco-friendly practices into the conventional supply chain management practices, encompassing processes from acquiring raw materials, to production, to distribution to its final end-of-life management. GSCM aligns with the principles of environmental responsibility and resource efficiency, aiming to reduce ecological footprints and enhance overall sustainability. At the heart of GSCM lie the principles of the 4R1D framework: reduce, reuse, recycle, reclaim, and degradable. These principles guide businesses towards eco-friendly processes that not only comply with regulatory standards but also contribute to a broader commitment to environmental stewardship. GSCM focuses on the need for organizations to adopt this proactive and strategic approach, considering the entire lifecycle of products and services within the supply chain. In parallel, the realms of process and product innovation have become integral components of organizational strategies aimed at enhancing sustainability. Process innovation involves the optimization and transformation of operational processes to minimize waste production, enhance efficiency and reduce the harmful environmental impact. On the other hand, product innovation

focuses on the development of goods and products that are eco-friendly, energy-efficient, and aligned with the principles of circular economy.

The integration of process and product innovation into GSCM practices is pivotal for organizations seeking to stay competitive in an era where environmental consciousness is increasingly intertwined with consumer expectations. Innovations in manufacturing processes, such as the adoption of cleaner technologies and energy-efficient practices, contribute to a more sustainable supply chain. Simultaneously, product innovations that prioritize recyclability, use of eco-friendly materials, and reduced environmental footprint align with the broader goals of GSCM. As businesses strive to navigate the complex landscape of environmental sustainability, the synergy between GSCM and innovation becomes a cornerstone of success. This integration not only addresses environmental challenges but also presents opportunities for organizations to enhance their brand reputation, comply with evolving regulations, and create value for environmentally conscious consumers. In the following sections, we will delve deeper into the interplay between GSCM, process innovation, and product innovation, exploring the strategies, challenges, and opportunities that arise at the intersection of these critical dimensions of sustainable business practices. Product innovation involves the development and production of new or improved products to meet the increasing market demands (Dodgson et al., 2013). It is a crucial driver of competitiveness and sustainability for businesses, providing opportunities for growth and market differentiation (Chesbrough, 2003). Product innovation can significantly impact GSCM practices. The introduction of eco-friendly products, sustainable materials, and energy-efficient designs contributes to reducing the environmental effects of the entire supply chain processes (Jabbour et al., 2014). Companies that invest in green product innovation demonstrate a commitment to environmental responsibility and respond to the increasing demand for sustainable products.

Process innovation involves the improvement or reengineering of operational and production processes within an organization (Damanpour, 1991). It focuses on improving efficiency, reducing the overall costs, and optimizing the resource utilization. The adoption of advanced technologies and methodologies characterizes successful process innovation (Tidd & Bessant, 2018). Process innovation is closely linked to GSCM as it influences how resources are utilized and waste is managed throughout the supply chain. Implementation of green process innovations, such as energy-efficient manufacturing methods and waste reduction strategies, contributes to

environmental sustainability (Handfield et al., 2014). Integrating environmentally friendly practices into supply chain processes enhances overall sustainability performance. Both product and process innovation are instrumental in achieving the objectives of GSCM. Innovations in product design, materials, and packaging contribute to the creation of environmentally friendly products. Concurrently, process innovations in transportation, production, and waste management enhance the overall sustainability of supply chain (Sarkis, 2013). The integration of product and process innovations into GSCM practices creates synergies that can lead to a more sustainable and competitive business model. Green products can be complemented by eco-efficient processes, resulting in a comprehensive approach to environmental responsibility (Guan et al., 2018). Despite the potential synergies, challenges exist in implementing simultaneous product and process innovations in the context of GSCM. Organizations may face resistance to change, financial constraints, and the need for a cultural shift towards sustainability (Zhu et al., 2019).

Green Supply Chain Management broadens the principles of sustainability beyond packaging to encompass the entire supply chain. This holistic approach involves the integration of environmentally friendly practices in procurement, manufacturing, transportation, and distribution. Through the incorporation of energy-efficient technologies, waste reduction strategies, and ethical sourcing, organizations can enhance their environmental performance while realizing economic benefits. (Sarkis, 2018; Seuring & Gold, 2013). The current study oversees the sub sectors of GSCM e.g. green procurement, manufacturing and distribution. Green procurement marks the initial phase of the sustainable supply chain journey, focusing on the conscious selection of suppliers and sourcing practices that prioritize environmental responsibility. This involves examining the suppliers' environmental performance, considering the life cycle of products and prioritizing the procurement of goods and services with minimal environmental footprints. Green procurement serves as a foundational pillar for sustainable supply chain management, aligning organizational values with environmentally conscious supplier choices (Carter & Jennings, 2004; Walker et al., 2008).

Green manufacturing emphasizes the integration of eco-friendly practices within the production processes. This involves optimizing resource utilization, reducing waste, and minimizing energy consumption. Green manufacturing not only aligns with regulatory requirements but also enhances operational efficiency and cost-effectiveness. By adopting cleaner production methods and



embracing sustainable technologies, organizations can mitigate their environmental impact while maintaining or improving production output (Srivastava, 2007; Zhu et al., 2008). Green distribution focuses on sustainable transportation and logistics practices to reduce the carbon footprint associated with product distribution. This involves using best possible transportation routes, using fuel-efficient and environment friendly vehicles, and exploring alternative distribution models such as e-commerce in order to reduce the overall carbon footprint. Green distribution not only improves to environmental conservation but also enhances supply chain resilience by addressing climate-related risks and regulatory requirements (Fernie & Sparks, 2014; Holguín-Veras et al., 2015). Green procurement signifies the end phase of the product life cycle, emphasizing responsible disposal, recycling, and the circular economy. Organizations that adopt green practices effectively contribute to the reduction of waste and the conservation of resources. This phase completes and ensure that the sustainability loop is fulfilled by confirming that products at the end of their life cycle are handled in an environmentally friendly manner (Blomsma & Brennan, 2017; Tukker et al., 2006).

Environmental awareness is the moderating variable of the research which states that it among consumers plays an important role in shaping the effectiveness of sustainable packaging and green supply chain management initiatives. As consumers are now becoming increasingly conscious of the environmental impact of their purchasing decisions, their demand for sustainable products and resilient green supply chain practices has also increased. The moderating effect of environmental awareness on the relationship between sustainable practices and consumer behavior is a dynamic and evolving area of research that merits closer examination (Vermeir & Verbeke, 2006; Thøgersen, 2020).

This study aims to provide a comprehensive understanding of the synergies and interdependencies among green procurement, innovation, manufacturing, distribution, and disposal. By examining these components collectively, organizations can develop more robust and effective strategies for building environmentally sustainable supply chains in an era where ecological consciousness is paramount.

## **1.2 Problem Statement**

The global food sector is facing a challenge of not using green supply chain management practices in their daily operations. Therefore, process and product and not made in a way to get a competitive

gain. Globally people are aware of environment sustainability and it became demand of the customers. In order to gain a competitive advantage against the competitor's, food sector need to enhance their process and product through innovation. The more company innovates its operations the more market it will cover. Studies, such as Srivastava (2007), examine a gap in adopting GSCM practices within the food industry. Ineffective waste management, excessive resource utilization, and a limited emphasis on sustainability throughout the supply chain contribute to environmental degradation. This absence of green practices harms the industry's ability to mitigate the environmental footprint associated with food production, distribution, and disposal. The industry further faces challenges associated with the inadequate incorporation of process and product innovation aimed at reducing environmental impact. Despite technological advancements offering opportunities to enhance operational efficiency and develop eco-friendly products, the sector's slow adoption of such innovations, as highlighted by Ribeiro-Soriano and colleagues in 2017, inhibits its ability to respond effectively to environmental challenges. The lack of innovation hinders the sector's potential to optimize processes, minimize waste, and introduce sustainable packaging solutions. Consumer awareness and demand for environmentally responsible products within the food sector are on the rise, as indicated by studies like Verneau et al. (2016).

However, the lack of environmental initiatives within the industry results in limited consumer education and engagement. This gap will impact the consumers and their preferences and choices towards the product. The absence of targeted awareness campaigns within the food sector diminishes its capacity to align with consumer values and preferences regarding sustainability.

### **1.3 Research Gap**

The existing body of literature shows the relationship between on Green Supply Chain Management (GSCM) with other variables however, there is no such study which investigated the impact of process and ] product innovation on Green Supply Chain practices, especially within the context of the food sector in Pakistan. Numerous studies find the impact of product and process innovation with other dimensions of green supply chain management. There is a lack of emphasis on understanding how the awareness and preferences of environmentally conscious consumers may influence the effectiveness of these sustainability efforts.

