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Green Supply Chain Learning And Green Innovation: The Moderating Role Of Market Turbulence (A Survey Of Firms In The Retail Sector In Greater Accra)

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DECLARATION

I hereby declare that this submission is my original work for the Master of Science degree in Procurement and Supply Chain Management and that, to the best of my knowledge, it contains no material previously published by another person or material previously accepted for the award of any other University degree, except where appropriate acknowledgement is made in the text.

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DEDICATION

I dedicate this research work first and foremost to the Almighty Father who upheld me with His right hand and gave men the strength to sail through my entire MSC program in spite of the difficult time I was going through.

To my late father, Kwaku Mensah Duse, who inspired me and encouraged me to go further in my academic pursuit in spite of my ill-health, who believed in me and taught me to believe in myself. Daddy, though you were taken away too soon before I could complete my program, I appreciate your support and wise counsel and dedicate this piece of work to your cherished memory.

Also, to my family, my mother and my three sisters who encouraged and supported me through the journey. I appreciate you all.

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ABSTRACT

Green supply chain learning can lead to green innovation by providing companies with the knowledge and resources they need to develop new, more sustainable solutions. By working together, companies can create a more sustainable supply chain that benefits the environment and the bottom line. This thesis investigates the relationships between green supply chain learning and green innovation, considering the moderating role of market turbulence. The objectives of the study were to examine the moderating role of market turbulence on the relationship between supply chain learning and green innovation. A quantitative methodology was adopted, with survey data collected from 200 retail firms in Ghana. SMART-PLS was used to analyze the data. Structural equation modelling analysis showed green customer learning and significantly influence green innovation. Green supplier learning was also found to negatively impact green innovation. Moreover, market turbulence has a positive moderation effect on the relationship between green supply chain learning and green innovation. The study recommends managers revisit their supplier learning strategies with a critical eye. Instead of solely focusing on enhancing problem-solving capabilities, consider a more holistic approach. Also, Supply chain managers should recognize the immense value of well-informed and engaged customers in driving sustainable innovation efforts. Actively involve customers in the innovation process by seeking their feedback, preferences, and ideas. Moreover, Supply chain managers should acknowledge that market conditions can significantly impact the effectiveness of supplier-driven innovation. In turbulent markets, considering recalibrating innovation strategies is necessary.

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LIST OF ABBREVIATIONS/ACRONYMS

GSCL: Green Supply Chain Learning

GSL: Green Supplier Learning

GCL: Green Customer Learning

MT: Market Turbulence

SEM: Structural Equation Modelling

AVE: Average Variance Extracted

CA: Cronbach's Alpha

CR: Composite Reliability

CFA: Confirmatory Factor Analysis

PLS: Partial Least Squares

HND: Higher National Diploma

SPSS: Statistical Package for the Social Sciences

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The increasing environmental contamination has significantly influenced the business operations of firms (Zhao et al, 2018). Both the industrial policies and stakeholders' pressures push firms to pursue sustainable development, which has brought new concerns and challenges to firms' innovative activities (Du et al., 2018; Lioutas & Charatsari, 2018). Green innovation, which implies that innovations in products or processes lead the companies to higher levels of environmental sustainability, stands out as an important strategic choice (Jiang et al., 2018; Zhao et al., 2018).

The importance of green innovation in enhancing firm performance has been verified by many previous studies (e.g., Chiou, Chan, Lettice, & Chung, 2011; Lin, Tan, & Geng, 2013; Tseng et al., 2013; Zhao et al., 2018). Then, how to proactively carry out green innovation becomes a worth in-depth research. In existing literature, some scattered antecedents of green innovation have been proposed and empirically tested, such as pressures from stakeholders, government regulations, corporate resources, technological capabilities, expected economic and social benefits, and environmental awareness of managers (Cuerva et al., 2014; Hu, Liu, Yu, & Yu, 2016). Green innovation is a complex task, which includes innovation in technologies that cover energy and material saving, pollution abatement, product recycling and reuse, green product development and improvement, or corporate environmental management (Chen et al., 2006). Because green innovation requires more interactions with external stakeholders, firms must learn from their suppliers and customers to obtain information, resources, and knowledge

(Chen & Hung, 2014). Thus, the paradigm of green innovation has shifted from a solo model to a supply chain learning model (Gong et al., 2018).

Supply chain learning refers to activities that a firm that looks both upstream and downstream of its supply chain to manage and monitor the internal and external learning processes. Although the importance of supply chain learning has been recognized (Gong et al., 2018; Willis et al.,2016), our understanding of how and under what conditions it impacts on green innovation is still limited. Thus, two research questions can be extracted. First, do two dimensions of green supply chain learning influence green innovation of the firm? Second, under what conditions do these relationships occur? Because green innovation needs more technical support from internal and external stakeholders, it is more likely to be affected by technological environment (Chan et al., 2016; Chen, 2019). Previous studies have highlighted technology turbulence as an important environmental factor that may affect knowledge sharing, technology transfer, and collaboration effectiveness among supply chain members (Wang et al., 2015). The turbulent technological environment can create ample opportunities for green innovation that may enable firms' sustainable competitiveness. However, the rapidly changing green technology environment may also bring challenges to firms that require them to develop green products and processes via learning from supply chain partners (Lisi et al., 2019).

1.2. Statement of the Problem

In recent years, there has been a growing interest in green supply chain learning (GSCL) and green innovation, as organizations recognize the importance of sustainable practices in their operations. Several studies have been conducted to understand the dynamics and benefits of GSCL in various industries. However, there remains a significant gap in the literature regarding

the moderating role of market turbulence on the relationship between GSCL and green innovation. This dissertation seeks to address these gaps by examining the influence of market turbulence on the link between GSCL and green innovation. Previous studies have explored the impact of green supply chain learning on various dimensions of sustainability, such as environmental performance (Chen et al., 2015; Jabbour et al., 2016), economic benefits (Akhtar et al., 2018) and customer satisfaction and loyalty (Mohd et al. (2021). For instance, research has highlighted the importance of green supply chain learning in reducing carbon emissions, enhancing operational efficiency, and improving customer satisfaction. Other studies have examined the antecedents and outcomes of green supply chain learning, including organizational culture, stakeholder engagement, and supply chain collaboration. (Tung et al., 2019)

Despite the valuable insights generated from previous studies, there is a knowledge gap that needs to be addressed. In terms of knowledge gap, there is a need to explore the role of green innovation and market turbulence in shaping the relationship between green supply chain learning and sustainable development. It is necessary to explore the role of market turbulence in this relationship because firms need to be able to adapt to changing market conditions and anticipate future trends to stay competitive and sustainable. Green supply chain learning and green innovation can help firms to improve their environmental performance and gain a competitive advantage, but their effectiveness may depend on how well firms can respond to market turbulence. For instance, a study by Gao et al. (2015) found that market turbulence negatively affects the relationship between green innovation and firm performance in the Chinese manufacturing industry. The authors argued that firms need to be able to anticipate changes in demand and adapt their green innovation strategies accordingly to overcome the negative effects of market turbulence. Similarly, a study by Wu et al. (2019) found that market

turbulence negatively moderates the relationship between green supply chain management and firm performance in the Taiwanese electronics industry. The authors suggested that firms need to adopt flexible and agile supply chain strategies to cope with market turbulence and achieve sustainable development. Therefore, understanding the role of market turbulence in shaping the relationship between green supply chain learning and green innovation is crucial for firms to effectively implement sustainable practices and stay competitive in a rapidly changing business environment. To address the knowledge gap, the proposed study examines the moderating role of market turbulence on the relationship between green supply chain learning and green innovation.

1.3 Objectives of the Study

This study's primary purpose is to evaluate the moderating effect of market turbulence on the relationship between green supply chain learning and green innovation.

Specifically, the study seeks to achieve the following objectives.

1. To examine the relationship between green supplier learning and green innovation
2. To examine the relationship between green customer learning and green innovation
3. To examine the moderating effect of market turbulence on the relationship between green supplier learning and green innovation
4. To examine the moderating effect of market turbulence on green customer learning and green innovation

1.4 Research Questions

2. What is the relationship between green supplier learning and green innovation?
3. What is the relationship between green customer learning and green innovation?

4. Does market turbulence positively moderate the relationship between green supplier learning and green innovation?
5. Does market turbulence positively moderate the relationship between green customer learning and green innovation?

1.4 Significance of the Study

This study contributes several ways to green supply chain learning and innovation literature. First, this study contributes to green innovation literature by investigating its antecedents from the perspective of supply chain learning. Existing studies have focused on the antecedents or performance consequences of green innovation (Chiou et al., 2011; Cuerva et al., 2014; Delgado-Ceballos et al., 2012; Huang et al., 2016; Lin et al., 2013; Murillo-Luna et al., 2008; Tseng et al., 2013). Although pressures from stakeholders, government regulations, corporate resources, technological capabilities, expected economic and social benefits, and environmental awareness of managers have been considered as driving factors of green innovation, the influence of green supply chain learning is ignored. Therefore, this study supplements previous literature by examining the influence of green supply chain learning on green innovation. This study validates the theoretical model using survey data collected from Ghanaian firms. Thus, this study extends the literature on green supply chain learning and green innovation in China. Because of the unique business culture and severe environmental pollution, empirically examining the influence of green supply chain learning on green innovation in Ghana is important (Feng & Wang, 2016). However, understanding whether and under what conditions green supply chain learning is related to green innovation in Ghana is limited. This research provides a timely and profound insight into whether and under what conditions green supply chain learning can facilitate green innovation in the Ghanaian context.

This research sheds light on the influence of green supplier learning and green customers learning on green products and process innovation. Learning from suppliers and customers can substitute for the insufficient formal institution. Thus, obtaining information and knowledge through green supplier and customer learning may be more trustworthy than gaining information and knowledge from other sources. Examining the influence of green supplier and customer learning on green innovation in Ghana provides insightful managerial implications for managers.

In green innovation, managers should learn from their suppliers and customers to gain green information and knowledge, jointly solving environmental problems and sharing benefits. Through green supplier and customer learning, firms can ensure that each stage of the product lifecycle conforms to environmental regulations and sustainable development. In this case, firms should attempt to seek ways of improving green supply chain learning capabilities to promote green innovation.

1.6 Overview of Methodology

The methodology includes aspects such as research design, research strategy, research technique, population, sample, sampling procedure, method of data collecting, data analysis, reliability and validity, ethical issues, and industry profile. When doing a research study, there are three research designs, descriptive, explanatory and exploratory. Nonetheless, this study employs an explanatory research design. The study also employs a convenience sampling strategy. Despite the researcher's familiarity with various data collection methods, a semi-structured questionnaire was used to obtain data from the selected respondents.

1.7 Scope of the Study

The geographical scope of this study is confined to the country of Ghana, specifically focusing on retail firms operating within the Greater Accra region. The study's findings and insights are centered within the context of this specific geographical area. The choice of Ghana as the country for the study acknowledges the unique socio-economic and business dynamics present in the region, allowing for a detailed examination of sustainable innovation within this specific context. The study is situated within the context of retail firms operating within the Greater Accra region of Ghana. This scope allows for an in-depth exploration of the green supply chain learning, related to sustainable innovation in the retail sector within this specific urban area. The context of Greater Accra region provides a rich environment for studying sustainable innovation, considering factors such as urbanization, consumer preferences, regulatory frameworks, and market trends that influence the dynamics of sustainable innovation in the retail sector.

Conceptually, the study delves into the intricate interplay between green supplier learning, green customer learning, market turbulence, and green innovation outcomes within the chosen geographical and contextual scope. The conceptual boundaries of the study encompass the understanding of how supplier and customer learning contribute to sustainable innovation, and how market turbulence moderates these relationships. The study's conceptual scope extends to uncovering the underlying mechanisms and dynamics that shape the innovation landscape in the context of retail firms operating within the Greater Accra region of Ghana.

1.8 Limitations of the Study

The study's sample size of 200 retail firms within the Greater Accra region might limit the generalizability of the findings to a broader population of retail firms in Ghana or other regions. The results may not fully represent the diverse range of retail contexts, sizes, and business practices that exist beyond the chosen sample. The study employs a convenient sampling technique, which could introduce selection bias. This might result in a non-representative sample that doesn't accurately reflect the entire population of retail firms in the region. The findings could be influenced by the characteristics of the firms that were more accessible or willing to participate. The explanatory approach used in the study might have limitations in providing an in-depth understanding of the underlying dynamics between variables. While quantitative data can show correlations, it might not capture the nuances and complexities of the relationships. Qualitative insights might have provided a more comprehensive understanding. The contextual limitation of focusing solely on the Greater Accra region might affect the external validity of the study's findings. The results might not be fully applicable to retail firms in other regions or countries, especially those with different socio-economic, cultural, and market conditions.

The study is delimited to retail firms operating specifically within the Greater Accra region. This delimitation provides a focused context for the research, enabling a detailed exploration of the sustainable innovation dynamics within this urban area. The study's sample size of 200 retail firms might not capture the entirety of the population, this sample size was chosen due to practical constraints and provides a manageable and representative subset of retail firms within the Greater Accra region. The study adopts a quantitative explanatory approach, focusing on survey data. This delimitation enables the exploration of relationships between variables using

statistical methods. However, it might not capture qualitative insights or the intricate details that qualitative methods can provide.

1.9 Organization of Research Study

The study is organized into five main chapters.

The first chapter outlines the study's background, problem statement, objectives, research questions, significance, the study scope, limitations, and organization of the study. The second chapter offers the study's literature review, consisting of the conceptual review, the theoretical review, the empirical review, and the conceptual framework. The third chapter describes the research methodology, including the research design, approach, population and sampling method, data collection instruments, data processing procedures, validity, reliability, and ethical considerations. Chapter four includes data analysis, presentation, and discussion of the findings. The fifth chapter summarises the findings, a conclusion, recommendations, and proposals for future research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Green supply chain learning and green innovation have gained increasing attention in recent years due to their potential in promoting sustainable development. However, the effectiveness of these practices may depend on how well firms can navigate market turbulence, which refers to the uncertainty, unpredictability, and instability in the business environment. To better understand the moderating role of market turbulence in the relationship between green supply chain learning and green innovation, it is important to conduct a comprehensive review of the existing literature. This chapter provides a detailed review of the conceptual, theoretical, and empirical literature on green supply chain learning, green innovation, market turbulence, and their interrelationships. The conceptual review section provides a comprehensive overview of the key concepts and definitions related to green supply chain learning, green innovation, and market turbulence. The theoretical review section presents an in-depth analysis of the relevant theoretical perspectives that inform the study of green supply chain learning, green innovation, and market turbulence. Specifically, the section draws on stakeholder theory and dynamic capabilities theory to provide insights into how firms can effectively leverage these practices to achieve green innovation in the face of market turbulence. The empirical review section reviews existing studies investigating the relationship between green supply chain learning, green innovation, and market turbulence. The section highlights the findings of these studies, identifies their limitations, and discusses the gaps in the literature that set the stage for the current study. Finally, the conceptual framework section presents a conceptual framework that integrates the key concepts and theories discussed in the preceding sections. The conceptual

framework guides the development of the research questions, hypotheses, and research design for the current study.

2.2 Conceptual Review

2.2.1 Green Supply Chain Learning

Green supply chain learning is acquiring and developing knowledge and skills related to sustainable supply chain practices. It involves identifying and addressing environmental and social issues throughout the supply chain, from raw materials sourcing to end-of-life disposal. Green supply chain learning has become increasingly important in recent years due to the growing demand for sustainable products and processes, the increasing focus on corporate social responsibility and environmental regulations, and the need to maintain competitiveness in a rapidly changing business environment. (Zhu et al.2015). The degree to which firms look up and down their supply chains to manage and monitor learning processes within and outside the firm is known as supply chain learning. Supply chain learning ensures that one's firm, suppliers, and customers actively manage the learning process and supply chain management issues (Flint et al.,2018). This involves suppliers and customers simultaneously in group meetings. Managing learning across multiple firms, suppliers, and customers defines minimal supply chain learning. One of the core strengths of logisticians and supply chain managers is their ability to think in a boundary-spanning way, both functionally and organizationally. This is an extension of that thinking. However, it is important to note that the requirement for joint learning processes as a supply chain management relationship issue suggests that the parties must have mutual trust, be committed to long-term cooperation and be willing to integrate key business processes (Mentzer et al., 2019).

