KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI

COLLEGE OF HUMANITIES AND SOCIAL SCIENCES

SCHOOL OF BUSINESS

LOGISTICS FLEXIBILITY AND SUSTAINABILITY PERFORMANCE: THE MEDIATING ROLE OF SUPPLY CHAIN RESILIENCE

BY

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A thesis submitted to the Department of Supply Chain and Information Systems, in partial fulfilment of the requirements of the award of the degree of

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DECLARATION

I hereby declare that this submission is my own work toward the MSc. Logistics and Supply Chain Management degree, and that to the best of my knowledge, it contains no material previously published by another person, nor material that has been accepted for the award of any other degree of the University, except where due acknowledgement is made in the text.

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(Head, SCIS Department)	Signature	Date

DEDICATION

This thesis is dedicated to Mr and Mrs Ahumah- Gati, who has been my inspiration, mentor, and role model throughout my academic journey. Their unwavering support, encouragement, and guidance have been instrumental in shaping me as a person and as a scholar.

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ABSTRACT

Logistics flexibility is an essential aspect of modern supply chain management, providing companies with the ability to respond quickly and effectively to changing market conditions, customer demands, and unexpected disruptions. The study examines the mediating role of supply chain resilience on the relationship between logistics flexibility and sustainability performance, using the resource-based view and dynamic capability theories as the theoretical foundation. The study adopts ana explanatory research design to examine the relationship between logistics flexibility, supply chain resilience and sustainability performance. The research strategy was a survey of manufacturing firms in Ghana. The study adopted a quantitative research approach. The sampling technique adopted in this study is simple random sampling. The research approach is quantitative. The study targets Manufacturing Firms operating within the Greater Accra Region. Based on data obtained from 149 respondents, the study revealed no significant despite a positive relationship between logistics flexibility and sustainability. The study, however revealed a positive and significant effect of supply chain resilience on sustainability performance. Finally, the revealed an indirect effect of logistics flexibility on sustainability performance via supply chain resilience. The study recommends that supply chain managers to always make the conscious effort to enhance their supply chain resilience as part of their logistics flexibility initiatives. The study also recommends that, to increase social, economic and environmental sustainability throughout a firm's supply chain, supply chain managers should work to increase their resilience

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LIST OF ABBREVIATIONS

PSF	Physical supply flexibility
PCF	Purchasing flexibility
PDF	Physical distribution flexibility
DMF	Demand management flexibility
JIT	Just-in-time
SCRES	Supply Chain Resilience
LSP	Logistics Service Provider
SEM	Structural Equation Modelling
SME	Small- and Medium-sized
LOF	Logistics Flexibility
EFA	Exploratory factor analysis

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Amid the backdrop of intensifying market competition and fluctuating customer preferences, coupled with exacting service and quality stipulations, there is a palpable shift from the erstwhile rigid manufacturing landscapes to more adaptive and flexible systems (Phaxaisithidet and Banchuen, 2020). Manufacturing entities are increasingly grappling with the imperatives of flexibility and variable capacity utilization. Concurrently, the phenomenon of efficiency loss looms large, thereby underscoring the criticality of infusing greater logistics flexibility into the supply chain architecture (Phaxaisithidet and Banchuen, 2020). Logistics flexibility, as delineated by Yu et al. (2017) denotes an enterprise's alacrity and finesse in responding to variances in distribution, service provision, and ancillary support requisites. This notion of logistics flexibility transcends mere operational acumen; it epitomizes an organization's strategic competency to adapt its logistical framework in harmony with emerging market conditions, customer preferences, and unforeseen disruptions. A robust logistical framework serves as the underpinning for seamless operations, efficient inventory management, and optimal resource allocation. Consequently, logistics flexibility emerges as an instrumental factor in mitigating efficiency losses and optimizing capacity utilization.

The imperative to steer operations towards sustainability has gained pronounced emphasis in recent decades. Various catalysts both from within and outside organizations contribute to this shift. Legislative measures like environmental laws and regulations set a mandatory framework that compels compliance. In parallel, stakeholders increasingly vocalize their demand for sustainable goods and services, thereby influencing organizational policies. Interest groups and social advocates add another layer of pressure. Moreover, a focus on sustainability is not solely a matter of compliance or social responsibility; it offers a strategic advantage. Organizations that proactively engage in sustainable practices often find themselves in a favorable position to manage risks better, reduce operational costs through improved quality, and gain an advantageous footing against competitors through enhanced brand image (Mangla *et al.*, 2016).

Logistics flexibility serves as a pivotal link in this chain of sustainable operational management. Research by (Aziz *et al.*, 2017; Yu *et al.*, 2017) elucidates that logistical adaptability can significantly influence an organization's sustainability performance, defined as a multifaceted construct that spans environmental, social, and economic dimensions (Sandberg, 2020). This kind of flexibility enables companies to adjust and optimize their logistics and transportation systems. The potential here is twofold: firstly, optimized logistics systems are generally more efficient, which translates into lower costs and reduced waste; secondly, they are typically less taxing on the environment, which aligns with broader sustainability goals.

Furthermore, logistics flexibility infuses resilience into the supply chain, enabling it to respond to fluctuations in demand and supply effectively, thereby preventing overproduction or underproduction, both of which have environmental implications. By leveraging logistics flexibility, organizations can better align their operational strategies with sustainability imperatives, thereby satisfying stakeholder demands, conforming to legislative requirements, and fulfilling corporate social responsibilities.

However, logistics flexibility is bolstered by developing and enhancing the supply chain's resilience. Supply chain resilience practices enable firms to cope with quick changes through flexibility. Agility and robustness enable the business to configure its market, sales, and production in a way that relies on creating competitive advantages over rivals (Tosun and Uysal, 2015). Furthermore, a resilient supply chain has the dynamic capability to sense disruptions within the supply chain and make the necessary adjustments. Supply chain resilience is "the adaptive capability of the supply chain to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function (Birkmaier et al. 2021)

Accordingly, this study, drawing on the Resource-based view and dynamic capability theories, examines the role of supply chain resilience in the relationship between logistics flexibility and sustainability performance. The study posits that logistics flexibility could drive improvements in firms' social, environmental and economic performance as a unique internal organisational capability. The study's model is unique and contributes to the existing literature on reverse logistics.

1.2 Statement of the Problem

Logistics flexibility is the ability of the organisation to respond quickly to customer needs in delivery, support, and service. Making such adjustments requires a sufficient quantity and quality of information as a resource. Logistics flexibility includes many activities, such as organising inbound and outbound shipments, providing manufacturing support, and supplying information to coordinate these efforts. With logistics flexibility, a firm can delay commitment, embrace change, and fine-tune delivery to meet specific customer needs (Phaxaisithidet and Banchuen, 2020)

Although many studies have been conducted in the past on logistics flexibility, such prior studies have yielded inconsistent results. While some studies revealed a positive effect of logistics flexibility on performance outcomes such as firm performance, logistics network, customer satisfaction, management flexibility, customer loyalty, and competitive advantage (Hohenstein et al., 2015; Jafari, 2015; Jafari et al., 2016; Modgil et al., 2022), yet still other studies have revealed a negative effect of logistics flexibility (Hosseini *et al.*, 2019a; Juan *et al.*, 2022). Other studies (Basu, 2014; Pettit et al., 2019) have found no relationship between logistics flexibility and performance outcomes, whilst other researchers have found an indirect positive relationship (Birkmaier et al., 2021; Mandal et al., 2016). One possible reason for such inconsistency in finding could be the linking of logistics flexibility to different performance outcomes such as firm performance, logistics network, customer satisfaction, management flexibility, customer loyalty, and competitive advantage. Secondly, mediating and moderating variables such as logistics service quality, supply chain collaboration, environmental uncertainty, and logistics service quality could account for the inconsistencies in the logistics flexibility findings.

Prior studies have also emphasised that, although the importance and role of logistics flexibility cannot be denied, logistics flexibility as a lone variable is insufficient to drive performance results". Logistics flexibility is therefore highly influenced by a plethora of mediating and moderating variables. For example, Yu et al. (2017) emphasised that the relationship between logistics flexibility and relationship satisfaction is positively and significantly moderated by environmental uncertainty and logistics service quality. This emphasises that various complex mediating and moderating variables influence the logistics flexibility-performance relationship.

However, there are still gaps in the logistics flexibility literature. Of all the studies on logistics flexibility, no study has been conducted to examine the mediating role of supply chain resilience in the relationship between logistics flexibility and sustainability performance. This study, therefore, seeks to address the literature gaps and add to the existing knowledge on logistics flexibility by developing a unique research model that examines the mediating role of supply chain resilience in the relationship between logistics flexibility and sustainability performance.

1.3 Research Objectives

1.3.1 General Objectives

The study's main objective is to examine the mediating role of supply chain resilience in the relationship between logistics flexibility and sustainability performance.

1.3.2 Specific Objectives

Specifically, the study seeks to;

1. Examine the relationship between logistics flexibility and sustainability performance
2. Examine the relationship between supply chain resilience and sustainability performance
3. Examine the relationship between logistics flexibility and supply chain resilience
4. Examine the mediating role of supply chain resilience on the relationship between logistics flexibility and sustainability performance

1.4 Research Questions

The Study, therefore, seeks to provide answers to the following questions.

1. What is the relationship between logistics flexibility and sustainability performance?
2. In what ways does supply chain resilience relate to sustainability performance?
3. What is the relationship between logistics flexibility and supply chain resilience?
4. What is the mediating effect of supply chain resilience on the relationship between logistics flexibility and sustainability performance?