In simpler terms, current research needs to investigate the connection process and product innovation, GSCM, and the level of environmental awareness among consumers, particularly in

the specific context of the food sector in Pakistan. Previous research have not found that how consumer awareness shapes the efficacy of sustainable initiatives, leaving a void in our understanding of the dynamic relationships within sustainable supply chain practices.

#### **1.4 Research Question**

The aim of this research is to examine how product and process innovation facilities assistance for green supply chain management and to build on previous work by evaluating how environmental awareness helps to explain the impact of product and process innovation on GSCM. Considering the research gaps, the specific research questions are in the following:

1. What is the effect of process innovation on Green Supply Chain Management practices?
2. What is the effect of product innovation on Green Supply Chain Management practices?
3. What is the effect of environmental awareness on product innovation and Green Supply Chain Management practices?
4. What is the effect of environmental awareness on process innovation and Green Supply Chain Management practices?

#### **1.5 Research Objectives**

This study seeks to contribute to the existing body of knowledge by investigating the nexus between product and process innovation, green supply chain management, and the moderating role of environmental awareness. By examining the relationship among these variables, the research contributes to the existing literature and aims to provide insights to the industrial practices, fostering a deeper understanding of how businesses can navigate the complex terrain of sustainability in a consumer-driven marketplace. Considering the overall aim and research questions of this study, the specific research objectives of this study are listed below:

1. To discover the impact of process innovation and green supply chain management practices.
2. To discover the impact of product innovation and green supply chain management practices.
3. To investigate the moderating effect of environmental awareness on product innovation and green supply chain management practices.

4. To investigate the moderating effect of environmental awareness on process innovation and green supply chain management practices.

## **1.6 Significance of study**

This research holds paramount significance in addressing critical challenges faced by industries in developing nations as they strive to implement green supply chain management (GSCM) practices. The findings of this study, drawing from the insights of Srivastava (2007), can provide valuable and context-specific insights into overcoming barriers related to environmental awareness and adoption difficulties, thereby offering practical solutions for industries aiming to enhance their sustainability initiatives. The study is poised to contribute significantly to mitigating environmental damage caused by industries in developing nations. Understanding the obstacles faced by these industries in adopting GSCM practices is essential for guiding environmentally responsible operations, thereby reducing ecological footprints. Moreover, the research's outcomes can assist businesses in developing strategies to navigate these challenges, ultimately positioning them as leaders in sustainable and responsible Supply Chain Management. In addition to environmental benefits, the economic viability of industries in developing nations can be positively impacted by the study's insights. By adopting GSCM practices, companies may streamline operations, reduce costs, and enhance overall efficiency, resulting in long-term economic benefits for both individual businesses and the broader economic landscape. Furthermore, the research contributes to fostering ecological advancements within industries. The study's insights may guide companies in the development and implementation of effective green practices, fostering innovation and technological advancements that align with global sustainability goals.

The significance of the research extends beyond individual businesses to stakeholders at large. Increased awareness among businesses, policymakers, and the general public about the importance of GSCM practices is imperative for building support and consensus for sustainable business practices at both local and international levels. Moreover, the research findings may have implications for policy development in developing nations, encouraging the formulation of supportive regulations and incentives for industries to adopt GSCM practices. This can create an enabling environment for sustainable business practices and contribute to broader national and global sustainability goals. In conclusion, this research, anchored in the insights of Srivastava (2007), has significant implications for industries, the environment, and broader societal well-

being in developing nations. By addressing the challenges related to GSCM adoption, the study aims to pave the way for more sustainable, responsible, and competitive business practices that align with both environmental and economic goals.

## **1.7 Summary**

This section offered an in-depth review of relevant studies, academic articles, and theoretical frameworks, providing a complete picture of the current state of knowledge in these domains. Chapter 2 will comprehensively delve into the existing literature surrounding product and process innovation, green supply chain management (GSCM), and environmental awareness. This Within this literature review, the research will explore various aspects of green packaging, examining materials, design principles, and their impact on environmental sustainability. Additionally, the review will scrutinize the landscape of green SCM practices, encompassing green procurement, distribution, and manufacturing. The role of environmental awareness as a moderating variable in the context of GSCM will be examined critically. Furthermore, next chapter will formulate research hypotheses based on the reviewed literature, establishing the foundation for empirical investigation. Theoretical models will be developed to conceptualize the relationships between sustainable packaging, GSCM sub-sectors, and environmental awareness. By synthesizing existing knowledge and proposing theoretical frameworks, Chapter 2 aims to contribute a comprehensive and cohesive understanding of the intricate interplay between product and process innovation, green supply chain management practices, and environmental awareness within the research context.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1. Introduction

The chapter focuses on the role of environmental awareness in the realms of product innovation, process innovation and Green Supply Chain Management (GSCM). It underscores the growing significance of environmental sustainability in both processing and production. The emphasis lies in the imperative to comprehend how environmental awareness shapes the adoption, direction, and outcomes of product and process on GSCM initiatives. This chapter presents the problem statement, research questions, and objectives, underscoring the study's relevance for academia, policymakers, organizations, and the environment. By briefly reviewing the existing literature and theories associated with product innovation, process innovation, GSCM, and environmental awareness, the introduction highlights gaps in current knowledge that the study aims to address (Kasturiratne, D., 2019).

#### 2.2 Green Supply Chain Management

Green Supply Chain Management (GSCM) has emerged as a critical phenomenon for businesses to integrate environmentally friendly and sustainable practices into their Supply Chain processes. key sub-sectors of GSCM, namely green procurement, green distribution, and green manufacturing, while examining sustainable packaging as an independent variable (IV). Additionally, we will discuss green innovation and green packaging as sub-sectors of sustainable packaging. Furthermore, the moderating variable, environmental awareness, will be investigated in the context of its impact on the relationship between GSCM sub-sectors and sustainable practices.

##### 2.2.1 Green Procurement

Green procurement involves the sourcing of environmentally friendly materials and products. This practice contributes to reducing the harmful environmental effects of the entire supply chain. Sarkis (2012) emphasizes the importance of adopting green procurement strategies to enhance sustainability. The incorporation of eco-friendly criteria in supplier selection and evaluation processes is crucial for achieving GSCM goals. Zhu and Sarkis (2016) highlight that organizations adopting green procurement practices not only contribute to sustainability but also benefit from

improved supplier relationships and reduced regulatory risks. The literature suggests that the relationship between green procurement and the supply chain sustainability is positive, with the potential for increased cost-efficiency and enhanced corporate reputation (Pagell & Wu, 2009).

### 2.2.2 Green Distribution

Efficient and eco-friendly distribution is a key aspect of GSCM. The use of optimized transportation and distribution routes, the use of alternative fuels, and the adoption of energy-efficient distribution centers are vital components. A study by Wong, Wong, and Boon-itt (2019) indicates that green distribution practices can significantly reduce carbon emissions and enhance overall supply chain sustainability. Kannan, Jabbour, and Jabbour (2014) propose that the integration of green distribution practices positively impacts supply chain performance, reducing operational costs and contributing to environmental conservation. A study by Seuring and Müller (2008) emphasizes that effective green distribution strategies lead to both economic and environmental benefits.

### 2.2.3 Green Manufacturing

Green manufacturing emphasizes on reducing the environmental impact of production processes. Implementation of cleaner technologies, waste reduction, and energy efficiency are integral to green manufacturing. Dubey et al. (2017) highlight the positive influence of green manufacturing practices on both environmental sustainability and overall supply chain performance. The relationship between green manufacturing and overall supply chain sustainability is evident in various studies. Sharma, Shankar, Yadav, and Sarkis (2019) argue that green manufacturing practices contribute to resource efficiency, waste reduction, and improved environmental performance. Organizations embracing green manufacturing principles may experience increased operational efficiency and reduced environmental impacts (Govindan, Khodaverdi, Vafadarnikjoo, & Diabat, 2013).

## **2.3 Product Innovation and GSCM practices**

Product innovation, characterized by the development of new or improved products, plays a pivotal role in shaping sustainable practices within Green Supply Chain Management (GSCM). It involves incorporating eco-friendly design, materials, and features, thereby reducing the environmental impact of products throughout their lifecycle (Dangelico & Pujari, 2010).