Green supply chain learning is a relatively new concept, and there is still much to learn about its implementation and effectiveness. However, numerous studies have been conducted on the topic, including those by Zhu et al. (2015), Sarkis et al. (2018), Jabbour et al. (2016), Tung et al. (2019), and Zhang et al. (2021). These studies have contributed to the understanding of the key concepts, trends, and issues in green supply chain learning. The trends and issues in green supply chain learning include the increasing adoption of sustainability strategies by firms, the need for supply chain collaboration, the use of technology to facilitate green supply chain learning, and the role of regulation in promoting sustainability. Firms are increasingly recognizing the importance of sustainability in their operations and are adopting green supply chain learning practices to reduce their environmental impact, enhance their reputation, and gain a competitive advantage.

Table 2.1 Definitions of Green Supply Chain Learning

Author	Definitions
Zhu et al. (2015)	The process of acquiring and developing knowledge and skills related to sustainable supply chain practices, including environmental and social responsibility.
Sarkis et al. (2018)	The development of knowledge and skills related to sustainable practices, such as reducing carbon emissions, improving energy efficiency, and promoting social responsibility.
Jabbour et al. (2016)	A collaborative process that involves the engagement of stakeholders to identify and address sustainability issues throughout the supply chain.
Tung et al. (2019)	A dynamic and continuous process of acquiring and applying knowledge related to sustainable supply chain practices and is influenced by internal and external factors.
Zhang et al. (2021)	A strategic initiative that enables firms to gain a competitive advantage and enhance their reputation by adopting sustainable practices throughout the supply chain.

2.2.1.1 Green Supplier Learning

In the contemporary landscape of sustainable business practices, the concept of green supplier learning has gained prominence as organizations seek to integrate environmentally responsible strategies into their supply chain management. Green supplier learning refers to the process through which suppliers acquire knowledge, skills, and awareness of environmentally sustainable practices within the context of their operations and interactions with their supply chain partners (Lisi, Zhu, & Yuan, 2020). This phenomenon is grounded in the recognition that suppliers play a pivotal role in influencing the ecological footprint of organizations, making their understanding and adoption of green practices essential for fostering sustainability in the broader business ecosystem.

Scholars have contributed diverse perspectives to the conceptualization of green supplier learning. Melander (2018) defines green supplier learning as the collaborative process through which suppliers engage in knowledge exchange with their organizational partners to enhance their capabilities in green product innovation. Tsai et al. (2016) extend this definition by emphasizing the evaluation of suppliers from a green environmental perspective, highlighting the importance of assessing not only their products but also their overall commitment to sustainable practices. Sajjad, Eweje, and Tappin (2015) contribute to this discourse by emphasizing the barriers and motivators in sustainable supply chain management, shedding light on the challenges and incentives that shape the learning processes for suppliers. These definitions collectively underscore the multifaceted nature of green supplier learning, emphasizing collaboration, evaluation, and the integration of sustainable practices into supply chain operations.

The importance of green supplier learning to organizations is underscored by its potential to drive positive environmental and economic outcomes. As highlighted by Nezakati et al. (2016), the government's role in green supply chain management reinforces the recognition that environmental sustainability is a shared responsibility. Green supplier learning enables suppliers to align their practices with evolving environmental regulations and standards, reducing the environmental impact of the entire supply chain. Moreover, organizations engaging in green supplier learning can enhance their reputations, responding to the growing consumer demand for environmentally responsible products and practices (Addo, 2017). The collaborative nature of green supplier learning, as seen in Melander's (2018) work, facilitates the co-creation of innovative solutions, further contributing to the overall competitiveness and resilience of the supply chain. Therefore, the integration of green supplier learning is not only a strategic choice but also a necessity for organizations aspiring to thrive in a business environment increasingly shaped by sustainability considerations.

2.2.1.2 Green Customer Learning

Green customer learning is a crucial aspect in the contemporary business landscape, particularly within the context of sustainable development. As organizations increasingly embrace environmental responsibility, understanding how customers acquire knowledge about green practices becomes pivotal. Green customer learning refers to the process through which customers acquire knowledge and awareness of environmentally friendly products, practices, and initiatives within the market (Du et al., 2018). This phenomenon plays a significant role in shaping consumer behavior and influencing market dynamics, as individuals become more informed and conscientious about the ecological impact of their consumption choices.

Several scholars have contributed to the conceptualization of green customer learning. Alamsyah et al. (2020) define green customer learning as the cognitive process through which individuals acquire awareness and understanding of environmentally sustainable practices, particularly in the context of consumer choices. Chitra and Gokilavani (2020) expand this definition by emphasizing the role of knowledge in green banking trends, illustrating how customers, through learning, contribute to the evolution of environmentally conscious financial practices. Another perspective by Lisi, Zhu, and Yuan (2020) underlines the interactive nature of green customer learning within the supply chain context, emphasizing the role of learning in fostering green innovation. These definitions collectively underscore the multifaceted nature of green customer learning, encompassing not only environmental awareness but also its application across diverse sectors.

The significance of green customer learning for organizations is underscored by its direct impact on consumer behavior and, consequently, market dynamics. Informed customers are more likely to make environmentally responsible choices, influencing demand patterns and shaping market trends (Guo et al., 2021). This informed decision-making process not only fosters a market for sustainable products but also encourages organizations to adopt and showcase environmentally friendly practices. Furthermore, as demonstrated by Issock et al. (2020), green customer learning is intricately linked to loyalty and positive word-of-mouth, creating a ripple effect that contributes to brand reputation and customer retention. Therefore, organizations that actively facilitate and leverage green customer learning are not only aligning with environmental values but are also strategically positioning themselves in a competitive market driven by environmentally conscious consumers.

2.2.2 Green Innovation

Green innovation refers to the development and implementation of new technologies, products, and processes that reduce the environmental impact of economic activities. Green innovation is becoming increasingly important as the world faces pressing environmental challenges such as climate change, resource depletion, and pollution. Green innovation has the potential to create new opportunities for businesses, promote sustainable development, and support the transition to a low-carbon economy.

Green innovation is a broad and complex topic that has been studied by many scholars and researchers. Some of the relevant references include Schiederig et al. (2012), Carayannis and Rakhmatullin (2014), Choi and Lee (2016), Jolly et al. (2018), and Huo et al. (2020).The trends and issues in green innovation include the increasing demand for sustainable products and services, the role of government in promoting green innovation, the need for collaboration and partnerships, the role of technology in driving green innovation, and the importance of measuring and communicating the environmental impact of innovation. Firms are under increasing pressure from consumers, investors, and regulators to adopt sustainable practices and reduce their environmental impact. Governments are also playing a key role in promoting green innovation through policies, regulations, and funding programs. Collaboration and partnerships among stakeholders are also becoming more important in driving green innovation, as firms cannot address sustainability challenges alone. Technology, such as renewable energy, energy-efficient buildings, and smart transportation, can also play a critical role in driving green innovation. Finally, measuring and communicating the environmental impact of innovation is important to ensure that firms are creating genuine environmental benefits.

Green innovations can help organizations to reduce their environmental impact and enhance their reputation for sustainability. According to Zhang et al. (2021), green supply chain management practices can improve a firm's reputation and corporate social responsibility performance. Similarly, Huo et al. (2020) argue that green innovation can help organizations to create environmentally sustainable products and services, which can enhance their brand image and improve customer loyalty.

Secondly, green innovations can help organizations to achieve cost savings through improved operational efficiency and reduced waste. Tung et al. (2019) found that green supply chain management practices can lead to cost savings through improved energy efficiency and waste reduction. Similarly, Jabbour et al. (2016) found that environmental management practices can improve operational performance and reduce costs for firms.

2.2.2.1 Product Innovation

Product innovation refers to the development of new or improved products that offer new or enhanced benefits to customers. Product innovation can take many forms, including new product development, product improvements, and product line extensions (Hippel, 2016). The literature on product innovation has identified several determinants of product innovation, including firm size, industry structure, technology intensity, and market competition. The outcomes of product innovation can include increased sales, market share, and profitability, as well as improved customer satisfaction and loyalty (Calantone, 2021). Empirical studies have examined various aspects of product innovation, such as its impact on firm performance, the factors that facilitate or hinder product innovation, and the role of customer involvement in product innovation. For example, research by Damanpour and Aravind (2012) found that firms that engage in product innovation tend to have higher levels of sales growth and profitability

compared to firms that do not innovate. Other studies have found that factors such as R&D investment, collaboration with external partners, and a culture of innovation can facilitate product innovation (Damanpour and Wischnevsky, 2006; Gunday et al., 2011). Additionally, research by von Hippel (2016) has highlighted the importance of customer involvement in product innovation, as customers can provide valuable feedback and ideas for new products.

2.2.2.2 Process Innovation

Process innovation refers to the development of new or improved processes that enhance the efficiency or effectiveness of a firm's operations. Process innovation can involve the adoption of new technologies, the reorganization of production processes, or the introduction of new management practices. The literature on process innovation has identified several determinants of process innovation, including firm size, technology intensity, and industry structure. The outcomes of process innovation can include cost savings, improved quality, and faster delivery times. Empirical studies have examined various aspects of process innovation, such as its impact on firm performance, the factors that facilitate or hinder process innovation, and the role of knowledge management in process innovation. For example, research by Jabbour et al. (2014) found that firms that engage in process innovation tend to have higher levels of operational performance compared to firms that do not innovate. Other studies have found that factors such as employee involvement, knowledge management, and a culture of innovation can facilitate process innovation (Calantone et al., 2010). Additionally, research by Zeng et al. (2018) has highlighted the role of knowledge integration in process innovation, as firms can leverage external knowledge sources to develop new processes.

Table 2.2 Definitions of Green Innovations

Author	Definition
Schiederig et al. (2012)	The development and diffusion of new products, services, and processes that reduce the environmental impact of economic activities.
Carayannis & Rakhmatullin (2014)	The creation of new products, services, or processes that provide environmental benefits while also creating economic value.
Choi & Lee (2016)	The application of scientific, technological, and organizational knowledge to develop solutions to environmental problems.
Jolly et al. (2018)	A multidimensional concept that encompasses technological, social, and institutional innovations aimed at reducing the environmental impact of economic activities.
Huo et al. (2020)	The creation and commercialization of new products, services, or processes that are environmentally sustainable and economically viable.

2.2.3 Market turbulence

Chen et al. (2020), defined market turbulence as "the degree of environmental instability, unpredictability, and uncertainty, which may result from changes in customer needs, competitive dynamics, and technological innovation." This definition emphasizes the importance of environmental uncertainty and the role of customer needs, competitive dynamics, and technological innovation in driving market turbulence. Market turbulence can have significant implications for firms, including their ability to innovate, compete, and achieve financial performance. The literature on market turbulence has identified several trends and issues that have contributed to the increasing importance of market turbulence for organizations. These include global economic instability, technological disruption, changing customer preferences, and increased competition. For example, research by Boso et al. (2018) found that technological turbulence significantly impacts firm performance, while research by

Biswas and Suar (2017) found that market turbulence can lead to increased competition and pressure on firms to innovate.

2.3 Theoretical Review

The theories underpinning the study are the stakeholder theory and dynamic capabilities theory.

2.3.1 Stakeholder Theory

This study utilizes stakeholder theory to explore the motivations for corporations to adopt Green Supply Chain Learning. Stakeholder theory endorses the importance of CSR, which not only requires an organization to fulfil its economic duty towards its shareholders but also recognizes the significance of the ethical or moral obligation of companies to other stakeholder groups (Freeman, 1984). Donaldson and Preston (1995) distinguish stakeholder theory into three types – descriptive theory, normative theory and instrumental stakeholder theory. However, two perspectives (i.e., normative and instrumental dimensions) of stakeholder theory are particularly useful to examine factors that influence companies to integrate GSCL practices in their supply chain operations. Instrumental stakeholder theory identifies the impact of proactive stakeholder management on the economic bottom line of a company (Donaldson and Preston, 1995). On the other hand, normative stakeholder theory postulates that the interests of all the stakeholders are of intrinsic value (Clarkson, 1995; Freeman and Phillips, 2002) and societal expectations merit corporate attention on ethical or moral grounds (Donaldson and Preston, 1995). Stakeholder theory suggests that firms have a responsibility to consider the interests of all their stakeholders, including customers, employees, suppliers, and communities. In the context of green supply chain learning and green innovation, stakeholder theory emphasizes the importance of engaging with stakeholders to identify and address sustainability

issues. For instance, firms can collaborate with suppliers to improve the environmental performance of their products and processes or involve customers in co-creating sustainable solutions. By doing so, firms can build trust and legitimacy with their stakeholders, and enhance their reputation for sustainability.

2.3.2 Dynamic Capability Theory

Dynamic capabilities include hard to imitate firm capabilities to create, deploy, and protect the intangible assets that support long-run business performance (Teece, 2007). Dynamic capability focuses actions taken by the organizations to change their resources in order to adapt to the changing business conditions (Yeowet al., 2017). The unstable environment would push firms from emerging markets to explore new opportunities and develop capabilities to compete with other firms (Cheng and Yang, 2017). The dynamic capabilities theory offers rational insights where the performance implication of capabilities may be subject to the environmental turbulence (Paul Patrick Tallon, 2008; Teece et al., 1997). A firm with greater dynamic capabilities is capable of rapidly responding to changes in turbulent environments, whereas firm with less dynamic capabilities are less able to swiftly respond (Leidner et al., 2011). Firms can regularly attain technical fitness by revising their capacities for turbulent environments through reconfigured resource bases with the help of dynamic capabilities (Tai et al., 2018). In turbulent environment, firms are ready to become more flexible in reconfiguring their resources, processes, and strategies to offer more effective responses (Chen et al., 2017). In turbulent environment the market updates are quicker, faster product/service obsolescence, rivals' moves, and frequently changing customer demand (Chen et al., 2014; Wang et al., 2012). Hence, firm's innovative capability provides the flexibility of responding to rapidly changing markets and customers' demand by exploiting on innovation-driven growth (Yang,

2012). In the context of green supply chain learning and green innovation, dynamic capabilities theory emphasizes the need for firms to develop new skills and capabilities that enable them to create more sustainable products and processes. For instance, firms can invest in employee training and development to improve their knowledge and skills in green supply chain management and green innovation. Additionally, firms can leverage their technological capabilities to develop new sustainable products and processes that meet evolving customer demands and regulatory requirements.

2.4 Empirical Review

Tsai (2015) conducted a study to develop green-supplier evaluation criteria and integrated the decision-making trial and evaluation laboratory method with the analytical network process, forming the decision-making trial and evaluation laboratory-based analytical network process model. The decision-making trial and evaluation laboratory-based analytical network process model was then used to calculate the degree to which the criteria of green suppliers influence one another and the causal relations among the evaluation criteria. Subsequently, the decision-making trial and evaluation laboratory-based analytical network process model was applied to calculate the weights of the criteria and a green-supplier evaluation criteria system was established.

Melander (2018) conducted a study which focuses on external and internal capabilities that firms need when collaborating in green product innovation. The paper builds on data from five large industrial firms in ten case studies, in which these firms collaborate with customers and suppliers to innovate green products to an industrial market. External and internal capabilities are investigated. The study points to the importance of finding a suitable partner. Partners need to have environmental expertise and contribute knowledge or technology that is new to the

firm. Firms need to combine relational capabilities, such as trust, with contractual agreements in collaborative innovations. The findings point to the importance of knowledge management with the partner as well as internally in the firm. The study shows that no partner collaboration operates in isolation but is situated in a network context.