1.5 Justification of the Study

The study on logistics flexibility and sustainability performance, particularly considering the mediating role of supply chain resilience, carries significant implications in multiple spheres.

Firstly, in terms of the economic development of Ghana, the study is expected to contribute substantially to policy formulation and strategy design for industrialization and supply chain management. Ghana, being an emerging economy, requires robust and resilient supply chains to boost its industrial performance, attract foreign direct investment, and enhance its economic competitiveness globally. Through a rigorous examination of logistics flexibility and its impact on supply chain resilience, the study aims to offer key insights that could guide governmental efforts in improving infrastructure, regulatory frameworks, and industry practices. Thus, the study holds the potential to accelerate economic growth and development in Ghana.

Secondly, concerning future research, the study paves the way for an in-depth understanding of the dynamics between logistics flexibility, sustainability performance, and supply chain resilience. As this subject area remains relatively underexplored, the study provides a foundational framework upon which subsequent research can be built. It is expected to act as a catalyst for a new body of knowledge that integrates sustainability and resilience in supply chain models. Consequently, this could lead to the development of more comprehensive theories and methodologies that could be applicable not just to emerging economies like Ghana, but to global supply chains.

Lastly, for supply chain managers, the findings of this study offer practical implications for decision-making and strategy development. By identifying the key variables that affect supply chain resilience, the study empowers managers with the knowledge required to prioritize investments in logistics flexibility and sustainability measures. This, in turn, enhances their ability to adapt to market volatility, mitigate risks, and achieve operational excellence. Therefore, the study stands as a vital resource for professionals looking to refine their supply chain strategies and contribute effectively to organizational success.

1.6 Overview of Research Methodology

The study framework for this research utilized an explanatory design with the objective of closely examining the link between logistics flexibility, supply chain resilience, and performance in sustainability. Adopting a quantitative research approach, the study concentrated on the creation and verification of hypotheses. The primary mode of data gathering was a survey, aimed at private businesses operating within the Regional Capital. From the target population, a sample size of one hundred and fifty (150) was chosen using purposive sampling methods. To analyze the data, the researcher executed ordinary least squares regression and moderated hierarchical moderation, employing IBM SPSS software, version 26.

1.7 Scope of the Study

The geographical focus for this research was the Greater Accra region in Ghana. Data was collected from private companies situated within this specific geographical area to empirically test the proposed theoretical framework. For measuring logistics flexibility, which serves as the predictor variable, the study employed seven (7) items from the works of Basu (2014) and Yu et al. (2017). In the case of supply chain resilience, which functions as the mediating variable, the study utilized five (5) items derived from research conducted by Pettit et al. (2019). For assessing sustainability performance, the dependent variable, the study incorporated fifteen (15) items from Kamble et al. (2020b).

1.8 Limitations of the Study

Firstly, the geographical focus of the study on the economic context of Ghana restricts the generalizability of its findings. Due to the unique economic, regulatory, and cultural conditions prevalent in Ghana, the outcomes may not apply seamlessly to other nations or broader economic contexts. This specific focus inherently limits the applicability of the study's insights to other geographical settings.

Another limitation resides in the study's methodology, particularly in its focus on the mediating role of supply chain resilience between logistics flexibility and sustainability performance. By choosing to explore the relationships among these specific variables, the study overlooks other potential mediating or moderating variables that could affect logistics flexibility and

sustainability performance. This exclusive focus narrows the scope of the inquiry and could lead to an incomplete understanding of the complexity of supply chain dynamics.

1.9 Organisation of the Study

The thesis is structured into five principal chapters to facilitate a logical progression and comprehensive understanding of the research. The initial chapter, titled "Introduction," outlines the background, problem statement, research objectives, research questions, justification for the study, an overview of the methodology, scope, limitations, and the organization of the study itself. Following this, the second chapter, labeled "Literature Review," encompasses the conceptual, theoretical, and empirical foundations of the study, as well as presenting the conceptual framework. The third chapter, termed "Methodology," elaborates on the research design, target population, sample size, sampling techniques, methods of data collection and analysis, tests for reliability and validity, ethical considerations, and a profile of the geographical area under study. The penultimate chapter, "Data Analyses," discusses participant demographics, confirmatory factor analyses, descriptive statistical analyses, tests of the research model, and interpretation of the findings. The final chapter, named "Summary, Conclusion, and Recommendations," completes the thesis by summarizing the research findings, drawing conclusions, providing recommendations, and suggesting avenues for future research.

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of pertinent literature on the study's variables. Chapter 2 begins with a conceptual review section that defines and discusses the key constructs of logistics flexibility and sustainability performance based on prior literature. This is followed by a theoretical review section that summarizes two relevant theories - the resource-based view and dynamic capabilities perspective - which provide a foundation for hypothesizing relationships between logistics flexibility and sustainability performance. The chapter then includes an empirical review section highlighting findings from previous studies that have empirically examined connections between these constructs as well as the potential mediating role of supply chain resilience. After laying this conceptual, theoretical, and empirical groundwork, the next section puts forth the study hypotheses and introduces the conceptual framework guiding this research.

2.2 Conceptual Review

This section reviews the concepts of logistics flexibility, supply chain resilience and sustainability performance in the light of existing literature.

2.2.1 Logistics Flexibility

Logistics Flexibility refers to an organization's aptitude for swiftly and proficiently responding to varying requirements concerning distribution, services, and support. This capability is achieved through proactive forecasting and real-time monitoring of the flow and storage of goods, from production to consumption. It entails nimble practices not only within the organization but also among its external partners (Yu et al., 2017). Such flexibility enhances customer service by aligning the dispatch of products with customer demands (MaldonadoGuzman et al., 2017). According to Tosun and Uysal (2015), this organizational asset is divided into four dimensions: Physical Supply Flexibility (PSF), Purchasing Flexibility (PCF), Physical Distribution Flexibility (PDF), and Demand Management Flexibility (DMF). Each dimension addresses different aspects of the supply chain, ranging from the procurement and storage of materials to meeting customer requirements effectively.

Furthermore, Logistics Flexibility is defined as a company's ability to react expeditiously and adeptly to continuous shifts in customer preferences in both inbound and outbound logistics, services, and support (Birkmaier et al., 2021). Rather than relying solely on forecasts, it allows organizations to respond to real-time demand, encompassing activities such as managing inbound and outbound shipments and coordinating manufacturing support (Sandberg, 2020). This form of flexibility also enables a company to defer commitments, adapt to changes, and tailor deliveries to meet unique customer requirements.

Logistics Flexibility aligns with a market-oriented strategy, where all stakeholders collaborate to establish a supply chain that is both quick and reliable (Jafari et al., 2016). Birkmaier et al. (2021) note that the importance of flexibility amplifies when contemplating the entire supply chain, which constitutes a complex network involving supply, production, and delivery firms. In such scenarios, a multitude of uncertainties must be managed, including fluctuating market demand, variable supplier lead times, product quality, and information delays. Flexibility in logistics provides the necessary agility for shifting production across different plants and suppliers, enabling management to adapt to both internal and external variances effectively.

2.2.1.1 Enhancing Logistics Flexibility

Enhancing logistics flexibility requires a comprehensive approach that involves a combination of strategies and tactics. In literature, the following strategies have been discussed.

- **Develop a culture of flexibility:** A flexible logistics system requires a culture that values agility, responsiveness, and adaptation. Companies should prioritize flexibility in their organizational culture and encourage employees to think creatively and adapt to changing circumstances (Yu *et al.*, 2017).
- **Invest in technology:** Technology can help to improve logistics flexibility by providing real-time data, analytics, and collaboration tools. Companies should invest in technology that supports flexibility, such as cloud-based software, mobile applications, and digital platforms that enable collaboration between different parts of the logistics system (Maldonado-Guzman *et al.*, 2017).

- **Diversify suppliers:** Relying on a single supplier for key components or raw materials can be risky, as disruptions at that supplier can cause significant supply chain

disruptions. Companies should consider diversifying their supplier base to reduce this risk and increase flexibility (Phaxaisithidet and Banchuen, 2020).

- **Develop contingency plans**: Companies should develop contingency plans that outline the steps to take in the event of disruptions, such as natural disasters, transportation disruptions, or supplier failures. These plans should be regularly reviewed and updated to ensure they remain relevant and effective (Shah and Sharma, 2014).
- **Implement just-in-time (JIT) inventory management:** JIT inventory management can help to improve logistics flexibility by reducing the amount of inventory held in stock and providing greater flexibility in response to changes in demand (Tosun and Uysal, 2015).
- **Foster collaboration:** Collaboration between different parts of the logistics system, such as suppliers, carriers, and customers, is essential for logistics flexibility. Companies should prioritize collaboration and develop processes and tools that support it (Sandberg, 2020).
- **Train employees:** Logistics flexibility requires employees who are skilled in adapting to changing circumstances and thinking creatively. Companies should invest in employee training and development to build these skills (Jafari *et al.*, 2016).