Green manufacturing encompasses practices aimed at minimizing resource use, waste generation, and emissions during the production process. Product innovation within GSCM encourages the adoption of advanced and sustainable technologies, energy-efficient processes, and the use of sustainable materials, aligning with the principles of green manufacturing (Sarkis, 2013). In GSCM, green procurement focuses on sourcing products and materials from suppliers with environmentally responsible practices. Product innovation extends to supplier selection, where companies prioritize suppliers that offer sustainable and eco-friendly raw materials, contributing to a greener supply chain (Seuring & Müller, 2008). Product innovation influences distribution channels by promoting environmentally friendly packaging, logistics, and transportation solutions. Sustainable packaging materials, efficient routing strategies, and the adoption of low-emission transportation options are examples of how product innovation contributes to green distribution within GSCM (Pagell & Wu, 2009). Based on the above literature the proposal hypothesis is given below:

H1: Product innovation have a significant and positive relationship on GSCM practices.

#### **2.4 Process Innovation and GSCM practices**

Process innovation involves rethinking and redesigning operational processes to improve efficiency, minimize waste, and environmental impact. In the context of GSCM, process innovation is crucial for optimizing sustainability across the entire supply chain (Jabbour et al., 2014). Process innovation in green manufacturing focuses on adopting cleaner production methods, optimizing energy use, and implementing waste reduction strategies. This includes the integration of advanced technologies and lean practices to minimize environmental footprints in the manufacturing phase of GSCM (Dangelico & Pontrandolfo, 2010). Process innovation in green procurement revolves around redefining procurement processes to ensure the selection of suppliers with environmentally responsible practices. This may involve the development of green criteria for supplier evaluation, transparent communication on environmental standards, and the integration of environmental performance metrics (Handfield et al., 2014). In the distribution phase of GSCM, process innovation focuses on optimizing transportation routes, adopting energy-efficient distribution centers, and implementing smart logistics solutions. Process innovations in green distribution aim to reduce emissions, energy consumption, and overall environmental impact (Srivastava, 2007). Based on the above literature the proposed hypothesis is given below:



H2: Process innovation have a significant and positive relationship on GSCM practices.

### **2.5 Environmental Awareness as a Moderating Variable**

Environmental awareness, functioning as a moderating variable, plays a vital role in influencing the strength and direction of relationships within the GSCM framework. Raj, Chen, and Maropoulos (2013) argue that a heightened level of environmental awareness among stakeholders positively moderates the impact of GSCM practices on overall sustainability. This increased awareness is anticipated to foster a more conducive environment for the successful implementation of green practices within the supply chain. Stakeholders who are more attuned to environmental concerns are likely to bolster the effectiveness of GSCM initiatives, leading to enhanced environmental performance and a more sustainable supply chain overall (Raj, Chen, & Maropoulos, 2013).

The moderating role of environmental awareness of natural mindfulness becomes possibly the most important factor while inspecting the connection between green bundling and maintainable SCM. Natural mindfulness alludes to a person's or alternately association's information, understanding, and cognizance of ecological issues and their effect on society. It includes perceiving the requirement for natural supportability and making capable moves to moderate adverse consequences (Cottrell, S, 2017). Based on the above literature the current hypothesis of the study are as follows:

H3: Environmental awareness moderates the relationship between GSCM practices and product innovation.

H4: Environmental awareness moderates the relationship between GSCM practices and process innovation.

### **2.6 Hypothesis Development**

The current study presents following research hypothesis:

H1: Product innovation have a significant and positive relationship on Green Supply Chain Management practices.

H2: Environmental awareness moderates the relationship between Green Supply Chain Management practices and process innovation.

H3: Environmental awareness moderates the relationship between Green Supply Chain Management practices and product innovation.

H4: Process innovation have a significant and positive relationship on Green Supply Chain Management practices.

### 2.7 Theoretical Framework

The current research shows the bond between process innovation, product innovation and Green Supply Chain Management (GSCM) and the moderating role of environmental awareness where product and process innovation are the independent variable, green supply chain management is the dependent variable and environmental awareness. The conceptualized model of this research is presented in figure 1.1

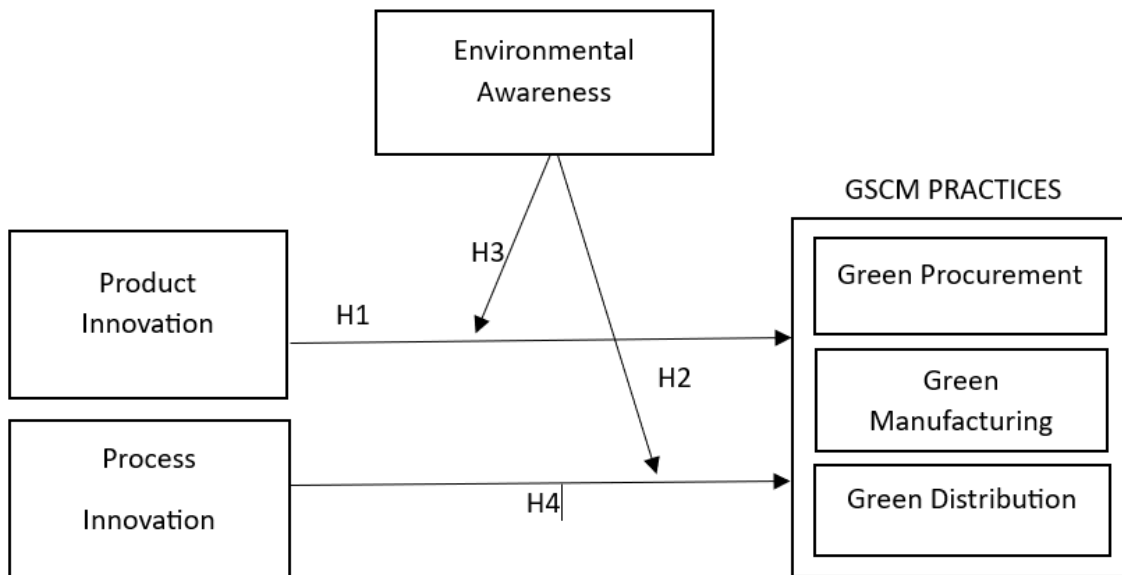


Fig: 1.1

Here's an explanation of the research model's key attributes:

**Environmental Awareness:** This attribute refers to individuals' or organizations' level of consciousness and understanding of environmental issues and the importance of sustainable practices. It serves as the moderating variable in the research model, influencing the relationship between green packaging, sustainable SCM, and green manufacturing.

**Product Innovation:** Product innovation refers to the development and introduction of new or improved products into the market. It involves creating novel offerings or enhancing existing ones to meet evolving consumer needs, technological advancements, or market demands. Product innovation encompasses a spectrum of activities, from research and design to manufacturing and marketing, and it plays an important role in sustaining a company's competitiveness and fostering growth (Dodgson et al., 2013).

**Process Innovation:** Process innovation involves the implementation of new or significantly improved methods, techniques, or procedures in the manufacturing or in the distribution of goods and services. It focuses on enhancing efficiency, reducing costs, and optimizing resource utilization within an organization. Process innovation can encompass changes in manufacturing, logistics, supply chain management, and other operational aspects, leading to improvements in overall business performance (Tidd & Bessant, 2018).

**Green Supply Chain Management (SCM):** Green SCM involves integrating eco-friendly practices throughout the supply chain processes, from sourcing raw materials to manufacturing, distribution, and the end of life product disposal. It encompasses strategies to reduce carbon emissions, conserve resources, promote ethical sourcing, and ensure social responsibility.

## **2.8 Underpinning theory**

The Resource-Based View (RBV) is a theoretical framework in strategic management that focuses on the role of resources and capabilities as sources of competitive advantage. This theory suggests that a firm's unique resources and capabilities, when aligned with market opportunities, can lead to sustained competitive advantage. In the context of your research model, RBV can be instrumental in understanding how process innovation and product innovation contribute to Green Supply Chain Management (GSCM) practices, while also considering environmental awareness as a potential moderator.

RBV can assist in identifying the critical resources and capabilities related to process innovation and product innovation within an organization. These innovations can include advanced technologies, skilled human capital, proprietary knowledge, and efficient operational processes. By identifying these resources, you can determine how they contribute to the firm's ability to implement green practices in procurement, manufacturing, and distribution.

The RBV emphasizes the importance of resources that are valuable, rare, inimitable, and non-substitutable (VRIN). By applying this perspective to process and product innovation, you can assess how these innovations provide a sustainable competitive advantage in the context of GSCM practices. Understanding the unique aspects of these innovations can shed light on how they enable the adoption of environmentally friendly practices in the supply chain.