Awan et al. (2020) conducted a study to examine a mediation model in which we explore whether a firm's knowledge acquisition capability and investment in environmental management mediate the impact of buyer-driven knowledge transfer activities on green product innovation and green process innovation. On the basis of an analysis of a sample of 239 manufacturing firms, they found that buyer-driven knowledge activities have a greater positive impact on green product innovation than green process innovation. Investment in environmental management fully mediates the relationship between buyer-driven knowledge transfer activities and green process innovation, and knowledge acquisition capability partially mediates the relationship between buyer-driven knowledge transfer activities and green product innovation. The current study provides evidence that internal competencies and the role of buyers in knowledge transfer are critical for explaining the green product innovation and green process innovation. Their results suggest that buyer involvement pushes firms to develop resource acquisition capability to enhance green product innovation. Their results also highlight the importance of investment in environmental management for overcoming the environmental challenges in the manufacturing firms.

Du et al. (2018) conducted a study to examine the direct and interaction effects of green customer and supplier integration on green innovation performance and the moderating effect of internal integration, using data from 176 Chinese manufacturing firms. The results reveal that green customer integration, green supplier integration, and their interaction are all positively related to green innovation performance. In addition, internal integration moderates

the relationship between green customer integration and green innovation performance but does not moderate the relationship between green supplier integration and green innovation performance. Further analysis indicates that the effects of interaction term on green innovation performance and the

moderating effects of internal integration on the relationship between green supplier integration and green innovation performance are significantly different across different firm sizes, providing useful insights for firms. This study provides novel insights for making environmental policies.

Alamsyah (2020)**,** conducted a study to review the correlation of environmental knowledge, eco-label, and perceived quality of green awareness customers with environmentally friendly products. Research method is based on a survey on 100 customers of a supermarket who are familiar with environmentally friendly products. The analysis technique conducted uses linear regression with smart tools of SPSS for testing the hypotheses of the paper. The research finding demonstrates that environmental knowledge, eco-label, and perceived quality had positive correlations with green awareness customers. Out of all the factors that influence green awareness, eco-label of the customer maintains the most determining impact on green awareness improvement. Research findings emphasize that antecedent of green awareness includes environmental knowledge, eco-label, and perceived quality. The results are useful information for stakeholders since they may use green marketing strategy and government in decision making to the green products.

Lisa et al. (2019) investigated the influence of two dimensions of green supply chain learning (i.e., green supplier and customer learning) on two types of green innovation (i.e., green product and process innovation) and the moderating role of green technology turbulence.

Survey data collected from 249 Chinese firms were used to test research hypotheses. The findings show that both green supplier and customer learning positively influence green products and process innovation. However, green technology turbulence moderates these relationships differently. Specifically, green technology turbulence strengthens the impacts of green customer learning on green product and process innovation, while weakens the impact of green supplier learning on green process innovation. The moderating effect of green technology turbulence on the link between green supplier learning and green product innovation is insignificant.

Table 2.3 LITERATURE REVIEW TABLE FOR STUDIES ON GREEN SUPPLY CHAIN LEARNING AND GREEN INNOVATION

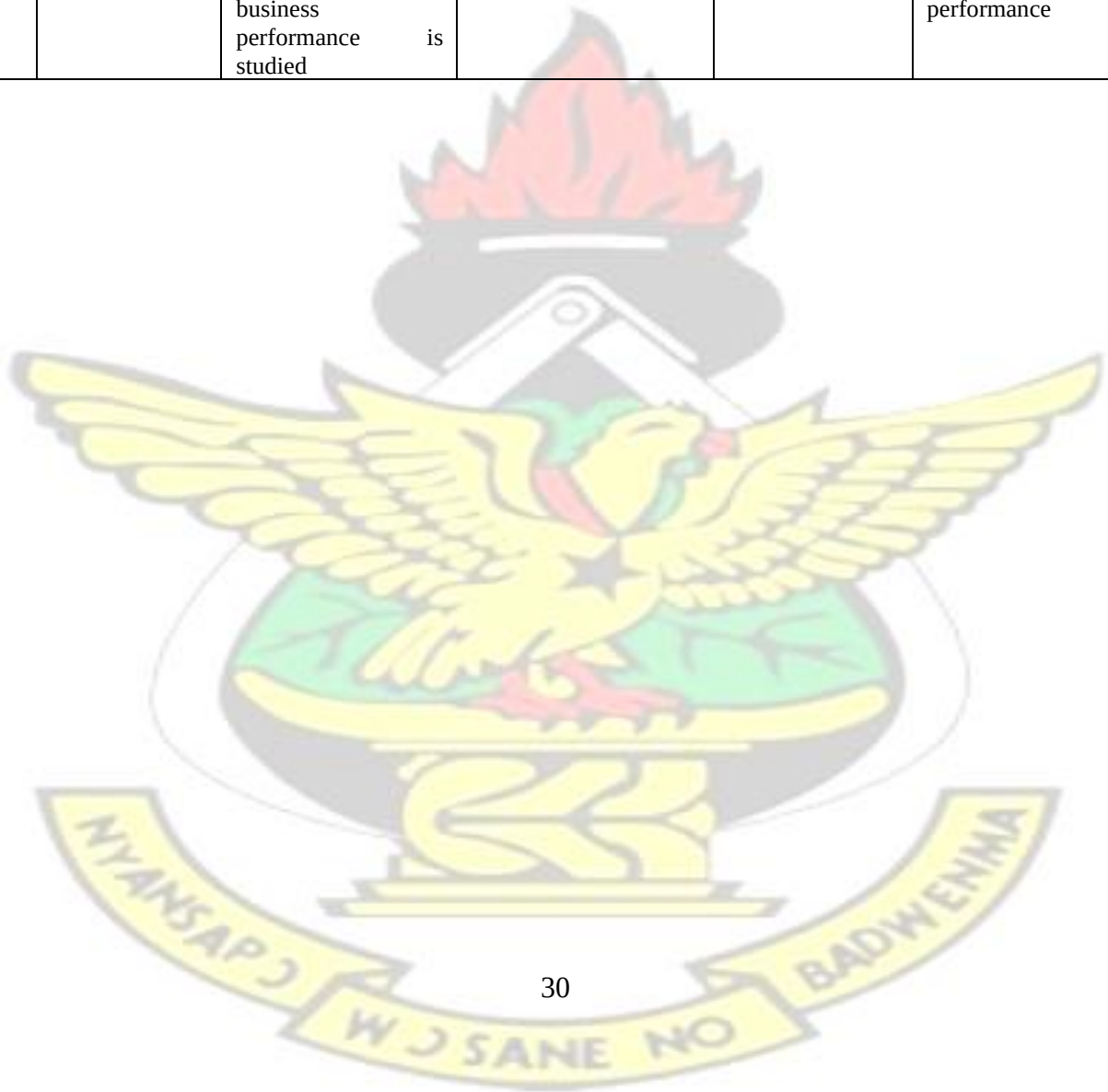
Author /year of publication	*Country*	*Construct's /Concepts used*	*Purpose of the Study/Research Objectives*	*Methodology*	*Underlying theoretical framework*	*Key findings*	*Identified Gap*
Lisi et al. (2019)	China	Green innovation via green supply chain learning: The moderating role of green technology	To study investigates the influence of two dimensions of green supply chain learning (i.e., green supplier and customer learning) on two types of green innovation (i.e., green product and process innovation) and the moderating role of green technology turbulence.	Survey and Hierarchical moderated regression method	Dynamic Capabilities	The findings show that both green supplier and customer learning positively influence green products and process innovation. However, green technology turbulence moderates these relationships differently. Specifically, green technology turbulence strengthens the impacts of green customer learning on green product and process innovation, while weakens the impact of green supplier learning on green process innovation. The moderating effect of green technology turbulence on the link between green suppliers learning and green product innovation is insignificant.	Other factors enhancing or inhibiting green innovation were not yet systematically studied, such as CEO leadership, market orientation, and environmental management practices. Future studies should examine whether and how other factors influence green innovation. This study only examined the moderating role of green technology turbulence. Future studies are encouraged to explore the moderating effects of other environmental and organizational factors. Third, the data used in this study was collected at one point in time and from single respondent. Although the influence of CMV has been proved to be not serious, future research should collect longitudinal and multi-source data to increase our certainty on the findings.
Agyabeng-Mensah et al. (2020)	Ghana	Internal Green	The study aims to examine the direct impact of internal green supply chain	Survey and Partial Least Square Structural equation modelling	Amo theory Stakeholder	The results suggest that the adoption of only IGSCP may negatively affect the market	First, in this study, we conceptualized GSCM as a single unidimensional construct. Previous research (e.g., Wong et

		Supply Chain Practices Green Human Resource Management Supply Chain Environmental Cooperation Firm Performance	practices (IGSCP) on green human resource management. (GHRM), supply chain environmental cooperation (SCEC) and firm performance (FP). The mediating influences of GHRM and SCEC on the influence of IGSCP on FP are also examined. The study further examines the mediating influence of SCEC on the link between GHRM and FP.		Resources based View. Complementarity theory	and financial performances of firms. However, the implementation of GHRM and SCEC may catalyze IGSCP to improve FP.	al., 2017; Yu et al., 2014; Zhu et al., 2013; Zhu and Sarkis, 2004) conceptualizing GSCM as a multidimensional construct, including internal environmental management and external environmental cooperation with customers and suppliers, has produced findings different from ours. Future research could compare the effects of both unidimensional and multidimensional GSCM constructs on different performance
Stekelorum et al., (2021)	France	Green supply chain management practices Third-party logistics providers' performances	To examine the impact of Green Supply Chain Management on organisational performance	Factor analysis and linear regression	Natural resource-based view and Coordination theory	Findings reveal that small and large TPLs can improve their performances by adopting alternative combinations of GSCM practices.	First, they used a cross-sectional dataset, and future research should examine the evolution of GSCM practices on TPL performances with longitudinal studies. Second, we collected data from a single informant from each TPL. Future research might conduct case studies involving TPLs and other relevant stakeholders like shippers to obtain a range of perspectives on GSCM implementation. Third, although

							they took into consideration TPL size, they did not take into account other factors that may influence the GSCM practice-TPL performance relationship examining other factors (e.g., TPL ownership) may provide additional explanations. Finally, future studies might do well to study the influence of GSCM practices on other types of performance, such as social performance.
Fang et al. (2018)	China	Green supply chain management Firm performance	To examine the relationship between Green Supply Chain Management and firm performance	Systematic literature review	Resource based theory and contingency theory	Internal and external GSCM practices are positively related, and they are both positively related to firm performance. Industry type, ISO certification, export orientation and the cultural dimension of uncertainty avoidance all has moderating effect on the practice-performance relationship	Second, our study does not further reflect on the specific relationship between GSCM practices and individual indicators of each performance category. Future research can be directed to discovering it. For instance, a specific GSCM practice may be able to improve the environmental performance in general, but this practice may reduce cost for energy consumption, while somewhat increasing environmental accidents and health hazards.
Darwish et al. (2021)	Bahrain	Green supply chain management practices Environmental performance Green innovation	To examine the impact of green supply chain practices such as green purchase, internal environmental management, and	Survey Structural Equation modelling		Results show that green purchase, internal environmental management and customer environmental cooperation have positive relationships with environmental performance. The outcomes also exposed that green innovation has	This paper addresses only three practices of green supply chain management (i. e internal environmental management, green purchasing and customer environmental corporation). There are a greater number of dimensions of green supply chain management which have a

			customer environmental cooperation on environment performance. The goal also includes examining the moderating role of green innovation among the nexus of green purchase, internal environmental management, customer environmental cooperation, and environmental performance.			played an influential moderating role among the nexus of green purchase, internal environmental management, customer environmental cooperation, and environmental performance in Bahrain.	deep relation with the achievement of superior environmental and these can be addressed by future studies. Moreover, the authors used a single source for the collection of data in support of this study. Hence, the data acquired is limited both in quantity and quality. Thus, future academics may have to utilize multiple reliable sources to collect data, which guarantees the acquisition of data in sufficient quantity and accurate in quality. The study lacks generalizability, and thus future scholars are recommended to make their studies generalizable by acquiring data from more than one industry and more than one country in support of their study.
Zhang et al. (2020)	China	Institutional Pressures, Green Supply Chain Management Practices Business Performance	To analyze which institutional pressures motivate manufacturers to implement GSCM, and which business performance is positively affected by GSCM. The moderating effect of enterprise scale and time of GSCM implementation on	Survey Partial Least Square Structural equation modelling	Institutional theory	The results reveal that (a) institutional pressures have significant positive impact on GSCM practices and business performance, (b) GSCM practices also have significant positive impact on enterprise environment, economy and operational performance, and (c)enterprise scale and practice time both	The study didn't introduce specific institutional pressures, specific GSCM practices and the interaction between various types of business performance. This study doesn't focus on a certain level of automobile suppliers. Later studies can deepen the analysis from a specific level of suppliers to consider the relationship between suppliers and manufacturers

			the relationship between GSCM practices and business performance is studied			positively moderate the relationship between GSCM practices and business performance	



2.5 Conceptual Framework and Hypothesis Development

A conceptual framework illustrates the expected relationship between variables. It defines the relevant objectives for the research process and maps out how they come together to draw coherent conclusions (Bas and Tegan, 2022). The conceptual framework for the study depicts eight (8) hypotheses between the variables (i.e., independent, dependent and moderating variables). The first hypothesis indicates that green supplier learning has a positive and significant effect on green product innovation (H1a). The Second hypothesis indicates that green supplier learning has a positive and significant effect on green process innovation (H1b). The third hypothesis (H2a) argues that green customer learning has a positive and significant effect on green product innovation The fourth hypothesis (H2b) argues that green customer learning has a positive and significant effect on green process innovation. The fifth hypothesis (H3a) argues that market turbulence moderates the relationship between green supplier learning and green product innovation. The sixth hypothesis of the study argues market turbulence moderates the relationship between green supplier learning and green process innovation (H3b). The seventh hypothesis argues that market turbulence moderates the relationship between green customer learning and green product innovation (H4a). The eighth hypothesis argues that market turbulence moderates the relationship between green customer learning and green process innovation (H4b). The diagram below depicts the conceptual framework of the study.