2.2.1.2 Benefits of Logistics Flexibility

The key benefits associated with logistics flexibility has been summarized by (Aziz *et al.*, 2017; Basu, 2014; Fantazy *et al.*, 2012). These are discussed below:

- **Improved responsiveness**: Logistics flexibility allows a company to respond quickly to changes in the market and in customer demand. This can help companies to better meet customer needs, improve customer satisfaction, and maintain a competitive advantage.
- **Reduced costs:** A flexible logistics system can help to reduce costs by minimizing the need for excess inventory, reducing transportation costs, and optimizing production and distribution capacity.
- **Improved agility:** A flexible logistics system can help companies to quickly adapt to unexpected disruptions, such as supply chain disruptions or transportation disruptions.

- **Improved efficiency:** Logistics flexibility can help to improve the overall efficiency of a logistics system by reducing waste, optimizing resources, and improving coordination and communication between different parts of the system.
- **Improved collaboration:** Flexible logistics systems require collaboration between different parts of the logistics system, such as suppliers, carriers, and customers. This can help to improve relationships and lead to better overall performance.

2.2.1.3 Challenges of Logistics Flexibility

Logistics flexibility has become an increasingly important factor for companies seeking to improve their supply chain performance and meet customer demands in an ever-changing market. However, while logistics flexibility offers many benefits, it also presents several challenges that must be addressed to ensure successful implementation. The challenges associated with logistics flexibility have been summarized by (Aziz *et al.*, 2017; Basu, 2014; Fantazy *et al.*, 2012)

- **Increased complexity:** Developing a flexible logistics system can be complex, requiring significant investment in technology, training, and organizational change.
- **Increased risk:** A flexible logistics system can be more vulnerable to disruptions, as there may be more points of failure and greater reliance on suppliers and carriers.
- **Increased costs:** While a flexible logistics system can help to reduce costs in the long term, there may be significant upfront costs associated with implementing new technology, training employees, and developing new processes.
- **Reduced stability:** A flexible logistics system may be less stable than a more rigid system, as it requires constant adaptation and adjustment to changing circumstances.
- **Reduced control**: A flexible logistics system may require companies to relinquish some control over certain aspects of the logistics system, such as relying on third-party carriers or suppliers.

2.2.2 Supply Chain Resilience (SCRES)

Supply Chain Resilience (SCRES) is understood as an organization's capability to endure disruptions and recuperate, either to its initial state or to a more favorable condition (Gunasekaran et al., 2015). Pettit et al. (2019) further elucidate this concept through the "four

Rs": robustness, resourcefulness, recovery, and review. Various strategies to bolster SCRES are discussed in academic literature, with Davis-Sramek and Richey (2021), Mandal et al. (2016b), and Tukamuhabwa et al. (2015) among those offering diverse approaches. Key organizational capabilities that notably enhance resilience include flexibility, agility, collaboration, and redundancy (Gunasekaran et al., 2015; Ivanov, 2018a; Jain et al., 2017; Singh and Singh, 2019).

Shekarian and Mellat-Parast (2021) advocate for the incorporation of resource redundancy, agility, supplier flexibility, and collaborative planning as essential components of a risk management culture aimed at fostering SCRES. Ivanov (2018) outlines twenty-four distinct strategies to achieve resilience, highlighting those enhancements in flexibility, agility, collaborative relationships within the supply chain, and resource redundancy exert the most significant impact on improving SCRES. Similarly, Scholten et al. (2014) and Hosseini et al. (2019) indicate that strategic and manufacturing flexibility contribute to greater supply chain agility.

In addition, supply chain resilience serves as a critical factor for an organization's capacity to react and adapt to unanticipated disruptions stemming from various sources, such as natural calamities, geopolitical uncertainties, cyber threats, or sudden shifts in consumer demand (Wieland and Wallenburg, 2013). Thus, the implementation of effective resilience strategies remains indispensable for sustaining operations, curtailing interruptions, and ensuring customer satisfaction.

2.2.2.1 Building Supply Chain Resilience

To build resilience into their supply chain, companies can adopt several strategies:

- **Diversify suppliers:** By having multiple suppliers, a company can reduce its dependence on any one supplier and better respond to disruptions (Min, 2019).
- **Build redundancy into the supply chain:** Companies can have backup plans and alternative sources of supply for critical components or materials to avoid supply chain disruptions (Munoz and Dunbar, 2015).
- **Improve communication and collaboration with suppliers:** A strong relationship with suppliers can improve the flow of information and increase transparency, enabling

companies to better understand potential risks and respond quickly to disruptions (Scholten and Schilder, 2015).

- **Implement risk management strategies:** Companies can use risk management tools to identify and assess potential risks to their supply chain and develop strategies to mitigate or manage those risks (Scholten and Schilder, 2015).
- **Invest in technology:** Technologies like advanced analytics, machine learning, and blockchain can provide real-time visibility into supply chain operations and help companies anticipate and respond to disruptions (Ivanov, 2018).

2.2.2.2 Benefits of Supply Chain Resilience

In supply chain resilience literature, the benefits associated with resilience have been extensively reviewed. The key benefits as summarized by (Abeysekara et al., 2019; Hosseini et al., 2019; Scholten and Schilder, 2015; Wieland and Wallenburg, 2013) are discussed below:

- **Reduced disruption costs:** Supply chain resilience can reduce the costs associated with disruptions such as lost sales, lost production, and increased transportation costs.
- **Improved customer satisfaction:** Supply chain resilience can help ensure that products and services are delivered to customers on time, which can improve customer satisfaction and loyalty.
- **Competitive advantage:** A resilient supply chain can provide a competitive advantage by enabling companies to quickly recover from disruptions and maintain business continuity.
- **Increased supply chain visibility:** Supply chain resilience can lead to increased visibility into the supply chain, allowing companies to better identify and mitigate potential risks.
- **Enhanced stakeholder confidence:** A resilient supply chain can enhance stakeholder confidence in a company's ability to manage risks and ensure business continuity.
- **Enhanced supplier relationships:** A resilient supply chain can help build stronger relationships with suppliers by increasing transparency, improving communication, and facilitating collaboration.
- **Increased agility:** A resilient supply chain can increase agility, enabling companies to quickly adapt to changes in the market or respond to unexpected events.

- **Improved risk management:** Supply chain resilience can improve risk management capabilities by helping companies better understand and prepare for potential risks.

- **Better decision-making:** Supply chain resilience can provide companies with better data and insights, enabling more informed decision-making and better risk assessment.

2.2.2.3 Challenges of Supply Chain Resilience

While there are many benefits to building a resilient supply chain, such as reduced disruption costs and improved customer satisfaction, there are also several challenges that companies may encounter when developing and implementing a resilience strategy. In this context, it is important for companies to carefully consider these challenges and develop strategies to address them in order to build a more resilient supply chain. These challenges as discussed by (Hosseini et al., 2019; Scholten et al., 2014) are provided below:

- **Increased costs:** Building a resilient supply chain can require additional investments in redundancy, inventory, and risk management.
- **Complexities in implementation:** Developing and implementing a supply chain resilience strategy can be complex, requiring collaboration across multiple functions and stakeholders.
- **Difficulty in measuring effectiveness:** Measuring the effectiveness of supply chain resilience can be challenging, as it requires capturing both the costs of disruptions and the benefits of resilience.
- **Uncertainty in risk assessment:** Assessing the potential risks to the supply chain can be difficult, as risks can be unpredictable and constantly evolving.
- **Limited resources:** Small and medium-sized enterprises may lack the resources to invest in building a resilient supply chain, putting them at a disadvantage compared to larger firms.
- **Lack of standardization:** There is currently no widely accepted standard for measuring supply chain resilience, which can make it difficult for companies to benchmark their resilience efforts against others in the industry.
- **Difficulty in managing supplier dependencies:** As supply chains become increasingly complex and global, it can be difficult to manage dependencies on key suppliers, which can create vulnerabilities and risks.

2.2.3 Sustainability Performance

Performance measurement remains a well-trodden concept in business studies, yet scholars have not reached a consensus regarding its definitive understanding. Singh et al. (2020) perceives it as the gauge for an organization's success level, while Shahzad et al. (2020) sees it as a method for assessing how proficiently organizations are managed and the value they provide to customers and other stakeholders.

In the context of business and corporate social responsibility, sustainability performance emerges as a more recent topic of discussion. Its objective is to scrutinize the social, environmental, and economic aspects of corporate management, particularly focusing on sustainability (Modgil et al., 2022b). Hohenstein et al. (2015) define it as the activity of assessing and managing the business's interplay with society and the environment across various dimensions and sustainability criteria. Saberi et al. (2019) note that robust management frameworks that tie environmental and social management to business and competitive strategies are essential for sustainability performance management.

Sustainability itself often receives interpretation through the triple bottom line framework: economic, social, and environmental dimensions (Narimissa et al., 2020). The economic aspect considered the backbone of all organizational endeavours, which includes activities that maintain competitiveness by judicious use of resources (Jia et al., 2018; Paulraj et al., 2017). Genovese et al. (2017) and Formentini and Taticchi (2016) emphasize its role in long-term viability and potential for sustained production. Brandenburg and Rebs (2015) and Kot (2018) extend this to include broader societal impacts, such as employment and tax contributions.

Environmental sustainability focuses on practices aimed at minimizing adverse impacts on natural resources (Hong et al., 2018; Ivanov, 2018c). The dimension extends to actions such as waste management, energy conservation, and the use of sustainable technologies like solar panels and biogas (Thaiprayoon et al., 2019; Ji et al., 2020).