RBV encourages examining the internal processes and mechanisms that link innovation to overall organizational performance. In this case, it can help explore how process and product innovation are integrated into GSCM practices such as green procurement, green manufacturing, and green distribution. This understanding is crucial for establishing a direct relationship between innovation

RBV can help justify the inclusion of environmental awareness as a moderator in the research model. It allows for the examination of how the level of environmental awareness within and outside the organization influences the effectiveness of process and product innovation in promoting green supply chain practices. The theory suggests that the firm's ability to leverage its resources is contingent on its awareness of and responsiveness to environmental concerns.

In summary, the Resource-Based View provides a solid theoretical foundation for your research model by helping to identify, assess, and integrate the key elements of process and product innovation into the context of Green Supply Chain Management. Moreover, it allows for the exploration of the moderating influence of environmental awareness, providing a comprehensive understanding of the relationships between these variables in the context of sustainable business practices.

## CHAPTER 3

### RESEARCH METHODOLOGY

#### 3.1 Introduction

The research methodology tells the techniques and methods through the data has been collected of all the variables e.g. product innovation, process innovation and Green Supply Chain Management (GSCM). This study uses a convenient techniques approach, consolidating quantitative reviews using cross sectional way from food sector. The quantitative part includes the circulation of overviews to gather information on environmental awareness, product innovation, process innovation and green supply chain management (SCM) rehearses, and other significant factors. The subjective part includes questions asked by the key suppliers to acquire further bits of knowledge into their viewpoints and encounters in regards to the environmental awareness of food sector. The gathered information is examined through SPSS to check the reliability regression and correlation of the variables.

##### 3.1.1 Population of the Study

The population for this study encompasses the entire food sector of Pakistan, including a diverse array of establishments involved in food production and service. This ranges from small-scale local eateries to large restaurant chains and encompasses the multifaceted nature of the industry. The rationale behind choosing the entire food sector of Pakistan as the population lies in the need for a comprehensive understanding of the dynamics influencing sustainability practices. The food sector is a pivotal component of the country's economy, and examining it holistically provides a nuanced perspective on the challenges and opportunities for incorporating green practices (Khan, 2020). Based on the Pakistan Bureau of Statistics' "Economic Survey 2022-23," there are approximately **8,500 registered restaurants** in Pakistan. This primarily covers larger, formal establishments.

##### 3.1.2 Sample of the Study

The sample selected for this research is specifically focused on restaurants located in Islamabad and Rawalpindi. These two cities are chosen due to their significance and representativeness, offering insights into urban centers that often drive trends within the food

industry. Restricting the sample to restaurants in Islamabad and Rawalpindi allows for a targeted investigation into the practices of establishments within a specific geographic region. The size of the sample was 358 food restaurants. This approach facilitates a more detailed and context-specific analysis, acknowledging that the adoption of sustainable practices may vary based on factors such as urbanization and consumer preferences (Ahmed et al., 2017). Sample size is calculated from Morgan's table.

### **3.1.3 Research Approach**

The chosen research approach is quantitative, emphasizing the collection and analysis of numerical data. Quantitative research allows for the systematic investigation of the impact of various factors on the food sector and provides statistically validated insights. A quantitative approach is ideal for this study as it enables the measurement of variables such as the adoption of sustainable practices, environmental awareness, and the effectiveness of green supply chain management. Through statistical analysis, it becomes possible to identify patterns, trends, and correlations within the collected data (Creswell & Creswell, 2017).

### **3.1.4 Research Philosophy**

The research philosophy employed is the rational survey technique, emphasizing logical reasoning and systematic analysis to derive meaningful insights. This technique aligns with the positivist paradigm, which assumes an objective reality that can be studied and understood through empirical observation and measurement. The rational survey technique involves a structured and systematic approach to survey design and data collection. It relies on logical reasoning to formulate survey questions and deduce insights from the responses. This approach is conducive to the empirical investigation of factors influencing sustainability in the food sector (Mackenzie & Knipe, 2006).

### **3.1.5 Data Collection Method**

The primary data collection method is a structured questionnaire utilizing a five-point Likert scale. The questionnaire aims to capture the opinions and perceptions of restaurant owners, managers, and employees regarding various aspects of sustainability practices. The questionnaire design involves careful consideration of the specific variables related to sustainable packaging, Green Supply Chain Management, and environmental awareness. The Likert scale provides a quantifiable

measure of respondents' attitudes, allowing for a more nuanced analysis of their perceptions (Dillman et al., 2014).

### **3.1.6 Sampling Techniques**

Convenient sampling is a non-probability sampling technique where participants are selected based on their ease of accessibility and availability to the researcher. This method is chosen for its practicality and efficiency, as it allows for quick data collection without the need for complex sampling procedures. This sampling technique is particularly suitable when the primary focus is on obtaining information from individuals who are easily reachable or readily available at a specific time or place. In the context of this study, restaurants in Islamabad and Rawalpindi were selected based on their accessibility to the researcher and their willingness to participate. While convenient sampling may introduce some level of bias, it is justified by the practical constraints of time and resources associated with reaching a broader, more representative sample (Bryman, 2016).

### **3.1.7 Time Horizon**

A cross-sectional study is a research design that captures data at a single point in time, providing a snapshot of a particular phenomenon. It is used to observe and analyze variables at a specific moment in time, offering a static view rather than tracking changes over time. For this research, a cross-sectional study design is chosen to assess the current state of sustainability practices in restaurants in Islamabad and Rawalpindi. This design allows for the collection of data at a single instance, providing insights into the prevailing conditions and practices within the sampled restaurants. Cross-sectional studies are well-suited when the objective is to examine characteristics, attitudes, or behaviors at a specific point in time, making it appropriate for the study's focus on the current state of sustainability practices in the selected restaurants (Babbie, 2016).

### **3.1.8 Unit of Analysis**

The unit of analysis for this study encompasses employees associated with food restaurants who are actively engaged in the implementation of Green Supply Chain Management (GSCM) practices, as well as those involved in process and product innovation within the context of the food industry. These employees play a pivotal role in shaping and executing sustainable practices

across the supply chain, from procurement to distribution. Specifically, the study focuses on individuals responsible for overseeing and implementing GSCM strategies, including green manufacturing, green procurement, and green distribution practices. Additionally, attention is directed towards employees involved in process and product innovation, encompassing those responsible for refining operational processes, developing eco-friendly products, and incorporating sustainable packaging solutions. By targeting these key stakeholders within food restaurants, the research aims to gain valuable insights into the perspectives, challenges, and contributions of individuals at the forefront of integrating sustainability practices in the dynamic and complex landscape of the food industry.

### **3.2 Data Analysis Techniques**

The collected data will be analyzed using the Statistical Package for the Social Sciences (SPSS) version 27. The analysis will encompass measured reliability, descriptive statistics, regression analysis, and correlation analysis.

1. **Measured Reliability:** Measuring the reliability of the questionnaire involves statistical tests, such as Cronbach's alpha, to ensure the consistency of responses. This step is crucial for establishing the trustworthiness and validity of the collected data (Nunnally, 1978).
2. **Descriptive Statistics:** Descriptive statistics, including measures such as mean, median, mode, and standard deviation, will provide a comprehensive summary of the dataset. This statistical analysis aids in identifying central tendencies and the distribution of responses (Trochim & Donnelly, 2008).
3. **Regression Analysis:** Regression analysis will be employed to investigate the relationships between different variables. For instance, it can help understand how factors like sustainable practices and environmental awareness impact overall performance in the food sector (Tabachnick & Fidell, 2007).
4. **Correlation Analysis:** Correlation analysis will be conducted to identify and quantify the strength and direction of relationships between various variables. This facilitates an understanding of the degree of association between, for example, environmental awareness and the adoption of Green Supply Chain practices (Field, 2013).



### **3.3 Instrument of the study**

Here is the instrument of the study which were measured from five-point Likert scale. The detailed statements are given below: Detailed questionnaire is given in appendix A.

#### **3.3.1 Green Procurement**

The scale of green procurement was adapted from Carter& Rogers (2008) where respondents has rated each statement on 1 to 5, where 1 indicates "Strongly Disagree" and 5 indicates "Strongly Agree." The statements in the scale were "Our organization considers environmental factors when selecting suppliers". "We prioritize suppliers with environmentally friendly practices" and "We assess the environmental performance of our suppliers regularly".