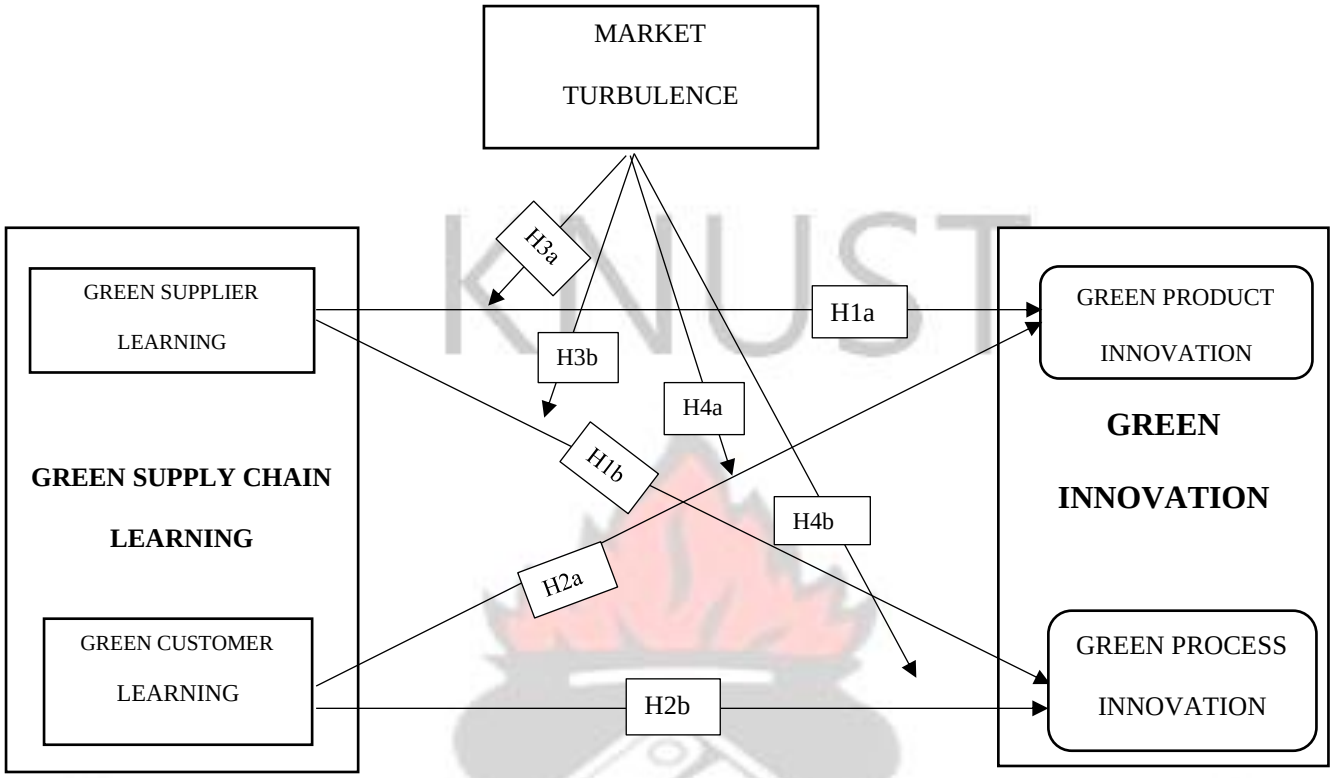


Figure 2.1 Conceptual Framework

2.5.1 Green Supplier Learning and Green Innovation

Green supplier learning includes acquiring environmental protection information, learning environmental management abilities, learning ways of jointly dealing with environmental issues, and establishing capabilities in understanding green knowledge and skills from suppliers. It has been suggested that learning from suppliers can facilitate firms' new product development. From a supply chain learning perspective, learning from suppliers enhances firms' capability of problem solving as suppliers are engaged early in the designing phase to identify potential problems of the new products.

green attributes (Lissi et et al., 2019). On the basis of expert knowledge, firms are able to obtain critical information from suppliers in terms of the choice of materials, energy efficiency, waste,

and collaborate with suppliers in developing new products or processes (Zhao et al., 2018). Through promoting mutual learning and knowledge assimilation, green supplier learning also enhance firms' capability of reusing materials and component parts and reducing resource consumption and waste generation. In addition, green supplier learning may improve the green attributes of existing product or services. For example, Feng and Wang (2016) argued that when suppliers take initiatives in providing green materials to minimize the products' environmental impact, or in providing reusable components, it facilitates the manufacturer to modify and adjust the design of existing products through an environmental management system to meet the requirements of new materials/components. This process enhances the effectiveness of green product innovation. Apart from green product innovation, green supplier learning can also enhance green process innovation. In the context of green supplier learning and green innovation, this theory suggests that organizations should engage with their suppliers to improve their environmental performance, which can lead to positive outcomes such as green product and process innovation.

Dynamic capability theory, on the other hand, emphasizes the importance of an organization's ability to adapt to changing environmental conditions and develop new capabilities that can create and sustain competitive advantage (Teece et al., 1997). In the context of green supplier learning and green innovation, this theory suggests that organizations should develop dynamic capabilities that enable them to learn from their suppliers and integrate environmental considerations into their innovation processes. Applying these two theories (stakeholder theory and dynamic capability theory) to the study hypothesis, green supplier learning can be seen as a dynamic capability that allows organizations to develop knowledge and skills related to environmental sustainability through engagement with their suppliers. This knowledge and skills can then be used to develop green product and process innovations that benefit both the

organization and its stakeholders, including the environment. By engaging with their suppliers and learning from them, organizations can improve their environmental performance and develop new capabilities that enable them to adapt to changing environmental conditions and sustain their competitive advantage. Stakeholder theory and dynamic capability theory provide theoretical frameworks for understanding how green supplier learning can lead to green innovation in organizations. These theories suggest that organizations should engage with their suppliers, develop dynamic capabilities that enable them to learn from their suppliers and integrate environmental considerations into their innovation processes, ultimately benefiting both the organization and its stakeholders, including the environment.

Green supplier learning could uplift the standards of the materials, components, and services suppliers provided to the firm, which may not fit into the firm's existing operational capabilities and procedures. Such misalignment could incur cost and jeopardize the firm's ability to maximizing gains from inputs. In order to save cost, the focal firm is likely to innovate on its manufacturing procedures, technology, or equipment to address the misfit that results in green and innovative manufacturing processes.(Lisi et al.2019). In addition, green supplier learning is conducive to the build of shared norms and goals between supplier and the manufacturer that is likely to reinforce both parties' implementation of green practices (Zhu et al., 2018). The manufacturer may particularly focus on innovating green processes such as installing energy efficient equipment and pollution control systems (Feng et al., 2016; Feng and Wang, 2016) to demonstrate its commitment to the shared environmental goals and as a way of role setting to reinforce the learning process. Therefore, this study hypothesizes:

H1. Green supplier learning has a positive impact on (a) green product innovation and (b) green process innovation.

2.5.2 Green Customer Learning and Green Innovation

Green customer learning includes the notion of information acquisition, capability enhancement, and jointly problem solving. It can facilitate information sharing and mutual understanding between the firm and its customers, provide insights to customers' desires and preferences of environment-friendly products, and reduce waste disposal alike (Feng et al. 2019; Kim et al., 2018). To fulfill customers' needs of reducing environmental risks, the firm is likely to invest greater attention and resources to designing new green products or product components that reduce the consumption of materials or emission of toxic chemicals and provide environmental benefits through recycling and recovery of materials and component parts. Green customer learning is likely to strengthen firms' green process innovation due to the pressure from customers of greening up the manufacturing process to protect a wider societal welfare (Huang et al., 2016).

In the context of green customer learning and green innovation, the stakeholder theory suggests that organizations should engage with their customers to understand their environmental concerns and preferences, which can lead to positive outcomes such as green product and process innovation. The dynamic capability theory emphasizes the importance of an organization's ability to adapt to changing environmental conditions and develop new capabilities that can create and sustain competitive advantage (Teece et al., 1997). In the context of green customer learning and green innovation, this theory suggests that organizations should develop dynamic capabilities that enable them to learn from their customers and integrate environmental considerations into their innovation processes.

To impress and retain customers, firms need to demonstrate their commitment to the environmental collaborating relationship and come up with green initiatives in the manufacturing process (Lissi et al.,2019). Huang et al. (2016) argued that customer pressure

related to environmental protection is able to reinforce manufacturers' R&D (research & development) input for improving their green processes and is also able to gain top management support for acquiring clean capabilities and installing energy efficient equipment. On the basis of empirical results from Chinese companies, Qi, Zeng, Tam, Yin, and Zou (2013) also found that customers play an important role in driving companies to adopt green process innovation, and this also applies to foreign-invested firms in China. Therefore, this study proposes the following hypotheses:

H2. Green customer learning has a positive impact on (a) green product innovation and (b) green process innovation.

2.5.3 The Moderating Role of Market Turbulence

Because firms operate in external environment, their business operations can also be influenced by environmental conditions (Lo and Shiah, 2016). Environmental factors should be incorporated to gain meaningful insights on how environmental factors constrain or empower the influence of green supply chain learning on green innovation. Considering the important roles of market turbulence in green innovation (Qui et al.,2020), this study chooses market turbulence as an important environmental factor that depicts the environmental condition of uncertainty and unpredictability in terms of market changes.

Market turbulence refers to imperceptible instability in the market, which is characterized by the continuous breaking and reshaping of traditional industrial boundaries and by changes in customers' preferences for products and services (Tsai and Yang, 2013; Ebrahimi and Mirbargkar, 2017; Qui et al.,2020). In the field of environmental research, it was observed that demand changes can result from improvements in customers' awareness of green products and services (Melander, 2018; Green et al., 2015). On one hand, consumers are becoming increasingly concerned with the health benefits and energy savings of the products that they

buy and use. On the other hand, consumers are paying much more attention to the quality of the environments in which they live (Rahman et al., 2020). Thus, whether a product is green has gradually become one of the most important considerations for customers when they purchase (Wu et al., 2015). Taking China's market for new energy automobiles as an example, sales rose from 12.8 thousand vehicles in 2012 to 1,256 thousand vehicles in 2018 with a minimum annual increase of 37.5% and maximum annual increase of 342.6%.2. Although much of the turbulence in the market for new energy automobiles can be attributed to Chinese policy guidance, consumer awareness of green products cannot be disregarded (Liao, 2018). When such market turbulence results from changes in attitudes towards green consumption, it becomes difficult for firms to satisfy market demand by providing old products and services under their original production models (Choi et al., 2019). As a result, firms must make changes to maintain sustainable development.

In the case of green supplier learning, rapid market changes will challenge firms to acquire new knowledge. In a highly turbulent market environment, firms may focus on keeping up with and meeting external market demands and simultaneously analysing and eliminating the obstacles of new market knowledge. In this case, firms are urgent to develop dynamic capabilities to overcome challenges and subsequently to seize opportunities. However, a solo company owns limited learning skills and judgment abilities. Under high level of market turbulence, green supplier learning may help focal firms obtain essential resources, information, and know-hows associated with green innovation. In addition, green supplier learning can involve and provide a problem-solving routine and additional capability (Lisi et al.,2020). These resources, information, and key technology can not only help firms mitigate the effect of market turbulence on the implementation of green innovation but also enhance firms' response ability to market risk (Zhao et al., 2018). It has been stated that “market turbulence breaks the status quo, steals customers, and forces firms to leave their comfort zone and provide new capabilities

and products" (Wong, 2014). As stated above, this study proposes that market turbulence can strengthen the green supplier learning-green innovation relationship. Therefore, the study hypothesizes the following:

H3. Market turbulence strengthens the impact of green supplier learning on (a) green product innovation and (b) green process innovation.

In the case of green customer learning, it is expected that when green market turbulence increases, firms' effort to involve customers in green decision making is more likely to help green innovation. This is because in a highly turbulent market, customer needs and preferences can provide the direction for a changing competitive landscape (Lisi et al.,2020), and therefore firms can benefit more from seizing consumer preferences and keeping up with their environmental demands. Therefore, the influence of green customer learning on green product innovation can be strengthened by market turbulence.

In the context of green customer learning, both stakeholder theory and dynamic capabilities theory suggest that organizations can benefit from developing innovative green products and processes. By working closely with their customers to learn about their preferences for environmentally friendly products and practices, organizations can create products and processes that meet the needs of their customers and contribute to sustainability. The development of green products and processes can benefit customers, who may be willing to pay a premium for environmentally friendly products, and the environment, which can benefit from reduced environmental impact. Additionally, suppliers may benefit from increased demand for their environmentally friendly products and services, which can improve their financial performance and reputation. The ability to innovate in response to market turbulence can help organizations stay competitive and adapt to changing customer needs. By developing green products and processes, organizations can differentiate themselves from their

competitors and build a reputation for sustainability. This can help them attract and retain customers, even during periods of market turbulence.

In addition, market turbulence is able to strengthen the impact of green customer learning on green process innovation. Under high level of market change, green customer learning is more likely to help firms maintain competitiveness in the marketplace. Green customer learning enables firms to take advantage of market updates to better fulfill customer demands in clean manufacturing processes and effective pollution control in production. (Feng and Wang, 2016). Therefore, this study hypothesizes the following:

H4. Market turbulence strengthens the impact of green customer learning on (a) green product innovation and (b) green process innovation.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter will begin by discussing the research design adopted for this study, followed by a description of the population of the study. The sample and sampling technique used in the study will be explained, along with an overview of the data collection methods employed. The section will also detail the data analysis methods used to analyze the collected data. Validity and reliability, ethical considerations, and the profile of the study area will be discussed in detail.

3.2 Research Design

The research design is a fundamental aspect of any study, as it determines the methods used to collect and analyse data. Research design refers to the overall strategy used to answer research questions, and it is essential in ensuring that the study is reliable, valid, and generalizable. In this section, we will discuss the types of research designs, and we will focus on the explanatory research design used in this study. There are three main types of research designs: exploratory, descriptive, and explanatory. Exploratory research design is used to explore and gain a deeper understanding of a research topic. Descriptive research design is used to describe and identify the characteristics of a particular phenomenon. Explanatory research design is used to establish cause-and-effect relationships between variables. The explanatory research design is used to investigate cause-and-effect relationships between variables. In this design, the researcher manipulates an independent variable and observes its effect on the dependent variable. The purpose of the design is to establish why a particular phenomenon occurs by establishing a cause-and-effect relationship.

According to Creswell (2014), explanatory research design is suitable for establishing causal relationships between variables. The design allows researchers to control extraneous variables and manipulate the independent variable to observe its effect on the dependent variable. By doing so, researchers can establish a causal relationship between the variables being studied. The research design used in this study is explanatory. It aims to establish the causal relationship between the green supplier learning and green innovation variable. The independent variable will be manipulated, and its effect on the dependent variable will be observed.

3.2.1 Research Strategy

The research strategy is a crucial component of any research project. It refers to the overall approach taken to collect and analyze data. In this section, we the types of research strategies will be discuss and focus on the survey research strategy used in this study. There are two main types of research strategies: quantitative and qualitative. Quantitative research strategies involve the use of numerical data and statistical analysis to answer research questions. Qualitative research strategies involve the use of non-numerical data such as interviews, observations, and case studies to answer research questions. The survey research strategy involves collecting data from a sample of individuals using a questionnaire or interview. Surveys are commonly used in quantitative research to collect numerical data from a large sample of participants. Survey research strategies can be used to investigate attitudes, opinions, beliefs, and behaviors of a particular group or population.

According to Babbie (2016), survey research strategies are particularly useful for collecting data from a large sample of individuals. Surveys allow researchers to collect data on a wide range of topics, and they can be administered in a variety of formats, including online, telephone, and in-person. The survey research strategy was chosen for this study due to several

reasons. First, the study aims to investigate the attitudes, opinions, and behaviors of a specific group of individuals related to green supplier learning and green innovation. The questionnaire can be designed to collect data on specific constructs, such as the level of supplier learning or the extent of green innovation, which can then be analyzed quantitatively. The survey research strategy is particularly useful for collecting data on attitudes, opinions, and behaviors as it allows researchers to collect data from a large sample of participants. The survey research strategy is suitable for collecting numerical data as it allows researchers to use statistical analysis to analyse the data collected. The survey research strategy is appropriate for your study on green supplier learning and green innovation with the moderating role of market turbulence for several reasons. First, survey research is a suitable method for collecting data on attitudes, opinions, and behaviours related to green supplier learning and green innovation. The questionnaire can be designed to collect data on specific constructs, such as the level of supplier learning or the extent of green innovation, which can then be analysed quantitatively. Second, survey research is a cost-effective and time-efficient method for collecting data from a large sample of participants. This is particularly important for the study, as data needs to be collected from a wide range of organizations in different industries to capture the moderating role of market turbulence.

3.2.2 Research Approach

The research approach refers to the systematic plan or strategy that a researcher employs to answer the research questions or hypotheses (Creswell, 2014). It involves decisions about the research design, data collection, and analysis methods. The research approach is crucial as it determines the rigor and validity of the study. There are two main types of research approaches: qualitative and quantitative. Qualitative research is concerned with understanding human behaviour and experiences through in-depth exploration and interpretation of data (Creswell,

2014). In contrast, quantitative research aims to establish causal relationships between variables through the collection and analysis of numerical data (Bryman, 2016). Quantitative research approach is a systematic empirical investigation of observable phenomena using statistical, mathematical, or computational techniques (Bryman, 2016). It involves the collection of numerical data that can be analyzed using statistical methods to test hypotheses and establish relationships between variables (Creswell, 2014). The aim of quantitative research is to provide precise and reliable measurements of the research constructs under investigation.

For the study of green supplier learning and green innovation, the quantitative research approach is appropriate because it enables the measurement of key constructs such as supplier learning, innovation, and market turbulence using numerical data (Bryman, 2016). The use of statistical techniques such as regression analysis can establish causal relationships between these constructs, which is essential for testing the research hypotheses (Creswell, 2014). Additionally, quantitative research provides precise and objective measurements, which can enhance the rigor and validity of the study (Bryman, 2016).