Social sustainability pertains to an organization's initiatives aimed at enhancing social equity and fulfilling basic human needs (Kaur and Mehta, 2017). Definitions by Schilke et al. (2018) and Ou et al. (2015) elaborate on its scope, including the provision of social services like education and healthcare and promotion of gender equality. Dillard et al. (2019) and Correia et

al. (2020) describe it as a comprehensive concept that encompasses administrative actions and contributions to human potential and societal resources.

Thus, the term "performance," while not novel in business studies, gains intricate layers of meaning when associated with sustainability, requiring a multi-dimensional approach for adequate measurement and management.

2.3 Theoretical Review

The present study engages with the Resource-Based View (RBV) and Dynamic Capabilities theories as guiding frameworks to investigate the moderating role of Supply Chain Resilience (SCRES) in the relationship between Logistics Flexibility and Sustainability Performance

2.3.1 Resource-based View Theory

The Resource-Based View (RBV) theory posits that a firm's growth and competitive advantage hinge on its unique resources and capacities (Barney, 2020). Resources are the critical determinants of a firm's performance and abilities, and they must be sufficiently leveraged to achieve organizational objectives (Molloy and Barney, 2015). The RBV asserts that the firm's competitive edge lies in its resource endowments, which are diverse and can serve as avenues for operational excellence (Barney, 2020).

In relation to the present study, logistics flexibility and sustainability performance are considered organizational resources that confer competitive advantage in supply chain operations. Logistics flexibility enables firms to adapt swiftly to variations in production, demand, or distribution. Sustainability performance allows a firm to integrate economic, environmental, and social dimensions in its functioning. Supply chain resilience serves as a capability that amplifies the effective utilization of these resources. The RBV theory implies that companies investing in logistics flexibility and sustainability performance gain a competitive advantage, a benefit that is heightened by the intermediary role of supply chain resilience. Essentially, the resilience of a firm's supply chain enhances its ability to capitalize on logistics flexibility and sustainability performance, thereby improving overall performance and sustaining competitive advantage.

2.3.2 Dynamic Capability Theory

The dynamic capability theory, introduced by David Teece and collaborators in the late 1990s, extends the principles of resource-based theories by emphasizing not just the ownership of unique resources and capabilities, but also their ongoing adaptation and reconfiguration in response to evolving market landscapes (Teece, 2018). Unlike traditional theories that focus primarily on resource endowment as a static feature, dynamic capability theory underscores the constant reshaping and updating of resources and capabilities as an integral part of maintaining competitive advantage (Schoemaker et al., 2018).

This theory is particularly concerned with how organizations maintain a competitive edge over time by effectively adapting to changing environments. It posits that to sustain competitive advantage, firms must regularly evolve and refine their organizational capabilities to meet the demands of a shifting market and respond to competitive pressures (Teece, 2018). In essence, the dynamic capability framework transcends the static view of resources and integrates adaptability as a critical variable in the equation of long-term competitive advantage.

Giniuniene and Jurksiene (2015) emphasise that there are three types of dynamic capabilities that organizations need to develop:

- **Sensing capabilities:** These refer to an organization's ability to detect changes in the market environment and identify new opportunities and threats.
- **Seizing capabilities:** These refer to an organization's ability to quickly and effectively take advantage of new opportunities through the allocation of resources and the development of new products, services, or processes.
- **Transforming capabilities:** These refer to an organization's ability to adapt and reconfigure its existing resources and capabilities to meet new challenges and sustain its competitive advantage over time.

Dynamic capability theory further suggests that organizations that are able to effectively develop and deploy these dynamic capabilities are more likely to achieve and sustain a competitive advantage over time. The theory has been widely applied in the fields of strategic management, innovation management, and organizational change (Lee and Rha, 2016).

The dynamic capability theory suggests that firms need to develop and refine a range of capabilities in order to respond effectively to changing market conditions (Teece *et al.*, 2016). Some examples of dynamic capabilities include:

- **Innovation Capabilities:** Firms that are able to develop and introduce new products, services, or processes more quickly and effectively than their competitors are more likely to achieve a competitive advantage.
- **Strategic Flexibility:** Firms that are able to adjust their strategies and business models in response to changes in market conditions are more likely to succeed over the long term.
- **Learning Capabilities:** Firms that are able to learn from their own experiences as well as those of others in their industry are more likely to be able to adapt to new challenges and opportunities.

The dynamic capability theory identifies three key concepts that are critical to understanding how firms can achieve and sustain competitive advantage over time (Teece *et al.*, 2016):

- **Resource Base:** This refers to the set of resources and capabilities that a firm possesses at any given point in time, including physical, financial, human, and intellectual resources.
- **Dynamic Capabilities:** These are the processes and activities that firms use to adapt and reconfigure their resource base in response to changing market conditions, such as innovation, strategic repositioning, and organizational learning.
- **Sustainable Competitive Advantage:** This is the ultimate goal of dynamic capability theory - firms that are able to develop and deploy dynamic capabilities effectively are more likely to achieve and sustain a competitive advantage over time.

In the context of this research, the dynamic capability theory offers a conceptual lens through which the role of logistics flexibility in achieving and sustaining competitive advantage in the logistics industry can be understood. The theory underlines the significance of dynamic capabilities, including logistics flexibility, for detecting, seizing, and transforming market opportunities and challenges. Logistics flexibility serves as an essential dynamic capability that permits firms to adapt rapidly and proficiently to alterations in the market, such as fluctuating demand, supply chain interruptions, or changes in regulations.

This flexibility in logistics facilitates firms in remaining competitive by adjusting swiftly to market variations. For instance, companies capable of promptly modifying their production and distribution systems in line with evolving consumer preferences or supply chain obstacles have a greater likelihood of enduring success. Therefore, dynamic capability theory provides valuable insights into the mechanisms by which logistics flexibility contributes to a firm's adaptability and long-term competitiveness.

2.4 Empirical Review

This section reviews the literature related to logistics flexibility and supply chain resilience.

Yu et al. (2017) conducted an inquiry into the relationship between suppliers and buyers in a distribution channel, utilizing contingency theory. They posited that logistics flexibility and relationship flexibility exert different influences on logistics service quality and satisfaction, depending on environmental factors. Data collected from Chinese manufacturers were analyzed through structural equation modeling and moderated regression. The study confirmed that both types of flexibility positively influence logistics service quality and, consequently, the firm's satisfaction with its key accounts.

Aziz et al. (2017) scrutinized the linkage between logistics flexibility and value-added capability in impacting the performance of Logistics Service Providers (LSPs). Through a survey of LSPs in Malaysia, they found that both logistics flexibility dimensions (operational flexibility and supply chain flexibility) had significant positive effects on value-added capabilities like packaging, labeling, and assembly. Further, their results from partial least square analysis indicated that these value-added capabilities fully mediate the relationship between logistics flexibility and LSP performance outcomes like cost, quality, delivery, and flexibility. They concluded that developing logistics flexibility allows LSPs to enhance valueadded capabilities, which in turn improve operational performance.

Maldonado-Guzman et al. (2017) aimed to explore the influence of logistics flexibility on customer satisfaction, gathering survey data from 322 companies in Spain's furniture industry. Their measures of logistics flexibility included adaptability, versatility, and response time. Using regression analysis, their findings demonstrated a positive impact of all three logistics flexibility dimensions on perceived customer satisfaction related to logistics services. They

concluded that furniture companies should invest in improving logistics flexibility in order to meet customer needs and enhance satisfaction.

Zhang et al. (2005) contended that logistics flexibility is pivotal for firms to adapt to an unpredictable environment. Using a large sample of respondents from the Society of Manufacturing Engineers in the USA, they developed and validated reliable instruments to measure various dimensions of logistics flexibility (e.g. operations systems flexibility, market flexibility) as well as logistics capability. Their survey results and structural equation modeling confirmed strong, positive relationships between flexible logistics competence, capability, and customer satisfaction. The study highlights the importance of logistics flexibility for manufacturing firms to achieve customer satisfaction and competitive advantage.Birkmaier et al. (2021) conducted an in-depth analysis focusing on the effects of digital transformation, specifically within the ambit of Industry 4.0, on the resilience of production and logistics networks. By employing simulation techniques, the researchers demonstrated that advancements in lot size algorithms significantly reduce average inventory levels of semifinished products. This study provides substantial evidence for organizations contemplating adopting digital transformation strategies, particularly in the production and logistics sectors, to enhance operational efficiency.

Hohenstein et al. (2015) presented a broad review aimed at identifying existing gaps and areas necessitating future research in the domain of Supply Chain Resilience (SCRES). The review revealed a noticeable absence of universal definitions and terminologies within the field. Moreover, it articulated the need for additional quantitative research to foster a more rigorous understanding of supply chain resilience. The study serves as a cornerstone for researchers and practitioners interested in bringing empirical rigor to the discipline.

Shah and Sharma (2014) undertook an exhaustive study to examine various elements constituting logistics flexibility and their subsequent impact on customer satisfaction. The study highlighted the critical differentiation between logistics competence and capability, elucidating that focusing on specific sub-dimensions could lead to higher levels of customer satisfaction. Their work suggests that organizations can enhance customer satisfaction by identifying and optimizing these crucial sub-dimensions within the broader framework of logistics flexibility.

Phaxaisithidet and Banchuen (2020) carried out an empirical investigation to assess the influence of logistics flexibility and service quality on the competitive advantage of logistics service users. Their research concluded that logistics flexibility exerts both direct and indirect effects on gaining a competitive advantage. They further identified service quality as a mediating factor, illuminating the interconnectedness between logistics flexibility, service quality, and competitive advantage. This study provides empirical evidence for companies seeking to leverage logistics flexibility and service quality to enhance their competitive positioning.