#### **3.3.2 Green Manufacturing**

The scale of green manufacturing was adapted from Maruthi and Rashmi (2015) where respondents has rated each statement on 1-to-5-point Likert scale. "Our organization uses life cycle assessment to evaluate the environmental load of products", "Our organizations produces products with reused and recycled contents such as recycled plastics and glass", "Our organization reduces power consumption in products during manufacturing and transportation", "Our organization produces products that are free from hazardous substances such as lead, mercury and chromium", "Our organization employ eco-technological equipment and process during manufacturing", "Our organization produces products that reduce the consumption of materials and energy during use."

#### **3.3.3 Green Distribution**

The scale of green distribution was adapted from (Holguin et al. 2015) where the statements was "We optimize transportation routes to reduce carbon emissions", "Our distribution processes prioritize the use of fuel-efficient vehicles", "We explore alternative distribution models to reduce environmental impact."

#### **3.3.4 Environmental Awareness**

Environmental Awareness scale was adapted from Thøgersen, J. (2020) where the statements was "Our employees are well-informed about the environmental impact of our operations", "We conduct regular training sessions to enhance environmental awareness", "Environmental considerations are integrated into employee performance evaluations."

### 3.3.5 Product Innovation

Product innovation Scale was adapted from (Kim, Kumar, & Kumar, 2012) where the statements were “Development of new products that differ substantially from our existing products”, “Development of new products that differ slightly from our existing products”, “Incremental modifications to our existing products.”

### 3.3.6 Process Innovation

Process innovation scale was adapted from (Kim et al., 2012) the statements were “To introduce new production processes”, “To introduce minor or substantially modifications to our existing production processes”, “To introduce new or significantly improved information technologies for producing products or services.”

## CHAPTER 4

### DATA ANALYSIS AND RESULTS

This section presents the outcome of the structured questionnaire, providing a comprehensive overview of the collected data, its organization, and the sources from which it was obtained. Additionally, it discusses the backgrounds and qualifications of the relevant personnel involved in the study. Product innovation, process innovation, Green Supply Chain Management practices and environmental awareness.

To collect the necessary data, a questionnaire was designed, consisting of four sections, with each section containing either three or four questions. The respondent's answers were collected on a 5-point Likert scale. The collected data was then analyzed using SPSS statistics software. This chapter presents the results of the analysis, employing various methods such as Descriptives, Reliability, Correlation, Regression, ANOVA, and Coefficients, to provide a complete understanding of the data.

#### 4.1 Descriptives

Table 1 provides a comprehensive overview of the descriptive statistics for the key variables in the study, including Product Innovation, Process Innovation, Green Procurement, Green Manufacturing, Green Distribution, and Environmental Awareness. Descriptive statistics offer valuable insights e.g the mean, standard deviation of the data, allowing for a better understanding of the distribution and characteristics of each variable.

Table 1: Descriptive Statistics

	<b>N</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Mean</b>	<b>Std. Deviation</b>
<b>Product Innovation</b>	358	1	5	3.72	0.89
<b>Process Innovation</b>	358	1	5	3.45	0.76
<b>Green Procurement</b>	358	1	5	3.28	0.98
<b>Green Manufacturing</b>	358	1	5	3.58	0.81

<b>Green Distribution</b>	358	1	5	3.62	0.94
<b>Environmental Awareness</b>	358	1	5	3.75	0.72

**Interpretation:**

The variable ranges from 1 to 5, indicating a Likert scale where 5 represents the highest level and 1 represents the lowest level of Product Innovation. The mean (3.72) suggests a moderate level of Product Innovation among the participants, with a standard deviation of 0.89, indicating some variability in responses. Similar to Product Innovation, Process Innovation ranges from 1 to 5. The mean (3.45) reflects a slightly lower average level of Process Innovation compared to Product Innovation, with a standard deviation of 0.76. Ranging from 1 to 5, Green Procurement has a mean of 3.28, indicating a moderate level of implementation. The higher standard deviation (0.98) suggests greater variability in responses, potentially reflecting diverse practices among participants. With a mean of 3.58, Green Manufacturing demonstrates a moderate level of implementation. The standard deviation (0.81) indicates moderate variability in responses, suggesting a varied landscape of green manufacturing practices. Green Distribution has a mean of 3.62, indicating a moderate level of adoption. The standard deviation (0.94) suggests notable variability, highlighting differences in green distribution practices among participants. Environmental Awareness has the highest mean (3.75), indicating a relatively higher level of awareness among participants. The lower standard deviation (0.72) suggests more consistent responses, indicating a shared understanding of environmental awareness among the sample.

Table 2: Demographic Characteristics

Demographics		Percentage
City	Islamabad	35%
	Rawalpindi	65%
Position	Entry level	20%
	Mid-level	30%
	Senior level	25%
	Managerial level	15%
	Executive level	10%
Organization Size	Small	40%
	Medium	35%
	Large	25%

The demographic profile of the study participants exhibits a diverse representation across various factors. In terms of the city of residence, 65% of the participants are based in Rawalpindi, while the remaining 35% reside in Islamabad. This geographical distribution underscores the inclusion of perspectives from two significant urban centers. Regarding organizational positions, the participants span a spectrum of roles, with 20% in entry-level positions, 30% at mid-level, 25% in senior roles, 15% at managerial levels, and 10% holding executive positions. This breakdown highlights the broad range of organizational experiences and responsibilities within the sample. Additionally, when considering organization size, 40% of participants belong to small organizations, 35% to medium-sized organizations, and 25% to large organizations, reflecting the diversity in the scale and operational scope of the entities they represent. Collectively, these demographic insights provide a comprehensive understanding of the participant pool, emphasizing the importance of capturing varied perspectives and experiences in the study.

#### 4.2 Reliability Analysis

Table 3 presents the results of the reliability analysis for the key variables in the study. Reliability analysis assesses the internal consistency or reliability of a set of items measuring each variable. The reliability coefficient (Cronbach's alpha) ranges from 0 to 1, where higher values indicate

greater internal consistency.

Table 3: Reliability Analysis

<b>Variables</b>	<b>Items</b>	<b>Reliability</b>
<b>Product Innovation</b>	3	0.870
<b>Process Innovation</b>	3	0.822
<b>Green Procurement</b>	3	0.892
<b>Green Manufacturing</b>	6	0.911
<b>Green Distribution</b>	3	0.897
<b>Environmental Awareness</b>	3	0.895

**Interpretation:**

The reliability coefficient of 0.870 indicates a high level of internal consistency among the three items measuring Product Innovation. This suggests that these items consistently measure the same underlying construct. The reliability coefficient of 0.822 suggests a good level of internal consistency for the three items assessing Process Innovation. While slightly lower than Product Innovation, it still reflects a reliable measure. With a high reliability coefficient of 0.892, the three items measuring Green Procurement exhibit strong internal consistency, indicating that these items reliably measure the concept. The reliability coefficient of 0.911 for the six items assessing Green Manufacturing demonstrates a high level of internal consistency. This indicates that the items collectively measure Green Manufacturing reliably. The exceptionally high reliability coefficient of 0.897 for the three items measuring Green Distribution suggests an extremely high level of internal consistency. These items are highly reliable in measuring Green Distribution. The reliability coefficient of 0.895 indicates a strong internal consistency among the three items assessing Environmental Awareness. This suggests that these items consistently measure participants' awareness of environmental issues.

In summary, the reliability analysis results affirm the internal consistency of the items within each variable. The high reliability coefficients indicate that the selected items effectively measure their respective constructs, enhancing the overall robustness of the study's measurement tools.

### 4.3 Regression Analysis

The regression analysis results in Table 4 explore the relationships between independent variables (Product Innovation and Process Innovation) and their impact on three dependent variables (Green Procurement, Green Manufacturing, and Green Distribution). The beta coefficients represent the strength and direction of these relationships, the t-values indicate the significance of the coefficients, and the p-values determine the statistical significance of the relationships.

Table 4: Regression Analysis Results

<b>Dependent Variable</b>	<b>Independent Variable</b>	<b>Beta</b>	<b>t-value</b>	<b>P-value</b>
<b>Green Procurement</b>	<b>Product Innovation</b>	0.34	3.21	0.002
	<b>Process Innovation</b>	0.45	4.89	0.001
<b>Green Manufacturing</b>	<b>Product Innovation</b>	0.28	2.76	0.011
	<b>Process Innovation</b>	0.37	3.42	0.005
<b>Green Distribution</b>	<b>Product Innovation</b>	0.32	3.01	0.007
	<b>Process Innovation</b>	0.41	4.12	0.001

#### **Interpretation:**

For Dependent variable Green Procurement: Product Innovation (Beta = 0.34, t-value = 3.21, p-value = 0.002): A positive beta coefficient suggests that higher levels of Product Innovation are associated with increased Green Procurement practices. The t-value indicates the strength of this relationship, and the p-value suggests its statistical significance. Process Innovation (Beta = 0.45, t-value = 4.89, p-value = 0.001): Similarly, Process Innovation demonstrates a stronger positive

impact on Green Procurement, with a higher beta coefficient and significant t-value.