3.3 Population of the Study

According to Sekaran and Bougie (2016), population refers to the complete set of individuals, objects, or events that the researcher is interested in studying. The Greater Accra Region is the capital city of Ghana and home to several retail companies. The retail sector in the region is composed of a wide range of businesses, including supermarkets, convenience stores, and specialty stores. Retail is one of the fastest-growing sectors in Ghana and accounts for a significant portion of the country's GDP (Ghana Statistical Service, 2019). The constituents of the population of this study are the employees of retail companies operating within the Greater

Accra Region. The study focused on employees who work in different departments, such as sales, marketing, operations, and supply chain management. The sample comprised individuals who are directly involved in or have knowledge of the company's green supplier learning and green innovation practices. The population of the study is justified for several reasons. Firstly, the retail sector is a critical part of the Ghanaian economy, and companies in this sector have the potential to significantly impact the environment through their operations. Secondly, the study would provide insights into the current state of green supplier learning and green innovation practices among retail companies in the Greater Accra Region. Thirdly, by focusing on employees, the study would capture the perceptions and experiences of individuals who are directly involved in or have knowledge of the company's practices. Finally, limiting the study to the Greater Accra Region would provide a more manageable sample size and allow for more in-depth data collection and analysis.

3.4 Sample Size and Sampling Technique

A sample is a subset of the population selected for study (Sekaran & Bougie, 2016). Sampling is the process of selecting a representative group from the population for the purpose of research (Creswell, 2014). The main types of sampling techniques are probability sampling and non-probability sampling. Probability sampling techniques include simple random sampling, stratified random sampling, and cluster sampling. Non-probability sampling techniques include convenient sampling, purposive sampling, and snowball sampling (Sekaran & Bougie, 2016). The sample size for this study is hundred (100) employees of retail companies in the Greater Accra Region. This sample size was chosen based on the resources available for data collection and analysis and the need to achieve a balance between data quality and sample size. According to Creswell (2014), a sample size of 100 is appropriate for most research studies, provided that the sample is selected using an appropriate sampling technique

and the data collection methods are carefully planned and executed. Additionally, a sample size of 100 is sufficient for the study's research questions and objectives.

The sampling technique used in this study is convenient sampling, which involves selecting participants who are easily accessible or readily available (Sekaran & Bougie, 2016). In this case, employees of retail companies in the Greater Accra Region who are willing and able to participate in the study were selected as part of the sample. The justification for using convenient sampling is that it is a practical and efficient method for selecting participants, especially when time and resources are limited (Creswell, 2014). Additionally, using convenient sampling in explanatory research can be a cost-effective and time-efficient way to collect data. In some cases, it may be difficult or impractical to recruit a representative sample of the population of interest using probability sampling methods, either because the population is too large or too dispersed, or because the time and resources required to select a representative sample would be prohibitive. In such cases, convenient sampling may be the most practical way to collect data.

3.5 Data Collection Method

Primary source of data refers to the collection of original and first-hand information from the field, without relying on any previously published data or information. According to Saunders et al. (2018), primary data is collected by the researcher or research team directly from the field, rather than relying on secondary data sources. Primary data is often collected through various methods, including surveys, interviews, observations, and experiments. In this study, a questionnaire was used as the data collection instrument. The questionnaire is a structured tool designed to collect data from the study participants in a systematic and standardized manner. A questionnaire consists of a set of questions or items that are used to collect

information on the variables of interest. The questionnaire used in this study consist of four sections. Section A collects background information on the respondents, including their age, gender, education level, and work experience. Section B focuses on Green Supplier Learning as the predictor variable. Section C focuses on Green Innovation as the outcome variable. Section D focuses on Market Turbulence as the moderating variable and will include questions on the extent to which the retail sector in Greater Accra experiences market turbulence.

Table 3.1 Summary of Measurement Items

Variables	No. of Items	Sources
GREEN SUPPLY CHAIN LEARNING		
• **Green Supplier Learning**	**5**	Lisa et al.,2019
• **Green Customer Learning**	**5**	Lisa et al.,2019
GREEN INNOVATION		Lisa et al.,2019
Product Innovation	**5**	Lisa et al.,2019
Process Innovation	**4**	Lisa et al.,2019
MARKET TURBULENCE	**5**	Elazhary et al. (2022)

Source: Author's Construct (2023)

3.6 Data Analysis

Definition of data analysis: Data analysis refers to the process of examining, cleaning, transforming, and modelling data with the goal of drawing meaningful conclusions and making informed decisions based on the data (Hair et al., 2017). For this study, data analysis will be performed using SmartPLS (version 4) and IBM SPSS version 26. SmartPLS is a software

program used for structural equation modelling (SEM) and is well-suited for the type of data analysis required in this study, which involves testing the relationship between variables (Hair et al., 2017). IBM SPSS is a statistical software package that will be used for data cleaning, descriptive statistics, and inferential statistics. The data analysis process will involve several steps. Descriptive statistics such as mean, standard deviation, kurtosis, and skewness will be calculated to summarize the data. Inferential statistics will also be used, including exploratory factor analysis (EFA), Kaiser-Meyer-Olkin (KMO) test, one-factor test, and Cronbach's alpha, to assess the validity and reliability of the questionnaire items. PLS-SEM will be used to test the model for the study, which involves assessing the direct and indirect effects of green supplier learning on green innovation, as moderated by market turbulence.

3.7 Data Reliability and Validity

Ensuring the validity and reliability of research findings is paramount to establishing the credibility and trustworthiness of the study. Validity refers to the accuracy and appropriateness of the inferences, applications, and implications drawn from the research, while reliability pertains to the consistency and stability of the measurements or instruments used to collect data (Trochim & Donnelly, 2008).

In this study, both validity and reliability are systematically addressed. Reliability, specifically internal consistency, is assessed through the utilization of established measures such as Cronbach's Alpha and Composite Reliability. Cronbach's Alpha, a widely accepted measure of internal consistency, evaluates the extent to which items within a scale consistently measure the same underlying construct (Cronbach, 1951). Similarly, Composite Reliability provides a more robust measure by accounting for the shared variance among items while considering the

measurement error (Raykov, 1997). These reliability measures ensure that the data collected are consistently and dependably capturing the intended constructs.

Validity, on the other hand, is evaluated through multiple methods. The study employs the Average Variance Extracted (AVE), a measure that assesses the amount of variance captured by the construct relative to the measurement error (Fornell & Larcker, 1981). The Fornell-Larcker Criterion, a widely recognized criterion in structural equation modeling, is used to assess discriminant validity by comparing the square root of AVE with the correlation coefficients between constructs (Fornell & Larcker, 1981). Cross-loadings in confirmatory factor analysis (CFA) are examined to ensure that items load more strongly on their intended constructs than on alternative ones, contributing to both convergent and discriminant validity assessments (Hair et al., 2019). Exploratory factor analysis is also employed to further validate the factor structure and confirm the consistency of the construct definitions across different samples.

The meticulous consideration of these reliability and validity measures is integral to fortifying the methodological rigor of this study. By employing established techniques such as Cronbach's Alpha, Composite Reliability, AVE, Fornell Larcker Criterion, Cross-loadings, CFA, and exploratory factor analysis, the study aims to provide a comprehensive and robust assessment of the internal consistency, convergent validity, and discriminant validity of the research measures. This approach ensures that the data collected and analyzed in the study are not only consistent and reliable but also valid and reflective of the intended constructs, reinforcing the overall trustworthiness of the research findings.

3.8 Ethical Consideration

Ethics, also called moral philosophy, is a discipline of philosophy that "systematises, defends, and promotes conceptions of acceptable and unacceptable behaviour." The term "research ethics" refers to a set of standards governing the conduct of researchers (Burns, 2000). To adhere to ethical standards, the researcher must perform the following tasks: First and foremost, all respondents' identities are protected. As a result, the study questionnaire will not request respondents' names or sensitive personal information. All additional information collected is for academic purposes exclusively. Before disseminating the questionnaires, the researcher asks for all respondents' permission. Nobody is obligated to participate in the study.

CHAPTER FOUR

DATA PRESENTATION ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter provides a critical examination of the findings obtained from the research, encompassing an array of analytical methods to ensure precision and reliability. The chapter commences with an evaluation of the response rate, where the participation of respondents is examined in terms of quantity and efficiency. This leads to an in-depth scrutiny of the demographic characteristics of respondents, in which distinctions such as age, gender, education, and profession are explored to offer an understanding of the surveyed population. Subsequently, the chapter focuses on the Reliability and Validity Test, which ensures that the research instruments applied during the study are both reliable and valid. These measures add credence to the findings and present the outcomes as both dependable and reflective of the phenomena under study. The descriptive statistics section follows, offering a quantitative summary of the data collected. This enables a systematic presentation of information using measures such as mean, median, mode, and standard deviation, providing a comprehensive overview of the central tendencies within the data set. The ensuing segment, model and hypotheses testing, is crucial in affirming or refuting the research hypotheses. Utilizing various statistical tests, this section ascertains the relationships between variables, confirming or rejecting the proposed theories. Finally, the chapter culminates in the discussion of results. Here, the implications of the research findings are explored, and the results are juxtaposed with previous studies, theories, and models. The discussion aims to synthesize the insights gathered, situating them within the broader context of the subject matter, and thereby contributing to the existing body of knowledge in the field.

4.2 Demographics of the Respondents

This section includes the respondent demographics to provide information on the individuals and organizations that participated in the study. The main information obtained from the respondent includes the position in the company, number of employees, retail sector, revenue of the company and the level of education of respondents.

Table 4. 1 Profile of Respondents

Category	Type/Group	Number of Respondents	Percentage (%)
Position in the company	Supervisor	40	20
	Middle Manager	126	63
	Top manager	34	17
Number of employees	Less than 6	30	15
	6-29	64	32
	30-59	84	42
	60-99	22	11
Retail sector	Food	26	13
	Clothing &Textile	28	14
	Consumer durables	44	22
	Footwear	40	20
	Building Materials	14	7
	Jewelry	30	15
	Books, Music, gift articles	12	6
	Pharmaceutical	10	5

Revenue of the Company	<40000		1
	40000-80000	22	11
	80000-120000	58	29
	1200000-160000	82	41
	160000-200000	30	15
	200000-500000	6	3
Level of Education	Diploma/HND	30	15
	1st Degree	132	66
	2nd Degree	38	19

4.2.1 Position in the Company

The survey encompassed a diverse range of respondents in terms of their positions within their respective companies. It was found that 20% of the respondents hold the role of Supervisor, signifying a crucial layer of management responsible for overseeing operational aspects. Middle Managers constituted the majority, with 63% of respondents falling into this category. These individuals are pivotal in coordinating and facilitating communication between higher management and frontline employees. The Top Managers, composing 17% of the participants, are at the helm of decision-making, steering the company's strategic direction.

4.2.2 Number of Employees

The distribution of respondents according to the number of employees in their companies provides insights into the scale of businesses represented. Notably, 15% of participants are associated with companies with less than 6 employees, reflecting the presence of small-scale

enterprises. Companies with 6-29 employees form the largest segment, accounting for 32% of respondents. Businesses with 30-59 employees (42%) and 60-99 employees (11%) showcase the prevalence of moderately-sized companies.

4.2.3 Retail Sector

The retail sector breakdown reveals the diversity of businesses present in the survey. Within this category, different segments are represented. Notably, Food and Clothing & Textile each constitute 13% and 14% of the respondents, respectively. Consumer durables and Footwear are each represented by 22% and 20% of respondents, underlining the significance of these areas. Additionally, Building Materials, Jewellery, Books-Music-Gift articles, and pharmaceutical sectors are also part of the survey, each with varying levels of representation.

4.2.4 Revenue of the Company

The revenue distribution showcases the financial magnitude of the surveyed companies. Companies with revenue falling below 40000 comprise a minimal portion. The bracket of 40000-80000 accounts for 11% of respondents, signifying a range of smaller enterprises. In contrast, the bracket of 80000-120000 captures a substantial portion at 29%, suggesting businesses of moderate scale. Further, the range of 120000-160000 forms the largest segment with 41% representation, indicating a significant number of companies at this revenue level. The ranges of 160000-200000 and 200000-500000 demonstrate a smaller presence.

4.2.5 Level of Education

The educational attainment of the respondents provides insights into the qualifications of those contributing to the survey. Participants with a Diploma/HND account for 15% of the responses. The majority, constituting 66%, possess a 1st Degree, highlighting a well-educated pool of

respondents. Respondents with a 2nd Degree, making up 19%, represent a subset with advanced academic accomplishments.

4.3 Reliability and Validity

The research evaluated the validity and reliability of the information obtained from 200 respondents in this part. Heale (2017) claims that dependability relates to a measure's consistency, or the extent to which a research tool yields consistent results when applied again in the same circumstance. In contrast, validity describes how precisely an idea is measured in a quantitative investigation. The reliability of the constructs was evaluated by the researcher using the composite reliability and Cronbach's alpha value. These metrics assess how well the measurements consistently capture the variables. For Cronbach's alpha and composite reliability, a threshold value of 0.7 is acceptable. The study used confirmatory factor analysis to look at the factor loadings of each item to its associated latent variable in order to guarantee the validity of the data acquired. A factor loading score over 0.50, demonstrating that the question properly measures the desired latent variable, is required for it to be deemed valid. The study initially employed confirmatory factor analysis to ascertain the factor loadings of each question to its latent variable in order to evaluate the validity of the data gathered. Each item must load at least 0.50 in order to be considered genuine.

The study calculated the average variance extracted (AVE) value using Hair et al's (2013) suggested threshold value of 0.5 to evaluate the convergent validity of the data (2013). To assess the discriminant validity, the study also applied the Fornell-Larcker criterion. By contrasting the correlation of each item with its own latent variable to the correlation of all other variables, these criteria may be applied to individual items. The correlation between an

item and its own latent variable must be greater than the correlation between the item and all other factors for the item to have discriminant validity.

Table 4.2 Cronbach Alpha, Composite Reliability, and Average Variance Extracted

Variable	Number Items	Cronbach Alpha (CA)	Composite Reliability (CR)	AVE
Green Customer Learning	5	0.902	0.970	0.770
Green Supplier Learning	5	0.959	0.966	0.858
Market Turbulence	5	0.903	0.948	0.720
Green process innovation	4	0.953	0.956	0.876
Green product innovation	5	0.966	0.968	0.881

This table 4.2 presents the results of construct reliability and discriminant validity for several key variables in the study. Each construct has been evaluated based on Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE).

The construct Green Customer Learning involves understanding the extent to which customers are educated about environmentally friendly practices. The Cronbach's Alpha value of 0.902 suggests a high level of internal consistency among the five measurement items related to Green Customer Learning. The Composite Reliability (CR) of 0.970 further reinforces this

reliability. The construct's Average Variance Extracted (AVE) value of 0.77 indicates that 77% of the variance in Green Customer Learning is captured by its measurement items. This suggests that the measurement items collectively contribute to a substantial portion of the construct's variability. Green Supplier Learning assesses the level of education and awareness among suppliers regarding green practices. The Cronbach's Alpha of 0.959 signifies strong internal consistency among the five measurement items. The Composite Reliability (CR) of 0.966 corroborates this reliability. With an Average Variance Extracted (AVE) of 0.858, it is evident that 85.8% of the variance in Green Supplier Learning is explained by its measurement items. This indicates that the items within the construct are distinct and contribute significantly to its measurement.

Market Turbulence reflects the instability and uncertainty within the business environment. The Cronbach's Alpha value of 0.903 demonstrates a high level of internal consistency among the five measurement items associated with this construct. The Composite Reliability (CR) of 0.948 supports this reliability. The construct's Average Variance Extracted (AVE) value of 0.720 indicates that 72.0% of the variance in Market Turbulence is captured by its measurement items. This suggests that the measurement items collectively reflect the construct's essence effectively. Green process innovation gauges the extent to which green practices are integrated into business processes. Cronbach’s Alpha of 0.953 indicates strong internal consistency among the four measurement items related to green process innovation. The Composite Reliability (CR) of 0.956 reinforces this reliability. With an Average Variance Extracted (AVE) of 0.876, it is clear that 87.6% of the variance in green process innovation is accounted for by its measurement items. This highlights the measurement items' strong contribution to the construct. The construct green product innovation evaluates the level of innovation in environmentally friendly products. The Cronbach's Alpha value of 0.966 signifies high internal

consistency among the five measurement items associated with green product innovation. The Composite Reliability (CR) of 0.968 strengthens the reliability aspect. The construct's Average Variance Extracted (AVE) value of 0.881 indicates that 88.1% of the variance in green product innovation is captured by its measurement items. This underscores the construct's robust measurement.