Hartmann and de Grahl (2011) devised a conceptual model exploring how flexibility within Logistics Service Providers (LSPs) affects customer loyalty. Their empirical findings established that flexibility in LSPs strongly contributes to the core dimensions of customer loyalty. This implies that LSPs can gain a competitive edge by focusing on flexibility as a critical component in maintaining and enhancing customer loyalty. Their study serves as a valuable resource for logistics service providers aiming to optimize their service offerings to enhance customer loyalty and secure a competitive advantage.Jafari et al. (2016) conducted an inquiry into the role of postponement in retail sectors and its linkage to logistics flexibility. Through primary qualitative data gathered from case studies in the electronics, furniture, and grocery sectors in Sweden, they observed diverse practices in postponement but also identified a growing trend toward the adoption of postponement among retailers.

Fantazy et al. (2012) conducted a comprehensive study to examine the relationship between strategic alignment, Logistics Flexibility (LOF), and operational performance among Small and Medium-sized Enterprises (SMEs) in the Canadian manufacturing sector. Utilizing a questionnaire-based approach and Structural Equation Modeling, the study concluded three significant insights: first, there exists a positive and direct correlation between an organization's strategic focus and its Logistics Flexibility; second, a positive direct relationship between LOF and operational performance is evident; and third, the combined effect of strategic alignment and LOF positively influences operational performance. This study offers valuable insights for SMEs aiming to align their strategic priorities with logistics flexibility to enhance operational efficacy.

Onwuegbuchunam and Obayi (2015) carried out a detailed analysis to explore the connection between supply chain resilience and operational performance in Nigeria's construction

industry. A survey comprising 170 construction firms followed by regression analysis substantiated a significant and positive correlation between supply chain resilience and operational performance in the construction sector. The study is particularly useful for practitioners in construction looking to boost operational efficiency through enhanced supply chain resilience.

El Saadany et al. (2016) embarked on a rigorous empirical study aimed at evaluating the influence of supply chain resilience on firm performance within Egypt's automotive industry. Employing structural equation modeling on a dataset from 106 automotive firms, the study found that supply chain resilience favorably affects company performance. This finding is noteworthy for automotive companies in emerging markets that are seeking to optimize their supply chain for improved performance.

Dubey et al. (2017) performed an extensive literature review to scrutinize the relationship between supply chain resilience and digitalization. The review identified gaps in existing research and suggested prospective directions for academic inquiry. The study is significant for scholars interested in the intersection of supply chain resilience and digital transformation, offering a roadmap for future research in this domain.

Ezeuduji and Chan (2018) conducted an empirical study to investigate the effects of supply chain resilience on sustainable performance within Nigeria's oil and gas sector. Employing a survey of 70 firms and structural equation modeling techniques, the research confirmed that supply chain resilience positively influences sustainable performance. This study contributes valuable knowledge to the oil and gas industry, particularly in contexts where sustainability is a focal concern.

Naim and Gosling (2018) examined the association between supply chain resilience and business performance in the UK's manufacturing sector. Using structural equation modeling on data collected from 172 firms, the study demonstrated that supply chain resilience has a positive impact on overall business performance. The study offers empirical evidence for manufacturing firms in developed economies, suggesting that investing in supply chain resilience can be a lever for improving business outcomes.

Gupta et al. (2019) investigated the level of supply chain resilience in India's automotive industry, utilizing a fuzzy logic methodology. The study indicated that the automotive sector in India exhibits a moderate degree of supply chain resilience, shedding light on the vulnerabilities and strengths of supply chain systems in emerging markets. This research provides a nuanced understanding of how resilience metrics can be quantified and utilized for performance enhancement in the automotive sector.

Haque and Islam (2019) engaged in a comprehensive analysis that explored the relationship between supply chain resilience and organizational effectiveness in Bangladesh's garment sector. The study utilized regression analysis on data from 120 firms and confirmed a positive correlation between supply chain resilience and organizational effectiveness. The findings bear significance for the garment industry, especially in emerging economies where supply chain resilience can be a determinant of organizational success.

Kim et al. (2020) developed and empirically tested a framework designed to bolster supply chain resilience, with a specific focus on South Korea's semiconductor industry. The study established the efficacy of the proposed model in enhancing supply chain resilience, offering important implications for sectors reliant on complex supply chain structures.

Jüttner and Maklan (2020) executed an exhaustive literature review concerning supply chain resilience in the context of digital transformation. Their review identified untapped research areas and suggested future avenues of investigation, thereby contributing to the expanding body of knowledge on supply chain resilience in digitally transforming environments.

Jiang et al. (2021) conceived a model aimed at assessing the resilience of perishable product supply chains that are susceptible to multiple forms of disruption. Employing simulation techniques and empirical data from China's fresh food industry, the study validated the utility of their framework in increasing supply chain resilience. This finding holds particular relevance for sectors dealing with perishable goods and multiple supply chain risks.

Qiao et al. (2021) investigated the role of supply chain integration in influencing supply chain resilience among manufacturing firms in China. Utilizing structural equation modeling, the study ascertained that supply chain integration has a positive impact on resilience, and this

relationship is mediated by organizational learning. The research sheds light on the nuances of supply chain dynamics and organizational capabilities in resilience building.

Safa et al. (2021) studied the effect of supply chain resilience on operational performance under uncertain conditions and highlighted the moderating role of supply chain agility. Employing a survey of 139 Iranian manufacturing firms and hierarchical regression analysis, the study found that supply chain resilience positively impacts operational performance, a relationship moderated by supply chain agility. This conclusion is pivotal for organizations aiming to understand the variables that influence performance under uncertainty.

Jia et al. (2015) explored the impact of logistics flexibility on supply chain performance in China's electronics sector. Through a case study approach and structural equation modeling, the research concluded that logistics flexibility has a favorable impact on supply chain performance. The study offers valuable insights for sectors with complex logistics and supply chain structures.

Yang et al. (2016) examined the relationships between logistics flexibility, logistics competence, and export performance, while also considering the moderating role of logistics innovation capability. Data for the study were collected from 193 Taiwanese companies and analyzed using hierarchical regression. The study established that both logistics flexibility and competence are positively correlated with export performance, providing significant implications for export-oriented firms.

Nguyen et al. (2021) assessed the impact of logistics flexibility on supply chain performance in Vietnam's retail sector. Using data from a survey of 199 retail firms and subsequent regression analysis, the study concluded that logistics flexibility positively influences supply chain performance. This research serves as an important reference for retail sectors in emerging economies.

Xie and Wang (2021) evaluated how logistics flexibility affects supply chain resilience within the broader framework of supply chain agility. With data collected from a survey of 214 Chinese manufacturing firms and analyzed through structural equation modeling, the study affirmed that logistics flexibility has a positive effect on supply chain resilience, a relationship

partially mediated by supply chain agility. This research underscores the interconnectedness of flexibility, resilience, and agility in supply chain management.

Vujović and Šarac (2019) explored the influence of logistics flexibility on firm performance in Serbia. Relying on a survey involving 187 Serbian companies and regression analysis, the study found that logistics flexibility positively impacts firm performance. This conclusion adds to the growing body of evidence supporting the role of logistics flexibility as a critical determinant of organizational success.

Dabbour et al. (2017) undertook an examination of the influence of logistics flexibility on supply chain agility and organizational performance within the Egyptian food industry. Employing a survey of 125 firms and structural equation modeling, the study revealed that logistics flexibility exerts a favorable impact on both supply chain agility and organizational performance. These findings contribute significantly to our understanding of supply chain dynamics within the food industry, particularly in developing economies like Egypt.

Jabbour et al. (2018) investigated the correlation between logistics flexibility and environmental performance, focusing on the food sector. The study was distinctive in recognizing the mediating role of reverse logistics. Through survey data from 170 Brazilian food companies and subsequent structural equation modeling, the research ascertained that logistics flexibility positively influences environmental performance, with reverse logistics acting as a partial mediator. This research adds depth to the burgeoning field of green supply chain management by highlighting the intersection of logistics flexibility, reverse logistics, and environmental performance.

Zhang and Zeng (2019) sought to elucidate the effects of logistics flexibility on supply chain integration and organizational performance in a Chinese setting. Utilizing survey data from 208 Chinese firms and structural equation modeling for analysis, the research confirmed that logistics flexibility positively impacts both supply chain integration and organizational performance. The study enhances the existing literature on logistics and supply chain management by delineating the multifaceted influences of logistics flexibility in the Chinese business environment.

Brintrup et al. (2018) conducted a comprehensive review of literature that pertains to logistics flexibility. The authors meticulously sifted through academic works published between 1990 and 2016 to identify key dimensions of logistics flexibility, including but not limited to, product, process, capacity, location, and time. The review underscores the importance of appreciating the multifarious ways in which logistics flexibility manifests across diverse contexts. This study serves as an invaluable reference point for scholars and practitioners interested in gaining a nuanced understanding of the concept of logistics flexibility.