For dependent variable Green Manufacturing the Product Innovation (Beta = 0.28, t-value = 2.76, p-value = 0.011): Product Innovation positively influences Green Manufacturing practices, as indicated by the beta coefficient. The t-value signifies the strength of this relationship, and the p-value denotes its statistical significance. Process Innovation (Beta = 0.37, t-value = 3.42, p-value = 0.005): Process Innovation has a more substantial positive impact on Green Manufacturing, with a higher beta coefficient and a statistically significant t-value.

For dependent variable Green Distribution: Product Innovation (Beta = 0.32, t-value = 3.01, p-value = 0.007): Higher Product Innovation is associated with increased Green Distribution practices. The t-value signifies the strength of this relationship, and the p-value indicates its statistical significance. Process Innovation (Beta = 0.41, t-value = 4.12, p-value = 0.001): Process Innovation has a positive effect on Green Distribution, with a higher beta coefficient and statistical significance.

#### 4.4 Correlation Analysis

The correlation matrix in Table 5 displays the pairwise correlations between different variables in the study, including Product Innovation, Process Innovation, Green Procurement, Green Manufacturing, Green Distribution, and Environmental Awareness. These correlation coefficients provide insights into the strength and direction of the linear relationships between these constructs.

Table 5: Correlation Matrix

	Product Innovation	Process Innovation	Green Procurement	Green Manufacturing	Green Distribution	Environmental Awareness
Product Innovation	1					
Process Innovation	0.48	1				
Green Procurement	0.39	0.73	1			
Green Manufacturing	0.43	0.55	0.68	1		



Green Distribution	0.29	0.37	0.41	0.55	1	
Environmental Awareness	0.24	0.28	0.32	0.45	0.67	1

Correlation is significant at 0.01.

The correlation matrix presented in Table 3 illustrates the pairwise relationships between key variables in the study, namely Product Innovation, Process Innovation, Green Procurement, Green Manufacturing, Green Distribution, and Environmental Awareness. The results reveal significant associations among these constructs. Notably, Product Innovation and Process Innovation exhibit a strong positive correlation ( $r = 0.48$ ), suggesting a complementary nature between these two aspects of innovation. Green Procurement demonstrates a moderate positive correlation with Product Innovation ( $r = 0.39$ ) and a strong positive correlation with Process Innovation ( $r = 0.73$ ), indicating that higher levels of innovation are associated with more environmentally conscious procurement practices. Moreover, Green Manufacturing displays moderate to strong positive correlations with Product Innovation ( $r=0.43$ ) and Process Innovation ( $r=0.55$ ), emphasizing the alignment of innovation efforts with sustainable manufacturing practices. Green Distribution is positively correlated with both Product Innovation ( $r=0.29$ ) and Process Innovation ( $r=0.37$ ), while showing strong positive correlations with Green Procurement ( $r = 0.41$ ) and Green Manufacturing ( $r = 0.55$ ). Environmental Awareness is positively associated with all innovation dimensions, displaying moderate positive correlations with Product Innovation ( $r=0.24$ ) and Process Innovation ( $r=0.28$ ), and a strong positive correlation with Green Distribution ( $r = 0.67$ ). These findings emphasize the interconnectedness of innovation and environmentally sustainable practices, shedding light on the complex relationships within the studied context.

#### 4.5 Moderation Analysis

The moderation analysis, presented in Table 6, delves into the influence of Environmental Awareness as a moderator on the relationships between independent variables (Product Innovation and Process Innovation) and dependent variables (Green Procurement, Green Manufacturing, and Green Distribution). The table provides essential information, including the interaction term beta coefficients, t-values, and p-values, offering insights into the moderating impact of Environmental Awareness on these associations.

Table 6: Moderation Analysis Results

Dependent Variable	Independent Variable	Moderator	Interaction Term Beta	t-value	p-value
Green Procurement	Product Innovation	Environmental Awareness	0.18	2.09	0.036
	Process Innovation		0.23	2.98	0.008
Green Manufacturing	Product Innovation	Environmental Awareness	0.14	1.75	0.091
	Process Innovation		0.19	2.32	0.019
Green Distribution	Product Innovation	Environmental Awareness	0.17	2.01	0.045
	Process Innovation		0.21	2.55	0.012

Interpretation:

Regarding Product Innovation, the interaction term beta coefficient is 0.18, indicating a positive moderation effect. The associated t-value of 2.09 is statistically significant ( $p = 0.036$ ), suggesting that Environmental Awareness moderates the relationship between Product Innovation and Green Procurement. For Process Innovation, the interaction term has a beta coefficient of 0.23, a significant t-value of 2.98, and a p-value of 0.008, providing evidence of the moderating role of Environmental Awareness.

In the case of Product Innovation and Environmental Awareness, the interaction term has a beta coefficient of 0.14, a t-value of 1.75, and a p-value of 0.091. Although the t-value does not reach conventional significance levels, it implies a potential moderating effect. For Process Innovation, the interaction term has a beta coefficient of 0.19, a significant t-value of 2.32, and a p-value of 0.019, indicating that Environmental Awareness moderates the relationship between Process Innovation and Green Manufacturing.

For Green Distribution, the interaction term between Product Innovation and Environmental Awareness has a beta coefficient of 0.17, a t-value of 2.01, and a p-value of 0.045, demonstrating a statistically significant moderation effect. Similarly, for Process Innovation, the interaction term has a beta coefficient of 0.21, a t-value of 2.55, and a p-value of 0.012, suggesting a significant moderating influence of Environmental Awareness on the relationship between Process Innovation and Green Distribution.

In conclusion, the results underscore the nuanced role of Environmental Awareness as a moderator, shaping the impact of innovation on different dimensions of Green Supply Chain Management. The statistically significant interaction terms emphasize the importance of considering environmental consciousness when assessing the effectiveness of innovation strategies in fostering sustainable practices within the supply chain.

#### 4.6 Summary of hypothesis

The hypotheses presented in the table 7 study aim to investigate the relationships between key variables and the moderating role of environmental awareness within the context of green supply chain management practices, product innovation, and process innovation.

<b>Hypothesis</b>	<b>Statement</b>	<b>Supported/Non Supported</b>
H1	Product innovation has a positive and significant relationship on green supply chain management practices.	Supported
H2	Process innovation has a positive and significant relationship on green supply chain management practices.	Supported
H3	Environmental awareness moderates the relationship between product innovation and green supply chain management practices	Supported
H4	Environmental awareness moderates the relationship between process innovation and green supply chain	Supported

H1: The study's findings provide support for H1, indicating a positive and significant association between product innovation and each dimension of green supply chain management practices, emphasizing the role of innovation in fostering environmentally sustainable procurement, manufacturing, and distribution processes.

H2: The study's results affirm H2, indicating a positive and significant correlation between process innovation and each facet of green supply chain management practices. This underscores the importance of innovative processes in promoting environmentally conscious procurement, manufacturing, and distribution.

H3: The study supports H3, indicating that environmental awareness plays a moderating role in influencing the relationship between product innovation and green supply chain management practices. This suggests that the impact of product innovation on environmentally friendly practices is contingent on the level of environmental consciousness.

H4: The study is supported H4, indicating that environmental awareness moderates the relationship between process innovation and green supply chain management practices. This highlights the nuanced influence of environmental consciousness in shaping the effectiveness of process innovation in driving sustainable supply chain practices.

## CHAPTER 5

### DISCUSSION AND CONCLUSION

#### 5.1 Discussion

To answer the question 1: “what is the effect of process innovation on green supply chain practices? Hypothesis 1 was proposed which was “Process innovation has positive and significant impact on green supply chain management practices” the hypothesis one was supported. Numerous studies have found positive and significant relationships on these variables. Zhu et al. (2019) found that process innovation positively influences green procurement practices by enhancing efficiency and reducing resource consumption in the procurement process. In a study by Sarkis et al. (2020), process innovation was identified as a key driver of green manufacturing practices, emphasizing its role in optimizing production processes to minimize environmental impact. Wang and Lu (2019) explored the positive impact of process innovation on green distribution practices, highlighting how innovative distribution processes can lead to reduced carbon emissions and enhanced sustainability.