The provided results of construct reliability and discriminant validity indicate that the measurement instrument used in the study is reliable and valid. The high values of Cronbach's Alpha and Composite Reliability suggest strong internal consistency within each construct. Moreover, the AVE values exceeding the recommended threshold confirm that the constructs have distinct measurement items that contribute significantly to their respective variance.

Table 4.3 Fornell Larcker Criterion

Variable	**Green Customer Learning**	**Green Supplier Learning**	**Green process innovation**	**Green product innovation**	**Market Turbulence**
Green Customer Learning	0.878				
Green Supplier Learning	0.643	0.936			
Market Turbulence	0.746	0.810	0939		
Green process innovation	0.866	0.536	0.542	0.926	
Green product innovation	0.749	0.898	0.784	0.743	0.848

Table 4.3 presents the Fornell Larcker Criterion, which offers insights into the discriminant validity among the constructs under study. This criterion is valuable for understanding how distinct these constructs are from each other in a multivariate analysis. It is particularly useful in assessing whether the constructs can be differentiated effectively, enhancing the credibility of the research findings.

It can be observed that the diagonal elements of the table, representing the squared correlations of constructs with themselves, unsurprisingly yield a value of 1 for each construct. This is expected, as any construct is perfectly correlated with itself. As regards the off-diagonal elements, the squared correlations between construct pairs provide a basis for evaluating the distinctiveness of these constructs. These squared correlations, also known as shared variances, should be smaller than the AVE values for the respective constructs to demonstrate good discriminant validity.

Starting with the construct pair of Green Customer Learning and Green Supplier Learning, the squared correlation is 0.643. This value is less than the AVE of both constructs, which is a positive sign of discriminant validity between these two constructs. Similarly, looking at Green Customer Learning and Market Turbulence, the squared correlation is 0.746, again lower than the AVE of both constructs, indicating effective differentiation. The squared correlation between Green Supplier Learning and Market Turbulence is 0.810, which is also lower than the AVE of both constructs, reinforcing their distinctiveness. Turning to innovation, the squared correlation between green process innovation and green product innovation is 0.926. This value is less than the AVE of both constructs, suggesting that they are distinguishable in the analysis. Furthermore, the squared correlation between green process innovation and Green Customer Learning is 0.866, and with Green Supplier Learning, it is 0.536. These values are

smaller than the AVE values of the respective constructs, indicating satisfactory discriminant validity.

The squared correlation between green product innovation and Green Customer Learning is 0.749, and with Green Supplier Learning, it is 0.898. Both values are smaller than the AVE values of the constructs, demonstrating their effective differentiation. Lastly, the squared correlation between green product innovation and Market Turbulence is 0.848, which is also smaller than the AVE values of both constructs, underscoring their distinct nature. The Fornell Larcker Criterion provides valuable insights into the discriminant validity of the constructs. The generally smaller squared correlations compared to the AVE values suggest that these constructs are indeed distinct from each other. This information enhances the credibility of the analysis, contributing to a more robust and accurate representation of the relationships within the research model.

Figure 4.1 Confirmatory Factor Analysis

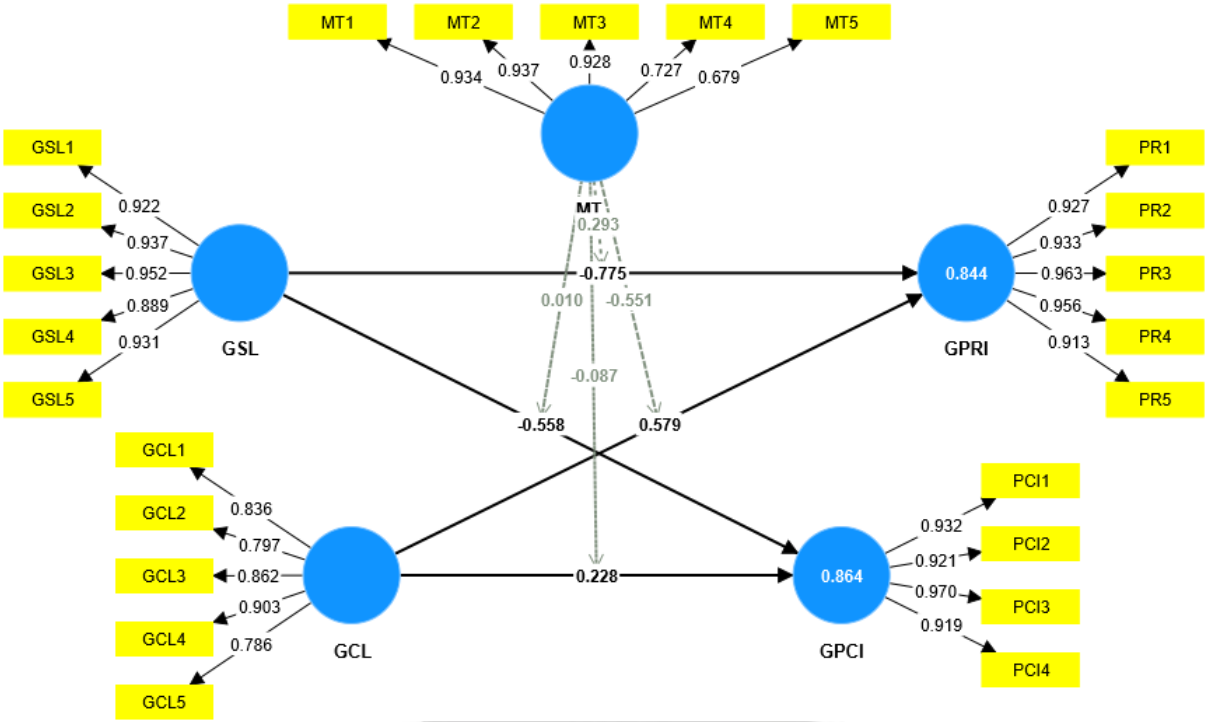


Figure 4.1 Confirmatory Factor Analysis

Source: Field Study (2023)

4.4 Descriptive Statistics

The descriptive statistics employed in this investigation provide a numerical depiction of three main constructs, utilizing a scale of 1 to 7, also known as a Likert scale. Each score within this scale signifies the extent to which the associated variables' indicators are present in the retail sector. To elaborate, each numerical rating corresponds to a certain level of agreement: 1 signifies strong disagreement, 2 indicates disagreement, 3 conveys slight disagreement, 4 represents neutrality, 5 implies slight agreement, 6 suggests agreement, and 7 denotes strong agreement. The occurrence frequency of the phenomena is differentiated by these scores: ratings from 1.00 to 2.99 denote a very low or less frequent occurrence, those ranging from 3.00 to 4.99 denote a low or infrequent occurrence. Scores from 5.00 to 5.99 reflect a moderate frequency, and those from 6.00 to 7.00 denote a consistent or regular frequency. The upcoming segments will provide an in-depth analysis of each measure.

4.4.1 Green Supply Chain Learning

This section presents ten (10) items used to measure green supply chain learning. Table 4.4 gives numerous descriptive results for green supply chain learning (Green supplier Learning and Green Customer learning) in detail.

Table 4.4 Descriptive Statistics Results for Green Supply Chain Learning

Items	**Min**	**Max**	**Mean**	**Std. Deviation**
Our company has acquired important environmental protection information from our major supplier.	1	7	5.55	1.532
Our company has learnt new environmental management abilities from our major supplier.	2	7	5.72	1.304

Our capacities to maintain sustainable development has been enhanced by our relationship with major supplier enhances	1	7	5.68	1.287
Our company constantly learns better ways to work with our major supplier jointly in dealing with environmental issues.	1	7	5.58	1.176
Our company has established a strong capability in understanding green knowledge and skills of our major supplier.	1	7	5.52	1.36
Our company has acquired important environmental protection information from our major customer.	2	7	5.6	1.304
Our company has learnt new environmental management abilities from our major customer.	1	7	5.5	1.269
our capacities to maintain sustainable development is enhanced by our relationship with major customer enhances	2	7	5.62	1.287
Our company constantly learns better ways to work with our major customer jointly in dealing with environmental issues.	1	7	5.7	1.432
Our company has established a strong capability in understanding green knowledge and skills of our major customer	2	7	5.4	1.679
OVERALL SCORE			**5.587**	**1.363**

Source: Field study (2023)

The data in Table 4.4 provides descriptive statistics for various elements related to green supply chain learning. Each element is measured using a Likert scale of 1 to 7, with higher values indicating stronger agreement. The table presents the descriptive statistics for a set of items related to the interactions and knowledge acquisition from major suppliers and customers in the context of environmental management. Each item is measured on a Likert scale ranging from 1 to 7, where higher values indicate stronger agreement with the statements. The table displays the minimum, maximum, mean, and standard deviation for each item, as well as an overall score.

Starting with the first item, "Our company has acquired important environmental protection information from our major supplier," the recorded mean value is 5.55, and the standard deviation is 1.532. This indicates that, on average, respondents leaned towards agreement with this statement. The moderate standard deviation suggests some variability in responses, implying that while the mean suggests agreement, there might be a range of opinions among respondents regarding the acquisition of environmental protection information from the major supplier. The second item, "Our company has learnt new environmental management abilities from our major supplier," the mean value is 5.72, with a standard deviation of 1.304. The relatively high mean suggests a strong tendency towards agreement with this statement. The standard deviation again points to some variability, implying that while most respondents agreed, there might be differing levels of perception regarding the extent to which new environmental management abilities have been acquired. The third item, "Our capacities to maintain sustainable development has been enhanced by our relationship with the major supplier," the mean value is 5.68, and the standard deviation is 1.287. This mean value reflects a noteworthy level of agreement among respondents. The standard deviation suggests moderate variability, indicating that while there is overall agreement, there might be some divergence in how respondents perceive the enhancement of sustainable development capacities. The fourth item, "Our company constantly learns better ways to work with our major supplier jointly in dealing with environmental issues," the mean value is 5.58, and the standard deviation is 1.176. The mean indicates a relatively strong agreement, while the standard deviation suggests that the responses are somewhat consistent around this mean, implying a moderate level of shared perception regarding joint learning with the major supplier.

The fifth item, "Our company has established a strong capability in understanding green knowledge and skills of our major supplier," the mean value is 5.52, and the standard deviation

is 1.36. The mean suggests a positive leaning towards agreement, and the standard deviation indicates moderate variability, implying that while there is an overall shared perception of understanding green knowledge and skills, there might be some diversity in respondents' perspectives. The sixth item, "Our company has acquired important environmental protection information from our major customer," records a mean value of 5.6, with a standard deviation of 1.304. The mean implies a general agreement with the statement, and the standard deviation indicates some dispersion of responses, suggesting varying degrees of agreement among respondents. The seventh item, "Our company has learnt new environmental management abilities from our major customer," has a mean value of 5.5 and a standard deviation of 1.269. The mean suggests a moderate level of agreement, and the standard deviation indicates variability in responses, highlighting that while there is agreement, there is also a range of perspectives regarding the acquisition of new environmental management abilities. The eighth item, "Our capacities to maintain sustainable development is enhanced by our relationship with the major customer," has a mean value of 5.62 and a standard deviation of 1.287. The mean indicates an inclination towards agreement, and the standard deviation suggests some diversity in responses, implying that while respondents generally agree, there are nuances in their perceptions of enhanced sustainable development capacities. The ninth item, "Our company constantly learns better ways to work with our major customer jointly in dealing with environmental issues," records a mean value of 5.7 and a standard deviation of 1.432. The mean reflects a relatively strong agreement, and the standard deviation points to variability in responses, indicating that while there is a shared perspective on joint learning, there might be differing opinions on the extent of this joint learning.

Finally, the tenth item, "Our company has established a strong capability in understanding green knowledge and skills of our major customer," has a mean value of 5.4 and a standard

deviation of 1.679. The mean suggests a moderate level of agreement, and the higher standard deviation indicates a wider range of responses, indicating diversity in perceptions of understanding green knowledge and skills.

4.4.2 Green Innovation (green product innovation and green process innovation)

The Green innovation of the firms was evaluated using eight (8) measures. Table 4.5 provides information regarding the descriptive results of green innovation.

Table 4.5 Descriptive Statistics Results for Green Innovation

Items	**Min**	**Max**	**Mean**	**Std. Deviation**
Our company choose the materials of the product that produce the least amount of pollution for conducting the product development or design.	1	7	5.3	1.628
Our company chooses the materials of the product that consume the least amount of energy and resources for conducting the product development or design.	2	7	5.27	1.333
Our company's success and growth are due to the amount invested in reverse logistics	1	7	5.13	1.701
Our company uses the fewest number of materials to comprise the product for conducting the product development or design.	1	7	5.17	1.686
Our company would circumspectly deliberate whether the product is easy to recycle, reuse, and decompose for conducting the product development or design.	1	7	5.39	1.522
Our company effectively reduces the emission of hazardous substances or waste.	1	7	5.15	1.699

Our company recycles waste and emission that allow them to be treated and re-used.	1	7	4.9	1.957
Our company reduces the consumption of water, electricity, coal, or oil.	1	7	5.06	1.827
OVERALL SCORE			**5.17**	**1.691**

Source: Field study (2023)

Table 4.5 presents descriptive statistics for several items pertaining to operational performance, each measured on a scale of 1 to 7, where higher scores indicate stronger agreement. The table presents descriptive statistics for a set of items related to green innovation practices. Each item is rated on a Likert scale ranging from 1 to 7, where higher values signify stronger agreement with the statements. The table displays the minimum, maximum, mean, and standard deviation for each item, as well as an overall score.

The first item, "Our company choose the materials of the product that produce the least amount of pollution for conducting the product development or design," the mean value is 5.3, and the standard deviation is 1.628. This mean value indicates a moderate level of agreement among respondents regarding the company's emphasis on selecting environmentally friendly materials. The relatively high standard deviation implies variability in respondents' opinions, suggesting that while the mean indicates agreement, there might be differences in how participants perceive the company's material selection practices. The second item, "Our company chooses the materials of the product that consume the least amount of energy and resources for conducting the product development or design," the mean value is 5.27, and the standard deviation is 1.333. This mean value suggests a similar level of agreement as the previous item. The standard deviation indicates that while there is overall agreement,

respondents have diverse perspectives on the company's emphasis on energy-efficient and resource-conscious material choices.

Regarding the third item, "Our company's success and growth is due to the amount invested in reverse logistics," the mean value is 5.13, and the standard deviation is 1.701. The mean suggests a moderate level of agreement, indicating that respondents tend to agree with the statement, although not as strongly as in previous items. The relatively high standard deviation implies that there is a range of opinions about the role of reverse logistics in the company's success and growth. The fourth item, "Our company uses the fewest number of materials to comprise the product for conducting the product development or design," the mean value is 5.17, and the standard deviation is 1.686. The mean indicates a moderate level of agreement, suggesting that respondents generally agree with the company's practice of minimizing material usage. The standard deviation underscores variability in responses, indicating that while the mean leans towards agreement, there might be different perceptions about the extent to which the company prioritizes minimizing material usage. The fifth item, "Our company would circumspectly deliberate whether the product is easy to recycle, reuse, and decompose for conducting the product development or design," the mean value is 5.39, and the standard deviation is 1.522. The mean implies a relatively strong agreement with the statement. The standard deviation indicates some variability, suggesting that while respondents generally agree with the company's consideration of recyclability and reusability, there might be differing opinions on the thoroughness of such considerations. The sixth item, "Our company effectively reduces the emission of hazardous substances or waste," the mean value is 5.15, and the standard deviation is 1.699. The mean indicates a moderate level of agreement, implying that respondents generally agree with the company's efforts to reduce hazardous emissions. The higher standard deviation suggests diversity in opinions, indicating that while respondents

agree to some extent, there are differing perceptions about the company's effectiveness in this regard.