2.5 Hypotheses Development

2.5.1 Logistics flexibility and sustainability performance

Drawing on the Resource-Based View (RBV) theory, which posits that the strategic deployment and mobilization of a firm's internal resources and capabilities can enhance its competitiveness and performance, this study explores the multidimensional nature of logistics flexibility. It identifies key aspects such as Physical Supply Flexibility (PSF), Purchasing Flexibility (PCF), Physical Distribution Flexibility (PDF), and Demand Management Flexibility (DMF) as critical organizational capabilities that could catalyze improvements in a firm's sustainability performance. Logistics flexibility is further defined, per Birkmaier et al. (2021), as a firm's capability to swiftly and efficiently adapt to ever-changing customer needs across both inbound and outbound logistical operations, including support and services. In existing literature, the impact of logistics flexibility on various performance outcomes presents a mixed landscape. While some studies point to positive effects on dimensions like firm performance, logistics network efficiency, customer satisfaction, and competitive advantage (Jain et al., 2017; Birkmaier et al., 2021; Banchuen and Phaxaisithidet, 2020), others suggest a negative relationship (Jafari, 2015; Jafari et al., 2016). Still, other researchers find no direct relationship between logistics flexibility and performance outcomes (Sandberg, 2020; Fantazy et al., 2012) or identify an indirect positive effect (Basu, 2013; Aziz et al., 2017). Based on this complex backdrop, the study posits that logistics flexibility serves as a driver for social, economic, and environmental sustainability. The argument rests on the idea that logistics flexibility allows for greater responsiveness and agility, which in turn can improve a firm's ability to meet customer demands, positively influencing its economic performance. Moreover, logistics flexibility offers the possibility of more efficient and eco-friendly combinations of transportation and packaging methods, potentially reducing a firm's environmental footprint. Thus, given these

considerations and the evidence marshalled, the researcher puts forth the aforementioned argument.

H_1: Logistics flexibility is positively and significantly related to sustainability performance

2.5.2 Logistics flexibility and Supply Chain Resilience

Drawing on the resource-based view of the firm (Barney, 1991), logistics flexibility is hypothesized to be positively and significantly related to supply chain resilience. The RBV perspective suggests that valuable, rare, inimitable, and non-substitutable capabilities provide sources of sustained competitive advantage (Peteraf, 1993). Logistics flexibility can be considered a dynamic capability that enables firms to reconfigure resources and processes in response to changing environments (Teece et al., 1997). By creating adaptable logistics capabilities, firms can better withstand disruptions and recover operations (Brandon-Jones et al., 2014). However, some scholars argue that flexibility leads to complexity trade-offs that may undermine resilience (Vlajic et al., 2012). Alternatively, empirical evidence indicates logistics flexibility is vital for robust supply chains (Singh et al., 2018; Maldonado-Guzman et al., 2021) and positively affects resilience (Clauss et al., 2021; Dubey et al., 2021). This study hypothesizes a significant positive relationship between logistics flexibility and supply chain resilience based on theoretical reasoning that flexible logistics capabilities provide agility, adaptability, and alignment needed to sense disruptions, respond effectively, and safeguard supply chain continuity under dynamic conditions. Developing logistics flexibility is expected to enable resilience through versatility, redundancy, collaboration, and information sharing.

H_2: Logistics flexibility is positively and significantly related to supply chain resilience

2.5.3 Supply chain resilience and sustainability performance

In line with the Resource-Based View (RBV) theory, this research asserts that supply chain resilience serves as a distinctive, internal, and heterogeneous capability that, when effectively leveraged, can lead to enhancements in a firm's sustainability performance. Supply chain resilience is understood as a firm's aptitude for both withstanding external disruptions and recovering—or even improving—its original operational state after such disruptions, as

described by Gunasekaran et al. (2015). The literature provides robust evidence supporting the impact of supply chain resilience on various performance outcomes, including sustainability performance. Notable authors like Abeysekara et al. (2019), Lee and Rha (2016b), Mandal et al. (2016a), and Pettit et al. (2019a) document positive relationships between supply chain resilience and performance indicators. On the other hand, works by Juan et al. (2022) and Mubarik et al. (2022) illustrate indirect effects of supply chain resilience on performance. Despite these variations, the overarching argument of this study is that supply chain resilience exerts a positive influence on a firm's sustainability performance. The underlying rationale is that a resilient supply chain typically features robust risk management policies, characterized by best practices and well-defined procedures. The faithful implementation of these guidelines not only helps in economic savings but also fosters socially responsible practices and mitigates negative environmental impacts. Therefore, by virtue of these considerations and in consonance with existing scholarship, this study articulates the proposition that supply chain resilience significantly contributes to enhancing a firm's sustainability performance.

H_3: Supply chain resilience is positively and significantly related to sustainability performance

2.5.4 Mediating role of supply chain resilience

This research extends its theoretical argument by postulating that supply chain resilience, recognized as a unique internal organizational capability, serves as a mediating factor that enables logistics flexibility to have a positive impact on sustainability performance. In this mediated relationship, supply chain resilience acts as a catalyst that accentuates the benefits derived from logistics flexibility. This conceptual approach finds support in the work of Tosun and Uysal (2015), who identify logistics flexibility as a critical determinant of a firm's supply chain resilience. According to these authors, flexibility in logistics equips a firm's supply chain with robustness and responsiveness, attributes crucial for adapting to external environmental dynamism. Further reinforcing this view, Birkmaier et al. (2021) suggest that effective supply chain resilience relies on several key attributes such as speed, flexibility, responsiveness, robustness, and capacity. These attributes, the study argues, can be significantly enhanced through an increase in logistics flexibility. Consequently, heightened logistics flexibility can lead to improved supply chain resilience. While some literature consistently establishes a direct and positive effect of logistics flexibility on various performance outcomes (Jain et al., 2017; Birkmaier et al., 2021; Banchuen and Phaxaisithidet, 2020), other scholars caution that the

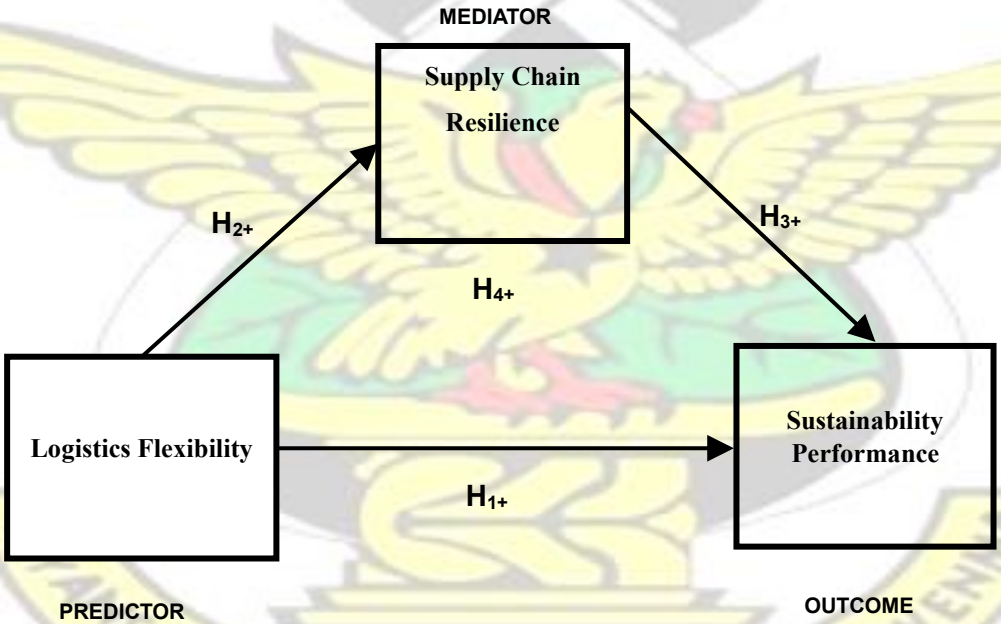
impact of logistics flexibility is not purely direct. It is subject to the influence of mediating variables, which can serve as catalysts in the relationship. This study, therefore, draws on these theoretical underpinnings to put forth the hypothesis that supply chain resilience mediates the relationship between logistics flexibility and sustainability performance.

H_4: The effect of logistics flexibility on sustainability performance is positively mediated by supply chain resilience

2.6 Conceptual Framework

According to the model for the study, illustrated in figure 2.1, logistics flexibility has a positive effect on sustainability performance. the model also contends a positive effect of logistics flexibility on supply chain resilience. The model further asserts that supply chain resilience positively relates to sustainability performance. lastly the model posits an indirect effect of logistics flexibility on sustainability performance via supply chain resilience.

Figure 2.1 Research Model



Source: Researcher's construct (2022)

CHAPTER THREE

RESEARCH METHODOLOGY AND PROFILE OF STUDY AREA

3.1 Introduction

This chapter examines the approaches the investigator used to meet the research goals. It encompasses the research plan, research framework, target population, sample scope and selection method, kinds and origins of data, method for gathering data, technique for data analysis, data trustworthiness and consistency, ethical considerations, and description of the research area.

3.2 Research Strategy

Utilizing the term "research strategy" denotes the comprehensive methodology employed for conducting the research. In this context, both quantitative and qualitative research approaches find acceptance (Bryman, 2009). In quantitative research, the emphasis lies on data gathering and analysis, with a focus on hypothesis validation and the interrelation between theoretical constructs and empirical investigation. Conversely, qualitative research favors textual data over numerical data, accentuating an inductive linkage between theory and empirical inquiry, with an emphasis on theory development (Bryman, 2009). The research under discussion implemented a quantitative research methodology and aimed to explore the correlation between logistics flexibility, supply chain resilience, and sustainability performance.