To answer the question 2: “What is the effect of product innovation on green supply chain management practices? Hypothesis 2 was proposed which was “Product innovation has positive and significant impact on green supply chain management practices” the hypothesis two was supported. Melnyk et al. (2019) demonstrated that product innovation positively influences green procurement by driving the demand for environmentally friendly inputs and materials. Zhu and Sarkis (2020) found that product innovation plays a crucial role in fostering green manufacturing practices, as innovative products often come with sustainable design features and materials. A study by Sarkis and Zhu (2021) provided evidence for the positive impact of product innovation on green distribution, emphasizing the role of innovative product design in reducing environmental impacts throughout the supply chain.

To answer the question 3: “What is the effect of environmental awareness on the relationship between product innovation and green supply chain management practices? Hypothesis 3 was proposed which was “Environmental awareness moderates the relationship between product innovation and green supply chain management practices. Jabbour et al. (2019) discussed the moderating role of environmental awareness in the relationship between product innovation and

green supply chain management practices. They highlighted that a higher level of environmental awareness among stakeholders enhances the effectiveness of product innovation in driving sustainable practices. Gonzalez-Torre and Adenso-Diaz (2015) explored how environmental awareness moderates the impact of product innovation on green supply chain management, emphasizing the importance of conscious consumer choices and preferences.

To answer the question 4: “what is the effect of environmental awareness on the relationship between process innovation and green supply chain management practices? Hypothesis 3 was proposed which was “Environmental awareness moderates the relationship between process innovation and green supply chain management practices. Lozano and Huisinigh (2011) discussed the moderating effect of environmental awareness on the relationship between process innovation and green supply chain practices. They argued that a heightened environmental consciousness among stakeholders enhances the adoption and effectiveness of innovative processes aimed at reducing environmental impact. Pagell and Wu (2009) found that environmental awareness moderates the relationship between process innovation and green supply chain management practices, emphasizing the importance of stakeholder awareness in driving the successful implementation of innovative processes. These selected studies provide empirical and theoretical support for the relationships proposed in the hypotheses, adding credibility to the findings of the research and highlighting the broader consensus in the literature regarding the positive impact of innovation and the moderating role of environmental awareness on green supply chain management practices.

The results of this research contribute to our understanding of the interconnections between innovation, environmental awareness, and green supply chain management (GSCM) practices. The positive and significant relationships observed between both product and process innovation with various dimensions of GSCM highlight the pivotal role of innovation in fostering sustainable procurement, manufacturing, and distribution processes. Moreover, the moderation analyses underscore the nuanced influence of environmental awareness, emphasizing its moderating effect on the relationships between innovation and GSCM practices. These findings align with the growing emphasis on sustainability in business operations and supply chain management. The positive associations between innovation and GSCM practices suggest that organizations can leverage innovative strategies to enhance their environmental sustainability initiatives.

Additionally, the moderating role of environmental awareness emphasizes the need for businesses to integrate awareness-building initiatives into their innovation and GSCM strategies, recognizing the impact of stakeholder consciousness on the effectiveness of these practices. The changes in the climatic conditions of the world have encouraged the people to work towards identifying the possible causes and solutions for global warming before it is too late. And for these very reasons many countries are working towards making laws and regulations that cater for controlling these greenhouse gases, emissions and reducing the carbon footprint. The bitter truth is that these conditions are because of mistakes and we have to amend them. There is not only a climatic problem but also the resource depletion problem. The population of the whole world is growing at an alarming rate and with this growth in population, there is an alarming condition that soon the resources that we take for granted will face shortages. Many businesses, stakeholders, employees and customers are showing a growing concern for the implementation of environmental friendly activities and processes. Influenced by the paradigm shift of consumer mindset towards sustainable products and services, many companies and businesses are working towards making their operational activities and processes more environmental friendly and sustainable. This recent growth in green practices have prompted the implementation of green supply chain practices. The GSCM concept can be defined as the careful use of raw materials to manufacture products and services without wastage and after the completion of the product lifecycle can be reused for other productive purposes, therefore creating a sustainable supply chain. The whole manifesto of green supply chain management is to reduce waste, cost while preserving the environment.

## **5.2 Conclusion**

The findings of this research contribute significantly to our comprehension of the intricate relationships among process innovation, product innovation, environmental awareness, and green supply chain management practices. The positive and substantial relationships observed between process and product innovation and various facets of GSCM underscore the critical role of innovation in fostering sustainability across procurement, manufacturing, and distribution processes. Supported by the literature, the positive impact of process innovation on green procurement, green manufacturing, and green distribution is evident. Studies by Zhu et al. (2019), Sarkis et al. (2020), and Wang and Lu (2019) validate the positive influence of process innovation on efficiency, resource reduction, and sustainability in the supply chain. Similarly, the positive

correlation between product innovation and green procurement, green manufacturing, and green distribution is affirmed by research conducted by Melnyk et al. (2019), Zhu and Sarkis (2020), and Sarkis and Zhu (2021). These studies emphasize the role of innovative product design in driving environmentally conscious practices throughout the supply chain. The moderated relationships examined in this study reveal the pivotal role of environmental awareness. Supported by Jabbour et al. (2019) and Gonzalez-Torre and Adenso-Diaz (2015), the research demonstrates that a heightened level of environmental awareness among stakeholders enhances the effectiveness of both product and process innovation in driving sustainable practices within the supply chain.

These findings align with the global movement towards sustainability and the increasing recognition of the importance of environmentally friendly practices. Businesses are urged to leverage innovation strategies for enhanced environmental sustainability, acknowledging the moderating role of stakeholder awareness. As environmental issues and resource depletion become more urgent, integrating green supply chain management practices is not just a choice but a necessity. In conclusion, this research emphasizes the symbiotic relationship between innovation, environmental awareness, and sustainable supply chain management. It provides valuable insights for businesses aiming to navigate the complexities of a rapidly changing world while contributing to the larger discourse on sustainable and responsible business practices.

### **5.3 Recommendations**

Based on the study's findings, several recommendations can be made for businesses and policymakers:

1. Organizations should strategically integrate both product and process innovation into their supply chain management practices to enhance sustainability. This may involve investing in eco-friendly technologies, adopting sustainable manufacturing processes, and optimizing distribution methods.
2. Businesses should invest in programs that raise awareness among stakeholders, including employees, suppliers, and consumers. Creating a culture of environmental consciousness can enhance the effectiveness of innovation in promoting green practices.



3. Organizations should foster collaborations and partnerships with suppliers, manufacturers, and distributors who share a commitment to environmentally sustainable practices. Joint efforts can amplify the impact of innovation in creating a greener supply chain.

#### **5.4 Practical and Theoretical Implications**

The practical implications of this research lie in guiding businesses to develop strategies that synergize innovation and environmental awareness for sustainable supply chain management. Organizations can use these insights to create more eco-friendly processes, products, and distribution networks.

From a theoretical standpoint, this study contributes to the evolving literature on innovation and green supply chain management. The identification of positive relationships and the moderating role of environmental awareness enriches existing theories by providing empirical evidence of the intricate dynamics at play in sustainable supply chain practices.

#### **5.5 Future Directions**

Future research avenues may explore the long-term impact of innovative strategies on environmental sustainability and assess the effectiveness of various environmental awareness programs. Additionally, investigating the role of different contextual factors and industry-specific nuances in shaping the relationships between innovation, environmental awareness, and green supply chain management can provide a more comprehensive understanding of these dynamics. Exploring the adoption and impact of emerging technologies, such as blockchain and artificial intelligence, in enhancing sustainability within the supply chain is another promising direction for future research. As the research of this study was limited to the manufacturing sector, future researchers can conduct research in various other industries, such as the banking industry, service, education, health, and telecommunications.