Regarding the seventh item, "Our company recycles waste and emission that allow them to be treated and re-used," the mean value is 4.9, and the standard deviation is 1.957. The lower mean suggests a tendency towards agreement but with less strength compared to previous items. The higher standard deviation implies significant variability in responses, indicating differing opinions about the company's recycling practices and their effectiveness. The eighth item, "Our company reduces the consumption of water, electricity, coal, or oil," the mean value is 5.06, and the standard deviation is 1.827. The mean suggests a moderate level of agreement, indicating that respondents tend to agree with the company's efforts to reduce resource consumption. The standard deviation indicates variability in opinions, implying diverse perspectives on the extent and effectiveness of these resource-saving practices.

The table provides insight into respondents' perceptions of sustainable product development practices within the company. While there is a general trend of agreement across the items, the standard deviations reveal variability in opinions. These findings highlight that respondents generally acknowledge the company's efforts towards sustainable practices, but there are differences in how these practices are perceived and their impact evaluated. These insights contribute to a deeper understanding of how stakeholders view the company's commitment to environmental responsibility and can inform future sustainability initiatives and communication strategies.

4.4.3 Market Turbulence

Using five (5) metrics, the moderating variable market turbulence across sampled enterprises was assessed. The descriptive outcomes of market turbulence are detailed in Table 4.6.

Table 4.6 Descriptive Statistics Results for Market Turbulence

Items	**Min**	**Max**	**Mean**	**Std. Deviation**
Our customers' product preferences change quite a bit over time	1	7	5.12	1.705
Our customers tend to look for new product all the time.	1	7	4.94	1.923
Our products and services have seen increased demand from customers who never bought them.	1	7	5.18	1.652
Our new customers tend to have product-related needs that are different from those of our existing customers.	1	7	5.68	1.287
Our company caters for many of the same customers that we used to in the past.	1	7	5.58	1.176
Total			**5.3**	**1.5486**

Source: Field study (2023)

Table 4.6 reveals descriptive statistics related to various aspects of market turbulence, each assessed on a scale of 1 to 7, where higher values suggest stronger agreement.

The first item, "Our customers' product preferences change quite a bit over time," the mean value is 5.12, and the standard deviation is 1.705. This mean value suggests a moderate level of agreement among respondents. The standard deviation indicates notable variability in opinions, suggesting that while the mean reflects a tendency towards agreement, there might be differences in how respondents perceive the extent to which customer product preferences

change over time. This could imply that some respondents perceive significant shifts in customer preferences, while others might see less pronounced changes. The second item, "Our customers tend to look for new products all the time," the mean value is 4.94, and the standard deviation is 1.923. The mean suggests a tendency towards agreement, albeit less strong than the previous item. The relatively high standard deviation points to significant variability in opinions, indicating that while there is some shared perception of customers seeking new products, there are differing views on the frequency and extent of this behaviour. The third item, "Our products and services have seen increased demand from customers who never bought them," the mean value is 5.18, and the standard deviation is 1.652. The mean implies a moderate level of agreement, suggesting that respondents generally agree with the statement. The standard deviation indicates some variability in responses, suggesting that while there is an overall shared perception of increased demand from new customers, there might be diverse opinions on the extent of this trend.

The fourth item, "Our new customers tend to have product-related needs that are different from those of our existing customers," the mean value is 5.68, and the standard deviation is 1.287. The mean suggests a relatively strong agreement among respondents. The standard deviation indicates moderate variability, implying that while respondents generally agree that new customers have different product-related needs, there might be some variance in the degree to which these needs differ. The fifth item, "Our company caters for many of the same customers that we used to in the past," the mean value is 5.58, and the standard deviation is 1.176. The mean suggests a strong tendency towards agreement, indicating that respondents largely agree that the company serves familiar customers. The low standard deviation indicates relatively consistent perceptions, implying a shared perspective that the company maintains its relationships with past customers.

Respondents tend to agree on several aspects of market turbulence, including changing preferences, new product searches, and differences in new customer needs. These findings underline the complex nature of customer behaviour and market dynamics. Understanding these dynamics is crucial for companies to adapt effectively to changing market conditions and meet evolving customer needs. The total mean for the items in the market turbulence section is 5.3, with a standard deviation of approximately 1.5486. This suggests that, on average, respondents show a moderate level of agreement with the statements related to market turbulence. The standard deviation indicates that while there is an overall tendency towards agreement, there are variations in how respondents perceive the different aspects of market turbulence.

4.4 Structural Equation Modelling

The PLS Structural Equation model was utilized in the study to look at the direct effects (path coefficients) and moderating relationship between the research variables. A bootstrap with 5000 iterations was utilized to estimate the route coefficients in the study model.

Table 4.7 Structural Equation Modelling

Path	Coefficients	T-value	P-value
Direct Effects			
GCL -> GPCI	0.228	2.883	0.004
GCL -> GPRI	0.579	7.01	0.000
GSL -> GPCI	-0.558	5.329	0.000
GSL -> GPRI	-0.775	7.447	0.000
Moderation Effect			

MT x GCL ->GPCI	-0.087	0.995	0.32
MT x GCL ->GPRI	-0.551	7.496	0
MT x GSL -> GPCI	0.01	0.155	0.877
MT x GSL -> GPRI	0.293	6.323	0

Source: Field Study (2022) Notes: GCL (Green Customer Learning); GSL (Green Supplier Learning); GPRI (Green product innovation); GPCI (Green process innovation); MT (Market Turbulence)

Table 4.7 displays the findings of testing the direct and moderation links between variables using the structural equation model. The table shows the results of a structural equation modelling (SEM) analysis of the relationships between green customer learning (GCL), green supplier learning (GSL), green product innovation (GPRI), and green process innovation (PCI) in a field study conducted in 2022.

Firstly, the examination of Green Customer Learning's direct effects indicated a positively significant influence on both green product innovation ($\beta = 0.579$, $p = 0.001$) and green process innovation ($\beta = 0.228$, $p = 0.004$). This implies that higher levels of Green Customer Learning are correlated with increased green product innovation and green process innovation. This aligns with the hypothesis and suggests that a deeper understanding of environmental aspects by customers positively impacts both the development of new environmentally friendly products and the enhancement of sustainable processes.

Conversely, the impact of Green Supplier Learning on innovation outcomes presented an inverse trend. The direct effects demonstrated a negative relationship with both green product innovation ($\beta = -0.775$, $p = 0.000$) and green process innovation ($\beta = -0.558$, $p = 0.000$). This

implies that as Green Supplier Learning increases, there is a reduction in both green product innovation and green process innovation. This finding may suggest that a supplier's familiarity with green practices could potentially hinder their contribution to innovative practices.

Turning to the moderation effects of market turbulence (MT), the results revealed interesting insights into how this external factor influences the relationships between constructs. For the relationship between Green Customer Learning and Green product innovation, market turbulence was found not to exert a moderating effect ($\beta = -0.551$, $p = 0.000$). This suggests that regardless of the degree of market turbulence, the positive link between Green Customer Learning and Green product innovation remains constant. Similarly, the moderation effect on the relationship between Green Customer Learning and Green process innovation was non-significant ($\beta = -0.087$, $p = 0.32$), indicating that the association between these constructs remains unaltered across varying levels of market turbulence.

However, a different trend was observed in the case of Green Supplier Learning. Market turbulence was found to moderate the relationship between Green Supplier Learning and Green product innovation ($\beta = 0.239$, $p = 0.000$), suggesting that the impact of Green Supplier Learning on Green product innovation is influenced by market turbulence. Conversely, the moderation effect on the relationship between Green Supplier Learning and Green process innovation was not significant ($\beta = 0.01$, $p = 0.877$), implying that market turbulence does not significantly affect the connection between these constructs.

The analysis elucidated nuanced relationships between Green Customer Learning, Green Supplier Learning, market turbulence, and innovation outcomes. The positive influence of Green Customer Learning on both Green product innovation and green process innovation contrasts with the negative relationship observed with Green Supplier Learning. Moreover, the

role of market turbulence as a moderator highlighted varying impacts on these relationships. These findings contribute to a richer understanding of the complexities underlying sustainable innovation dynamics in a dynamically changing market landscape.

Figure 4.2 Structural Equation Modelling

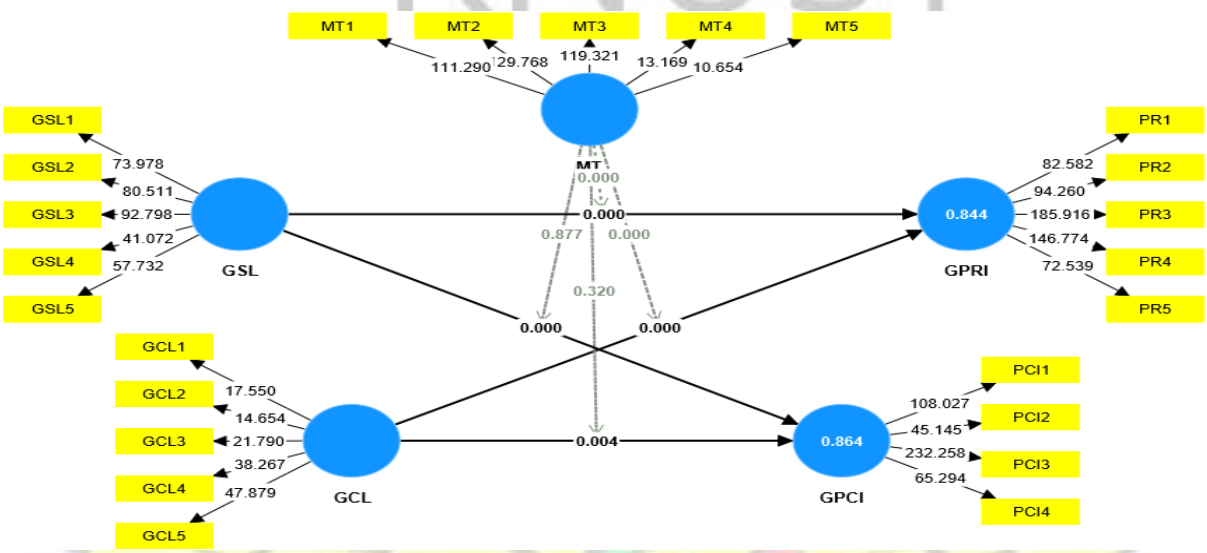


Figure 4.2 Structural Equation Modelling

4.6 Hypotheses Confirmation

Three hypotheses were created for this study based on a review of past research. Each of these hypotheses is confirmed or refuted by analysing the collected data. The confirmation of hypotheses is summarised in table 4.8 below.

Table 4.8 Confirmation of the Hypothesis

Hypothesis	Path	T-value	Coefficient (P-value)	Decision
H1a	GSL ->GPRI	7.447	-0.775; p<0.01	Not supported

H1b	GSL -> GPCI	5.329	-0.558; p<0.01	Not supported
H2a	GCL -> GPRI	7.01	0.579; p<0.01	Supported
H2b	GCL -> GPCI	2.883	0.228; p<0.01	Supported
H3a	MT x GSL -> GPRI	6.323	0.293; p<0.01	Supported
H3b	MT x GSL -> GPCI	0.155	0.01; p>0.05	Not supported
H4a	MT x GCL -> GPRI	7.496	-0.551; p<0.01	Not supported
H4b	MT x GCL -> GPCI	0.995	-0.087; p>0.05	Not supported

4.7 Discussion of Results

The findings of this study are explored in relation to the body of prior research that is pertinent to it. The following sections offer a thorough and in-depth examination of the results in accordance with the investigation's stated goals.

4.7.1 Green Supplier Learning and Green Innovation

The results derived from the study offer a compelling and noteworthy perspective on the association between green supplier learning (GSL) and the dimensions of green innovation, namely green product innovation (GPRI) and green process innovation (GPCI). The empirical analysis reveals a statistically significant and negative linkage between GSL and both GPRI and GPCI (β = -0.775, t-value = 7.447, p-value = 0.000; β = -0.558, t-value = 5.329, p-value =

0.000). The study's results diverge from the initial hypotheses proposed in the literature (H1a and H1b), which posited a positive relationship between GSL and both GPRI and GPCI. This discrepancy between the empirical findings and the existing scholarly literature introduces an intriguing perspective. Specifically, the common assertion in prior research that GSL augments problem-solving capabilities and fosters green innovation (Lissi et al., 2019; Zhao et al., 2018; Feng and Wang, 2016) finds a departure point in the empirical reality observed in this study. The results of this study underscore that GSL does not significantly cultivate a positive relationship with either GPRI or GPCI. This implies that the enhancement of problem-solving abilities within suppliers, as captured by GSL, does not appear to lead to a proportional advancement in either dimension of green innovation. This nuanced conclusion prompts a re-evaluation of the prevailing assumptions regarding the impact of GSL on innovation within the green domain. The non-corroborative nature of the empirical results challenges the established narrative and demands a deeper exploration into the complex dynamics that influence the relationship between GSL and green innovation outcomes. This could encompass an investigation into potential contextual factors, organizational intricacies, or unique market conditions that might mediate or modulate the anticipated positive effects.

In summary, the study's empirical results underscore a significant deviation from the existing literature's hypotheses. The observed negative association between GSL and both GPRI and GPCI introduces a fresh layer of complexity to the discourse on green supplier learning and its influence on green innovation. This finding encourages a more comprehensive understanding of the factors that shape innovation dynamics within sustainable contexts, paving the way for further scholarly inquiry and offering practical insights for businesses navigating the intricate landscape of green innovation.

4.7.2 Green Customer Learning and Green Innovation

The findings extracted from the study shows a compelling perspective regarding the interplay of green customer learning (GCL) with two vital dimensions of innovation: green product innovation (GPRI) and green process innovation (GPCI). The empirical analysis uncovers a statistically significant and positively inclined relationship between GCL and both GPRI and GPCI ($\beta = 0.579$, t-value = 7.01, p-value = 0.000; $\beta = 0.228$, t-value = 2.883, p-value = 0.004). Notably, these outcomes lend robust support to the formulated hypotheses H2a and H2b, thus fortifying the assertion that GCL engenders a noteworthy and affirmative association with both GPRI and GPCI. This harmonious alignment with the existing scholarly literature substantiates the premise that GCL serves as a catalyst in fostering green product and process innovation. This alignment echoes the sentiments expressed in the literature, which suggests that GCL plays a pivotal role in facilitating the exchange of information and nurturing mutual understanding between a company and its clientele (Feng et al., 2019; Kim et al., 2018; Huang et al., 2016).The synchronization between the empirical findings of this study and the insights offered by the scholarly discourse accentuates the pivotal role that customers assume in propelling enterprises towards the realms of green innovation. The empirical substantiation of the relationship between GCL and both GPRI and GPCI underlines the significance of customer insights, preferences, and feedback in shaping the innovative trajectories of environmentally conscious products and processes.

4.7.3 The Moderating Role of Market Turbulence

The outcomes of the study introduce a nuanced perspective when considering the moderating role of market turbulence (MT) in the context of the relationship between green supplier

learning and innovation. The structural equation modelling analysis yielded a blend of results, revealing diverse effects influenced by market turbulence.

Firstly, the results point to an intriguing scenario in which market turbulence positively moderates the connection between green supplier learning and green product innovation (β = 0.293, t-value = 6.323, p-value = 0.000). The endorsement of Hypothesis H3a underscores the notion that market turbulence amplifies the link between Green Supplier Learning and Green product innovation. This finding aligns with existing literature that highlights the capacity of market turbulence to bolster the relationship between green supplier learning and innovation (Zhao et al., 2018; Wong, 2014; Lisi et al., 2020). This suggests that, under conditions of greater market turbulence, the influence of Green Supplier Learning on Green product innovation is accentuated, fostering a more pronounced innovation outcome. Conversely, the results indicate a contrasting scenario with respect to the effect of market turbulence on green process innovation. Hypothesis H3b, which postulated that market turbulence would bolster the relationship between Green Supplier Learning and green process innovation, does not garner empirical support (β = 0.01, t-value = 0.155, p-value = 0.877). This unexpected outcome reveals a distinct facet of the relationship dynamics between these variables. The absence of a significant strengthening effect on green process innovation suggests a complex interplay that merits further exploration.