3.3 Research Design

A research design serves as the foundation for data accumulation and interpretation, shaping the importance accorded to various aspects of the research procedure. Types of research designs can include experimental designs, cross-sectional or sociological surveys, longitudinal investigations, case studies, or comparative studies, among others (Bell and Roberts, 1984). The research design employed in the present study is a survey, as the focus remains largely on manufacturing firms situated in the Greater Accra region of Ghana.

3.3 Population of the Study

Babbie (1975) characterizes population as "the entire assemblage of individuals, items, or numerical figures that a researcher aims to study." In the context of this investigation, The research population consists of manufacturing firms functioning in the Greater Accra Region.

3.4 Sample size and Sampling Technique

A sample represents a subset of a population and serves as a basis for drawing inferences about the entire group. Various sampling methodologies enable researchers to limit the amount of data to be collected by considering only a subgroup of the population rather than all possible members (Saunders et al., 2019). Sampling techniques can be categorized into two primary types: probability sampling and non-probability sampling.

In probability sampling, every member of the population possesses a known, non-zero likelihood of selection. This category includes methods such as simple random sampling, systematic sampling, stratified sampling, and cluster sampling. Conversely, in non-probability sampling, selection occurs in a non-random manner, and the likelihood of any specific member being chosen remains unknown. Quota sampling, convenience sampling, judgment sampling, and snowball sampling fall under this category.

For the present study, the researcher employs purposive sampling, which is a form of nonprobability sampling. Based on expertise about the research topic and the population, the researcher selectively chooses a sample (Laerd, 2012). A sample size of 150 was deemed adequate for the study, as it allowed for the collection of viewpoints from employees across various departments and levels of seniority within the organization. This moderate sample size sought to balance the feasibility of data collection with the need to capture a sufficiently diverse range of opinions across the target population.

3.5 Types and Sources of Data

Data collection denotes the systematic gathering and measurement of information on specific variables, facilitating the answering of research questions, testing of hypotheses, and evaluation of results (Dudovskiy, 2018). The two main data types are primary and secondary data. In this study, primary data serves as the primary source of information, gathered directly from the unit of analysis under investigation. Primary data consists of firsthand information collected by the researcher, as opposed to data acquired from previously published sources. The choice of questionnaires as the data collection instrument for this study arises from their efficacy in collecting data from a substantial sample in an efficient manner.

3.5.1 Data Collection Method

To achieve the objectives of this study, the researcher employed an online questionnaire survey instrument for primary data collection. This online questionnaire was disseminated to participants through email and WhatsApp platforms to enhance both accessibility and participation rates. Table 3.1 offers a summary of the constructs under study, their corresponding measures, and the sources in literature from which these measures are derived.

Logistics flexibility was operationalized using 7 survey items adapted from two sources - Basu (2014) and Yu et al. (2017). Basu (2014) developed and validated a scale for logistics flexibility focused on adaptability, while Yu et al. (2017) proposed additional measures capturing reconfigurability. Supply chain resilience was measured using 5 survey items taken from the resilience scale developed and validated by Pettit et al. (2019) in their journal article. Sustainability performance was a multidimensional construct measured using 15 survey items adapted from Kamble et al. (2020). It includes three dimensions: Economic performance was measured through 5 survey items adapted from Kamble et al. (2020). Social performance was measured through 5 different survey items taken from Kamble et al. (2020). Environmental performance was measured using 5 survey items also adapted from Kamble et al. (2020).

Table 3.1 Summary of Measurement Items

Variables	No. of Items	Sources
LOGISTICS FLEXIBILITY	**7**	(Basu, 2014; Yu et al., 2017)
SUPPLY CHAIN RESILIENCE	**5**	Pettit et al. (2019)
SUSTAINABILITY PERFORMANCE		
• **Economic dimension**	**5**	Kamble et al. (2020)
• **Social dimension**	**5**	Kamble et al. (2020)
• **Environmental dimension**	**5**	Kamble et al. (2020)

Source: Author's Construct (2022)

3.6 Data Analysis Method

Analysis of data is a process of analyzing data to uncover important information, draw conclusions, and assist in making better decisions (Berry, 2004). The researcher performed both descriptive and inferential analyses. Analyses of frequency and frequency distributions were included in the descriptive analysis. Linear regression and Hayes Process mediated regression were incorporated in the inferential analysis. IBM SPSS analyses (v. 26) were used to conduct these analyses. SmartPLS was used to perform the confirmatory factor analysis.

3.7 Reliability and Validity Tests

Both the reliability and validity of the study were considered at all times. Study findings must be repeatable, and metrics used to evaluate each component must be consistent with being considered reliable (Barnes, 1995). On the other hand, validity is how an indicator intended to assess a notion properly measures that concept (Barnes, 1995).

To ensure the reliability of the data obtained, the data were tested with Cronbach Alpha. All the variables scored above the 0.70 threshold, indicating a high level of internal consistency. The research conducted an exploratory factor analysis (EFA) to test for discriminatory and convergent validity. All of the items adopted to measure the study's variables scored above the 0.50 threshold.

3.8 Ethical Issues

In the realm of research, ethics serve as a guiding framework that stipulates the acceptable conduct of researchers. These ethical guidelines exist to protect the dignity, rights, and wellbeing of study participants (Burns, 2000). Within the scope of this study, multiple measures were implemented to uphold ethical standards. Firstly, the anonymity of all respondents was preserved. The research questionnaire was designed such that it did not solicit names or other sensitive personal information from the participants. All data acquired were strictly utilized for academic aims. Secondly, informed consent was secured from every respondent prior to the dissemination of the research questionnaires. Participation in the study was voluntary; no individual was pressured to contribute to the research. This approach not only respects the autonomy of the participants but also ensures the integrity of the research process.

3.9 Profile of Greater Accra Manufacturing Industry

The manufacturing industry is a key contributor to Ghana's economy, accounting for about 25% of GDP (ISSER, 2020). Within the Greater Accra region, manufacturing accounts for approximately 18% of regional output (GSS, 2018). Food and beverages, oil refining, pharmaceuticals, cement, and aluminum smelting are major manufacturing activities in the region (Boateng, 2016).

The Greater Accra region dominates Ghana's manufacturing sector, accounting for over 50% of national industrial output. The region benefits from proximity to the harbor in Tema and Ghana's main international airport in Accra (Addo, 2017). Key manufactured exports include aluminum products, petroleum products, gold, cocoa products, food and beverages, and pharmaceuticals (GIPC, 2021).

However, the manufacturing sector faces challenges such as high utility costs, limited access to financing, inadequate infrastructure, and unfair competition from imported goods (OseiAssibey, 2019). To boost competitiveness, the government has established export processing zones and provided incentives for manufacturing companies (Asamoah et al., 2017). The One District One Factory initiative also aims to stimulate industrialization and job creation in the region (Effah, 2020).

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

4.1 Introduction

This chapter delineates the findings and analysis derived from the fieldwork, thereby addressing the research questions and concluding the study. The chapter is divided into six distinct sections. The initial section discusses the demographic characteristics of the respondents. The second section elaborates on the reliability and validity of the constructs utilized in the study. The third section offers descriptive statistics of the study's constructs. The fourth section sheds light on the partial least square (PLS) structural equation modeling. The fifth section revolves around the validation or invalidation of the study's hypotheses, and the sixth section provides a comprehensive discussion of the results.

For data collection, a questionnaire was formulated and disseminated among employees of manufacturing firms situated in the Greater Accra region. Of the 150 questionnaires distributed, 149 were returned, culminating in an impressive response rate of 99 percent. These responses were initially processed using SPSS and later imported into SMART PLS for more nuanced analysis. Subsequent sections of this chapter summarize the insights garnered from this analytical process.

4.2 Demographics of the Respondents

This section is devoted to delineating the demographic profile of the respondents, thus offering essential contextual information about the individual participants and their respective firms involved in the study. Critical data points extracted from these respondent individuals include the duration of their firm's existence, gender, age, highest academic qualification, years of work experience, managerial level, and current position within the organization. These demographic variables provide a comprehensive overview, aiding in the nuanced interpretation and understanding of the study's findings.

Table 4.1 Demographics of Respondents

CONSTRUCTS	FREQUENCY	PERCENTAGE (%)

Length of operation	1-5	11	7.4
	6-10	80	53.7
	11-15	21	14.1
	Above 15 years	37	24.8
Gender of Respondents	Male	79	53
	Female	70	47
Age of Respondent	20 to 29	57	38.3
	30 to 39	84	56.4
	40 to 50	8	5.4
	Above 50 years	-	-
Working experience of respondents	1-5 years	100	67.1
	6-10 years	41	27.5
	11-15 years	7	4.7
	Above 15 years	1	0.7
The educational level	HND	22	14.8
	1st Degree	72	48.3
	Masters	45	30.2
	PhD	4	2.7
	Professional	6	4
Position at the Firm	Line manager	49	32.9
	Supervisor	68	45.6
	Senior Manager	32	21.5
TOTAL		**894**	**600.1**

The identified demographics (Length of operations, Gender, Age of respondents, Educational level, Working experience, Position with firm and Reliability and validity test) from the above table have been further elaborated on below;

4.2.1 Length of Operations

Of the 149 valid replies, 11 or 7.4 percent of the respondents belong to firms with a history of 5 years or fewer. A majority, represented by 80 individuals or 53.7 percent, indicated their firms

have been in operation between 6 to 10 years. Additionally, 21 or 14.1 percent belong to firms existing for 11 to 15 years, while the remaining 37 or 24.8 percent are from firms that have been in operation for over 15 years. This data suggests that the study largely incorporates views from employees in long-standing, experienced firms as opposed to newly established enterprises.