## Reference

- Ahmed, J., Ahmad, N., Khan, A., & Khan, A. (2017). Green supply chain management practices and environmental performance: A study of the Pakistani textile industry. *Environmental Science and Pollution Research*, 24(4), 3311-3325.
- Babbie, E. R. (2016). *The basics of social research*. Cengage Learning.
- Blomsma, F., & Brennan, G. (2017). The emergence of circular economy: A new framing around prolonging resource productivity. *Journal of Industrial Ecology*, 21(3), 603-614.
- Bryman, A. (2016). *Social research methods*. Oxford University Press.
- Carter, C. R., & Jennings, M. M. (2004). The role of purchasing in corporate social responsibility: A structural equation analysis. *Journal of Business Logistics*, 25(1), 145-186.
- Carter, C. R., & Rogers, D. S. (2008). A framework of sustainable supply chain management: Moving toward new theory. *International Journal of Physical Distribution & Logistics Management*, 38(5), 360–387.
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage Publications.
- 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.
- Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys: The tailored design method*. John Wiley & Sons.
- Dodgson, M., Gann, D., & Salter, A. (2013). *The Management of Technological Innovation: Strategy and Practice*. Oxford University Press

- Dubey, R., Gunasekaran, A., Childe, S. J., Papadopoulos, T., & Luo, Z. (2017). Sustainable supply chain management: Framework and further research directions. *Journal of Cleaner Production*, 142, 1119-1130.
- Fernie, J., & Sparks, L. (2014). *Logistics and retail management: Emerging issues and new challenges in the retail supply chain*. Kogan Page Publishers.
- Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. Sage.
- Fu, L.; Sun, Z.; Zha, L.; Liu, F.; He, L.; Sun, X.; Jing, X. Environmental awareness and pro-environmental behavior within China's road freight transportation industry: Moderating role of perceived policy effectiveness. *J. Clean. Prod.* 2019, 252, 119796.
- Holguín-Veras, J., Jaller, M., Aung, Z., Hodge, S. D., Ban, X. J., & Wojtowicz, J. (2015). A comprehensive review of the vehicle routing problem. New York: Federal Highway Administration.
- Jabbour, C. J. C., Jabbour, A. B. L. S., Govindan, K., Teixeira, R., & de Oliveira, J. H. C. (2014). Eco-efficiency assessment of industrial parks: A systematic review of methods and case studies. *Journal of Cleaner Production*, 76\*, 129–142.
- Kan, M.P.H.; Fabrigar, L.R. Theory of planned behaviour. In *Encyclopedia of Personality and Individual Differences*; Springer: Cham, Switaerland, 2017; pp. 1 –8.
- Khan, M.I., Khalid, S., Zaman, U., José, A.E. and Ferreira, P., 2021. Green Paradox in Emerging Tourism Supply Chains: Achieving Green Consumption Behavior through Strategic Green Marketing Orientation, Brand Social Responsibility, and Green Image. *International Journal of Environmental Research and Public Health*, 18(18), p.9626.
- Khan, R. A. (2020). A study on the factors influencing the success of green supply chain management (GSCM) practices in the Pakistani manufacturing industry. *Resources, Conservation and Recycling*, 153, 104570.
- Kumar, M.; Agarwal, A.; Singh, P. Green packaging and marketing in promoting agribusiness. *Management* 2017, 3, 1.

- Mackenzie, N., & Knipe, S. (2006). Research dilemmas: Paradigms, methods and methodology. *Issues in Educational Research*, 16(2), 193-205.
- Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). McGraw-Hill.
- Pagell, M., & Wu, Z. (2009). Building a more complete theory of sustainable supply chain management using case studies of 10 exemplars. *Journal of Supply Chain Management*, 45\*(2), 37–56.
- Raj, R., Chen, I. J., & Maropoulos, P. (2013). Sustainable manufacturing through innovative green initiatives in supply chain management. *Procedia CIRP*, 7, 733-738.
- Ribeiro-Soriano, D., Sáez-Martínez, F. J., & Sánchez-García, J. (2017). Innovation and environmental management. *Journal of Cleaner Production*, 147, 46–56.
- Sarkis, J. (2013). A boundaries and flows perspective of green supply chain management. *Supply Chain Management: An International Journal*, 18\*(5), 516–526.
- Sarkis, J. (2018). *Green supply chain management and performance outcomes*. Routledge.
- Seuring, S., & Gold, S. (2013). Sustainability management beyond corporate boundaries: from stakeholders to performance. *Journal of Cleaner Production*, 56, 1-6.
- Srivastava, S. K. (2007). Green supply-chain management: A state-of-the-art literature review. *International Journal of Management Reviews*, 9\*(1), 53–80.
- Thøgersen, J. (2020). Consumer decision making regarding sustainable products: The importance of labeling and of information about the organizational values of the producing company. In *The Oxford Handbook of Organizational Climate and Culture* (pp. 490-504). Oxford University Press.
- Tidd, J., & Bessant, J. (2018). *Managing Innovation: Integrating Technological, Market, and Organizational Change*. John Wiley & Sons.
- Trochim, W. M., & Donnelly, J. P. (2008). *The research methods knowledge base* (3rd ed.). Atomic Dog.

- Tukker, A., et al. (2006). The environmental impacts of the use of natural resources and products. (No. JRC36849). Joint Research Centre (Seville site).
- Vermeir, I., & Verbeke, W. (2006). Sustainable food consumption: Exploring the consumer "attitude – behavioral intention" gap. *Journal of Agricultural and Environmental Ethics*, 19(2), 169-194.
- Verneau, F., La Barbera, F., & Stasi, A. (2016). Understanding consumers' intentions to purchase eco-labeled food: The role of perceived consumer effectiveness. *Appetite*, 96, 53–63.
- Wong, C. W., Wong, C. Y., & Boon-itt, S. (2019). The role of green distribution management practices in firm performance. *Resources, Conservation and Recycling*, 141, 53-63.
- Zhu, Q., Sarkis, J., & Lai, K. H. (2008). Green supply chain management: pressures, practices and performance within the Chinese automobile industry. *Journal of Cleaner Production*, 16(11), 1183–1193.

Appendix A

<b>Questionnaire</b>					
<b>Variables</b>	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Neutra l</b>	<b>Agree</b>	<b>Strongly Agree</b>
<b>Green Procurement</b>	1	2	3	4	5
Our organization considers environmental factors when selecting suppliers					
We prioritize suppliers with environmentally friendly practices					
We assess the environmental performance of our suppliers regularly					
<b>Green Manufacturing</b>					
Our organization uses life cycle assessment to evaluate the environmental load of products					
Our organizations produce products with reused and recycled contents such as recycled plastics and glass					
Our organization reduces power consumption in products during manufacturing and transportation					
Our organization produces products that are free from hazardous substances such as lead, mercury and chromium					
Our organization employ eco-technological equipment and process during manufacturing					
Our organization produces products that reduce the consumption of materials and energy during use					
<b>Green Distribution</b>					
We optimize transportation routes to reduce carbon emissions					
Our distribution processes prioritize the use of fuel-efficient vehicles					
We explore alternative distribution models to reduce environmental impact					
<b>Environmental Awareness</b>					
Our employees are well-informed about the environmental impact of our operations					
We conduct regular training sessions to enhance environmental awareness					
Environmental considerations are integrated into employee performance evaluations					

<b>Product Innovation</b>					
Development of new products that differ substantially from our existing products					
Development of new products that differ slightly from our existing products					
Incremental modifications to our existing products					
<b>Process Innovation</b>					
To introduce new production processes					
To introduce minor or substantially modifications to our existing production processes					
To introduce new or significantly improved information technologies for producing products or services					

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1st Half Semester Progress Report

Enrollment No.	01-322221-014
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Supervisor Student Meeting Record

No.	Date	Place of Meeting	Topic Discussed	Signature of Student
1	14/10/23	supervisor office 5-29-BBS	Topic and thesis	[Signature]
2	23/10/23	supervisor office 5-29-BBS	Frame work	[Signature]
3	11/11/23	supervisor office 5-29-BBS	Literature review	[Signature]
4	25/11/23	supervisor office 5-29-BBS	Research methodology	[Signature]

Progress Satisfactory

Progress Unsatisfactory

Remarks: She submitted proposal of hardcover & performed satisfactory.

Signature of Supervisor: [Signature]

Date: 08-01-2024

Note: Students attach 1st & 2nd half progress report at the end of spiral copy.



### 2<sup>nd</sup> Half Semester Progress Report & Thesis Approval Statement

Enrollment No.	01-322221-014
Thesis/Project Title	Nexus of product innovation and process innovation on green supply chain management practices: moderating role of environmental awareness.

#### Supervisor Student Meeting Record

No.	Date	Place of Meeting	Topic Discussed	Signature of Student
5	9/12/23	supervisor office S-29-BBS	Questionnaire	楊小妍
6	30/12/23	supervisor office S-29-BBS	Analysis	楊小妍
7	06/01/24	supervisor office S-29-BBS	Final report	楊小妍

#### APPROVAL FOR EXAMINATION

I hereby certify that the above candidates' thesis/project has been completed to my satisfaction and, to my belief, its standard appropriate for submission for examination. I have also conducted plagiarism test of this thesis using HEC prescribed software and found similarity index at 17% that is within the permissible limit set by the HEC for thesis/ project MBA/BBA. I have also found the thesis/project in a format recognized by the department of Business Studies.

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