The correspondence between the empirical findings and the scholarly discourse reinforces the notion that the interplay between market turbulence, green supplier learning, and innovation is intricate and multifaceted. While literature indicates the potential of market turbulence to enhance the relationship between green supplier learning and innovation, the current study's findings spotlight a granularity that warrants deeper investigation, particularly in the realm of green process innovation.

In essence, the results reflect the dual nature of market turbulence as a moderating force in the relationship between green supplier learning and innovation. The empirical endorsement of H3a signifies the potential of market turbulence to amplify green product innovation. Simultaneously, the absence of support for H3b unveils an intricate dimension, urging scholars and practitioners to delve deeper into the complexities that dictate the relationship between green supplier learning and green process innovation.

Finally, the study fails to support the hypotheses H4a and H4b, regarding the strengthening effect of market turbulence on the relationship between green customer learning and green product innovation (β = -0.551, t-value = 7.496, p-value = 0.000) and the relationship green customer learning and green process innovation (β = -0.092, t-value = 0.995, p-value = 0.320). The literature, on the other hand, emphasizes that market turbulence strengthens green customer learning's impact on innovation (Lisi et al., 2020; Feng and Wang, 2016). The non-support for H4a and H4b calls for further investigation and might indicate that other contextual or intervening factors play a significant role in this relationship.

The study's results present a complex picture, with some hypotheses being supported and others not. The findings corroborate some aspects of the extant literature but diverge in others, indicating the multifaceted nature of the relationships between green supplier learning, green customer learning, market turbulence, and green innovation. The deviations between the study results and the existing literature open new avenues for research, shedding light on the intricate dynamics that underlie these relationships in the context of sustainability and organizational adaptability. The study emphasizes the need for a nuanced understanding, possibly integrating additional theoretical frameworks or considering other contextual variables that might influence these relationships.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a summary of the research findings, conclusions, recommendations, and future research ideas. The study's specific objectives were (1) To examine the relationship between green supplier learning and green innovation (2) To examine the relationship between green customer learning and green innovation (3) To examine the moderating effect of market turbulence on the relationship between green supplier learning and green innovation (4) To examine the moderating effect of market turbulence on green customer learning and green innovation.

5.2 Summary of Findings

5.2.1 Green Supplier Learning and Green Innovation

The first objective of the study was to examine the relationship between green supplier learning and green innovation. The study's structural equation modelling (SEM) results unveil a complex relationship between Green Supplier Learning and green innovation. The findings demonstrate a significant and negative association between Green Supplier Learning and both green product innovation (β = -0.775, t-value = 7.447, p-value = 0.000) and green process innovation (β = -0.558, t-value = 5.329, p-value = 0.000). These outcomes counter the hypotheses H1a and H1b, which suggested positive relationships. This divergence from the expected could be attributed to various factors, such as the specific context of the study, variations in the operationalization of variables, or the influence of unaccounted external

factors. The results indicate a more intricate dynamic that warrants further investigation and may prompt a re-evaluation of prevailing assumptions in the literature.

5.2.2 Green Customer Learning and Green Innovation

The second objective of the study was to examine the relationship between green customer learning and green innovation. The SEM analysis sheds light on the relationship between Green Customer Learning and green innovation, yielding a consistent and anticipated pattern. The results underscore a significant and positive connection between Green Customer Learning and both green product innovation ($\beta = 0.579$, t-value = 7.01, p-value = 0.000) and green process innovation ($\beta = 0.228$, t-value = 2.883, p-value = 0.004). These findings align with hypotheses H2a and H2b, which were postulated to have a positive relationship. The convergence between the empirical results and the literature suggests that fostering Green Customer Learning enhances the prospects of achieving successful green innovation outcomes. The validation of these hypotheses underscores the pivotal role that informed and engaged customers role in driving sustainable innovation efforts.

5.2.3 The Moderating Role of Market Turbulence

The third objective was to examine the moderating role of market turbulence on the relationship between Green Supplier Learning and Green Innovation.The study on this basis hypothesized that market turbulence positively moderates the relationship between Green Supplier Learning and Green innovation. The investigation into the moderating effect of market turbulence on the relationship between Green Supplier Learning and green innovation unveils intriguing dynamics. The results exhibit a dual effect. On one hand, market turbulence positively moderates the connection between Green Supplier Learning and green product innovation ($\beta = 0.293$, t-value = 6.323, p-value = 0.000), corroborating Hypothesis H3a. This suggests that

in the presence of heightened market turbulence, the positive influence of Green Supplier Learning on green product innovation is magnified. Conversely, H3b, proposing a similar effect on green process innovation, lacks empirical support (β = 0.01, t-value = 0.155, p-value = 0.877). This might be attributed to the intricate nature of green process innovation, which might be less responsive to market turbulence. The contrasting moderation effects highlight the intricate interplay of supplier learning, market conditions, and innovation outcomes.

The study also hypothesized that market turbulence positively moderates the relationship between green customer learning and green innovation. The study's investigation into the moderating role of market turbulence on the relationship between Green Customer Learning and green innovation yields intriguing insights. Market turbulence is found not to significantly moderate the relationship between Green Customer Learning and either green product innovation (β = -0.551, t-value = 7.496, p-value = 0.000) or green process innovation (β = -0.087, t-value = 0.995, p-value = 0.32). The lack of moderation support for H4a and H4b suggests that the relationship between customer learning and innovation outcomes remains relatively consistent across varying levels of market turbulence. This could indicate the robust nature of the customer-driven innovation dynamics, which may be less influenced by external market fluctuations.

5.2.4 Conclusion

In the landscape of sustainable innovation, where the quest for environmental responsibility intersects with the pursuit of competitive growth, the outcomes stemming from the Structural Equation Modelling (SEM) analysis unveil profound and multifaceted insights. This study embarked on an exploratory journey into the intricate interactions among green supplier learning, green customer learning, market turbulence, and their cumulative impact on green

innovation outcomes. The findings collectively rewrite conventional assumptions and deliver a more nuanced comprehension of the dynamics within this intricate domain. A pivotal discovery arises from the inquiry into the relationship between green supplier learning and green innovation. Defying prevailing hypotheses, the empirical evidence exposes a significant and unanticipated negative link between green supplier learning and both green product innovation and green process innovation. This counterintuitive finding implies that while supplier learning enhances the capacity for problem-solving, this doesn't guarantee a corresponding advancement in innovation outcomes. This revelation lays bare the intricate nature of the supplier-innovation relationship, underscoring the necessity for a contextual perspective that transcends learning capabilities.

In contrast, the investigation of green customer learning consistently aligns with projections. The empirical findings accentuate a robust and affirmative connection between green customer learning and both green product innovation and green process innovation. This validation of hypotheses underscores the pivotal role of well-informed and engaged customers in propelling organizations towards triumphant sustainable innovation. It accentuates the importance of mutual understanding and knowledge exchange between the firm and its clientele, forming the bedrock for prosperous innovation endeavours the introduction of market turbulence as a moderating factor injects a layer of complexity. While market turbulence magnifies the association between green supplier learning and green product innovation, its influence is not replicated in the realm of green process innovation. This intricacy underscores the multifaceted interaction of market conditions with supplier-driven innovation, prompting queries about the intricate determinants shaping innovation outcomes. Similarly, market turbulence's negligible moderating impact on the relationship between green customer learning and the dimension of green innovation underscores the stability of customer-driven innovation dynamics, even amid

fluctuations in the market. This study unravels a captivating narrative within the domain of sustainable innovation. The empirical revelations provide fresh perspectives on the intricate relationships involving green supplier learning, green customer learning, and the contextual impact of market turbulence. These outcomes collectively challenge established paradigms, beckoning a deeper exploration of these interactions. As organizations navigate the evolving landscape of sustainable innovation, these findings serve as a compass to navigate the complexities, guiding endeavours towards a harmonious blend of environmental stewardship and innovative prowess.

5.2.5 Recommendations for Managers

The unexpected negative association between green supplier learning and both green product innovation and green process innovation underscores the complexity of the supplier-innovation relationship. Supply chain managers should revisit their supplier learning strategies with a critical eye. Instead of solely focusing on enhancing problem-solving capabilities, consider a more holistic approach. This might involve nurturing partnerships that prioritize not only learning but also collaborative innovation efforts. Encourage suppliers to actively participate in the ideation and development phases of green innovations. By fostering a culture of innovation within their supplier network, they can potentially bridge the gap between learning and tangible innovation outcomes.

The consistent positive relationship between green customer learning and both dimensions of green innovation highlights the pivotal role of customer insights. Supply chain managers should recognize the immense value of well-informed and engaged customers in driving sustainable innovation efforts. Actively involve customers in the innovation process by seeking their feedback, preferences, and ideas. Managers must create channels for open communication

and knowledge exchange with their clientele. This can lead to the development of products and processes that align more closely with customer expectations and sustainability goals. Harness the power of customer-driven innovation to stay ahead in the competitive landscape.

The nuanced moderating role of market turbulence on the relationship between supplier learning and innovation outcomes warrants special attention. Supply chain managers should acknowledge that market conditions can significantly impact the effectiveness of supplier-driven innovation. In turbulent markets, considering recalibrating innovation strategies is necessary. Managers must invest in supplier relationships that are adaptable and responsive to changing market dynamics. Also, managers must encourage suppliers to provide innovative solutions that can thrive in uncertain conditions. This might involve diversifying your supplier base to spread risk or implementing flexible supply chain practices that can swiftly adapt to market shifts. Embracing agility and resilience in their supply chain can help harness the potential benefits of market turbulence on innovation.

The study's unexpected finding of a significant and negative association between green supplier learning and both green product and process innovation challenges conventional wisdom in sustainable innovation. Organizations aiming to enhance their green innovation outcomes may need to reevaluate their strategies regarding supplier learning. Rather than assuming a direct positive link between supplier learning and innovation, companies should adopt a more nuanced approach. This may involve understanding the specific contextual factors that influence the impact of supplier learning on innovation outcomes. Practically, organizations could tailor their supplier engagement strategies to consider not only learning capabilities but also other contextual elements that may be influencing the relationship.

The study contributes significantly to the academic understanding of sustainable innovation dynamics by revealing the intricate and nuanced relationships between green supplier learning, green customer learning, and market turbulence. This challenges existing knowledge paradigms and suggests the need for a more comprehensive and context-specific theoretical framework.

Policy implications arising from this study highlight the importance of recognizing the multifaceted nature of sustainable innovation. Policymakers should consider promoting not only supplier learning but also fostering effective communication and collaboration between suppliers and firms. Moreover, acknowledging the diverse effects of market turbulence on different facets of green innovation emphasizes the need for adaptive and flexible policies. Policymakers should encourage organizations to adopt strategies that can adapt to varying market conditions. Additionally, promoting initiatives that enhance customer awareness and education can play a crucial role in driving sustainable innovation. Overall, the study suggests that policies supporting a holistic and context-aware approach to sustainable innovation can be more effective in achieving meaningful environmental and economic outcomes.

5.3 Suggestion for Further Research

Future research might delve into the complex relationship between green supplier learning and green customer learning. While the current study recognizes the importance of both, a more nuanced examination of how these two aspects interact, influence each other, and shape green innovation would provide valuable insights. This could include the development of models or frameworks that precisely articulate the mechanisms of interaction and the conditions under which they exert the greatest influence on green innovation. Another area for future exploration could be conducting longitudinal studies that track how market turbulence impacts green

innovation over time. Such research could identify trends, patterns, and underlying dynamics that are not easily detectable in cross-sectional studies. Investigating how organizations navigate and adapt to varying degrees of turbulence, and how these adaptations influence their innovation processes, would contribute to a deeper and more robust understanding of the subject.

Future research could delve deeper into the contextual factors that mediate or moderate the relationship between supplier learning and green innovation. Additionally, exploring alternative models that capture the complex dynamics between supplier learning, customer learning, and market turbulence may contribute to refining theoretical perspectives in the field of sustainable innovation.

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APPENDIX

SURVEY QUESTIONNAIRE

My name is Barbara Duse. I am a Student at Kwame Nkrumah University of Science and Technology School of Business. This survey instrument has been designed to enable me carry out research on ***Green Supply Chain Learning (GSCL) and green innovation. The moderating Role of market turbulence in the retail sector in Ghana.*** The purpose of the research is to provide practical insights that will assist business executives in retail the retail sector to effectively green their supply chains to improve innovation. Any information provided will *ONLY* be used for general information, and it will be treated as ***HIGHLY CONFIDENTIAL.***

INSTRUCTIONS: Please kindly write in ink in the box which corresponds to the statement, which in your opinion is the most appropriate answer to the related question. For the following questions, kindly select by checking (✓) all that apply.

Title or Job Position in the Company [] supervisor [] middle manager [] top manager	Level of education: ☐ diploma/HND ☐ 1st Degree ☐ 2nd Degree or more
Number of Employees [] <6; [] 6-29; [ ] 30-59; [ ] 60-99; [ ] 100+	When was the company incorporated in Ghana? _____
Please place a check in your company's corresponding retail items	□Food; □Clothing and textiles; □Consumer durables; □Footwear; □building materials; □Jewellery; □Books, music, gift articles; □Fuel; □Pharmaceuticals
Please indicate the Revenue of the Company in New Ghana Cedis	□<40,000; □40,000-80,000; □80,000-120,000; □120,000-160,000; □160,000-200,000; □200,000-500,000; □500,000-1,000,000; □>1,000,000

Instructions: Indicate your opinion for the following statement by placing a checkmark (✓) in the right column under the 7-point Likert Scale.

	7-point Likert Scale						
	Strongly Disagree	Moderately Disagree	Disagree	Neither Agree nor Disagree	Agree	Moderately Agree	Strongly Agree
Our company has acquired important environmental protection information from our major supplier.							
Our company has learnt new environmental management abilities from our major supplier.							
Our capacities to maintain sustainable development has been enhanced by our relationship with major supplier enhances							
Our company constantly learns better ways to work with our major supplier jointly in dealing with environmental issues.							
Our company has established a strong capability in understanding green knowledge and skills of our major supplier.							

Our company has acquired important environmental protection information from our major customer.							
Our company has learnt new environmental management abilities from our major customer.							
our capacities to maintain sustainable development is enhanced by our relationship with major customer enhances							
Our company constantly learns better ways to work with our major customer jointly in dealing with environmental issues.							
Our company has established a strong capability in understanding green knowledge and skills of our major customer							
	Strongly Disagree	Moderately Disagree	Disagree	Neither Agree nor Disagree	Agree	Moderately Agree	Strongly Agree
Our company choose the materials of the product that produce the least amount of pollution for conducting the product development or design.							
Our company chooses the materials of the product that consume the least amount of energy and resources for conducting the product development or design.							
Our company's success and growth is due to the amount invested in reverse logistics affect							
Our company uses the fewest number of materials to comprise the product for conducting the product development or design.							
Our company would circumspectly deliberate whether the product is easy to recycle, reuse, and decompose for conducting the product development or design.							

Our company effectively reduces the emission of hazardous substances or waste.							
Our company recycles waste and emission that allow them to be treated and re-used.							
Our company reduces the consumption of water, electricity, coal, or oil.							
	Strongly Disagree	Moderately Disagree	Disagree	Neither Agree nor Disagree	Agree	Moderately Agree	Strongly Agree
Our customers' product preferences change quite a bit over time							
Our customers tend to look for new product all the time.							
Our products and services have seen increased demand from customers who never bought them.							
Our new customers tend to have product-related needs that are different from those of our existing customers.							
Our company caters for many of the same customers that we used to in the past.							

Thank you. Your participation is greatly appreciated. If you are interested in a personalized copy of the analyzed results, please attach a business card or provide your contact information.