4.2.2 Gender

Of the 149 valid answers, 79, or 53 percent, were from male respondents, and 70, or 47 percent, were from female respondents. The data indicates a slightly higher male participation in the study, but the difference in gender representation is not significant enough to warrant concerns about self-selection bias.

4.2.3 Age of Respondents

Among the 149 valid respondents, 57 individuals, accounting for 38.3 percent, were aged 29 and below; 84 individuals, constituting 56.4 percent, fell within the 30–39 age bracket; and 8 individuals, making up 5.4 percent, were between 40 and 49 years old. The data reveals a broad age distribution, confirming the diversity of the respondents across various age categories. Additionally, the majority of respondents are above the age of 29, underscoring the maturity level necessary for providing valid answers to the research instrument. The rationale for presenting this demographic information serves to affirm that neither minors, for ethical reasons, nor individuals who are too aged to provide meaningful responses were included in the study.

4.2.4 Education Level

Among the 149 respondents, 22 individuals, which constitute 14.8 percent, hold an HND as their highest level of education; 72 respondents, representing 48.3 percent, have a first degree; 45 respondents, accounting for 30.2 percent, possess a master's degree; 4 individuals, making up 2.7 percent, have a PhD; and the remaining 6 individuals, or 4 percent, have received a professional education. This educational distribution demonstrates that the majority of respondents possess the necessary academic qualifications to provide valid responses to the study instrument.

4.2.5 Working Experience

Among the 149 valid responses, 100 individuals, constituting 67.1 percent, possess between 1 to 5 years of work experience; 41 respondents, which make up 27.5 percent, have 6 to 10 years of work experience; 7 individuals, accounting for 4.7 percent, have work experience ranging from 11 to 15 years; and the remaining individual, representing 0.7 percent, has more than 15 years of work experience. This distribution indicates that the majority of respondents selected for this study possess the necessary work experience to provide valid responses to the research questionnaire.

4.2.6 Position with firm

Out of the 149 valid responses, 49 individuals representing 32.9 percent are line managers; 68 individuals representing 45.6 percent are supervisors; 32 individuals representing 21.5 percent are senior managers. This distribution is advantageous for the study objectives, as perspectives from all levels provide a comprehensive view of supply chain resilience across the organization.

4.3 Reliability and Validity Test

The analyses for reliability and validity are conducted to assess the consistency and accuracy of the variables in measuring the designated constructs, respectively. In terms of reliability, both the Cronbach alpha value and composite reliability are employed to gauge the consistency of the metrics in evaluating the variables. These indicators ought to register values of at least 0.7 to be deemed acceptable, according to Hair et al., 2013.

For assessing convergent validity, the metric of average variance extracted (AVE) is utilized. The threshold for acceptability for this measure is a value greater than 0.5, as delineated by Hair et al., 2013. Discriminant validity, on the other hand, is scrutinized using the FornellLarcker criteria along with cross-loadings. In this context, the correlation of an item with itself ought to surpass its correlation with all other variables for discriminant validity to be established.

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

Construct	Number of items	Cronbach Alpha (CA)	Composite Reliability (CR)	AVE

Logistics flexibility	7	0.79	0.85	0.55
Supply Chain Resilience	5	0.72	0.78	0.53
Sustainability Performance	15	0.88	0.90	0.56
Total	**27**			

Source: Field Study (2022)

The table 4.2 delineates the Cronbach Alpha (CA), Composite Reliability (CR), and Average Variance Extracted (AVE) scores for the variables under study. Specifically, Logistics Flexibility, the predictor variable, registers CA and CR values of 0.79 and 0.85, respectively. Similarly, Supply Chain Resilience, the mediating variable, records CA and CR values of 0.72 and 0.78, respectively. Lastly, Sustainability Performance, the outcome variable, exhibits CA and CR values of 0.88 and 0.90, respectively. Each of these values surpasses the recommended threshold of 0.70, thereby affirming the strong internal consistency of the data. Thus, the data collected for the research remains reliable.

In terms of Average Variance Extracted (AVE), the values for Logistics Flexibility, Supply Chain Resilience, and Sustainability Performance stand at 0.555, 0.53, and 0.56, respectively. These scores exceed the minimum required threshold of 0.50, confirming that the constructs are effectively measuring their intended latent variables. Hence, convergent validity is established.

Furthermore, table 4.3 elucidates the cross-loadings of the items employed to quantify the variables for the study. Each item is expected to meet two conditions: initially, to load above 0.5 and, secondarily, to correlate more strongly with itself than with other items. All but one o the 27 items satisfy these requirements, each loading above 0.50 and correlating more closely with itself than with other items. The item, SCR1 that loaded lower than 0.50 was eliminated from the study

Table 4.3 Cross-Loadings

	Logistics Flexibility (LF)	Supply Chain Resilience (SCR)	Sustainability Performance (SP)
LF1	**0.71**	0.52	0.41
LF2	**0.69**	0.52	0.50
LF3	**0.65**	0.49	0.36
LF4	**0.65**	0.57	0.48
LF5	**0.66**	0.52	0.44
LF6	**0.68**	0.48	0.43
LF7	**0.60**	0.48	0.48
SCR2	0.54	**0.71**	0.50
SCR3	0.39	**0.47**	0.31
SCR4	0.48	**0.70**	0.56
SCR5	0.54	**0.70**	0.53
SP1	0.36	0.45	**0.58**
SP2	0.45	0.47	**0.49**
SP3	0.44	0.46	**0.58**
SP4	0.38	0.41	**0.68**
SP5	0.28	0.27	**0.51**
SP6	0.43	0.49	**0.64**
SP7	0.46	0.49	**0.69**
SP8	0.45	0.45	**0.74**
SP9	0.46	0.41	**0.63**
SP10	0.46	0.50	**0.72**
SP11	0.39	0.52	**0.55**
SP12	0.37	0.53	**0.62**
SP13	0.31	0.32	**0.51**
SP14	0.40	0.30	**0.59**
SP15	0.45	0.40	**0.66**

Source: Field Study (2022)

4.4 Descriptive Statistics

The descriptive statistics are employed to illustrate the scores for the individual variables that make up the study's three primary constructs. These variables are assessed using a Likert scale

that ranges from 1 to 7, intended to quantify the degree of consensus among respondents. The scale is arranged in the following manner: 1 stands for "Strongly Disagree," 2 for "Disagree," 3 for "Somewhat Disagree," 4 for "Neutral," 5 for "Somewhat Agree," 6 for "Agree," and 7 for "Strongly Agree." For the interpretation of these descriptive outcomes, scores from 1.00 to 2.99 indicate an extremely low or infrequent manifestation of the phenomenon in question. Scores between 3.00 and 4.99 signify a low or infrequent manifestation, scores from 5.00 to 5.99 suggest a moderate manifestation, and scores between 6.00 and 7.00 point to a frequent manifestation of the phenomenon. Each of the constructs and their corresponding scores will be elaborated upon in subsequent sections.

4.4.1 Logistics Flexibility

The study identifies logistics flexibility as the predictor variable, conceptualized as the firm's ability to respond quickly and effectively to needs related to distribution, services, and assistance, as outlined by Yu et al. (2017). The variable of logistics flexibility is operationalized using seven specific items, sourced from the works of Basu (2014) and Yu et al. (2017). The following section, denoted as Table 4.5, provides a detailed presentation of the descriptive statistics related to logistics flexibility.

Table 4.4 Descriptive Statistics on Logistics Flexibility

Latent variables	Mean	Min	Max	Std. Dev
Ability to shift transport routes quickly based on customer changes	5.56	1	7	1.6
Ability to change transport modes (air, marine, road, rail) based on legitimate commercial traffic flows for improved logistics flow	5.06	1	7	1.74
Rapid location changes in warehousing and distribution facilities (stash houses) due to changes in customer demands	5.24	1	7	1.5
Flexible logistical solutions to accommodate unique customer requests	5.52	1	7	1.44
Adjust storage capacity if demand fluctuates	5.66	1	7	1.37
Adjust delivery capacity to meet volume for delivering	5.56	1	7	1.45
Make flexible use of multiple transportation modes to meet the schedule for delivering	5.49	1	7	1.46
Composite Scale	**5.44**	**1**	**7**	**1**

Source: Field Study (2022)

The table outlines the descriptive statistics of logistics flexibility, focusing on multiple aspects such as ability to shift transport routes, change in transport modes, warehousing and distribution facilities adjustments, among others. The composite scale, which can be interpreted as an overall measure of logistics flexibility, stands at a mean value of 5.44 with a standard deviation of 1. This suggests that the sample predominantly leans towards higher levels of logistics flexibility. The mean value of the composite scale, which is above the midpoint of the scale range (1 to 7), indicates that logistics flexibility is generally high among the surveyed population. It reflects the readiness and adaptability of firms in addressing varying logistics needs, substantiating the Resource-Based View theory's relevance in understanding these capabilities. The standard deviation of 1 in the composite scale signifies a relatively low dispersion around the mean. This implies that most responses are clustered around the mean, suggesting uniformity in the perception of logistics flexibility across the sample. As for the lowest and highest mean values in the individual aspects, the lowest mean is 5.06 (change in transport modes) and the highest is 5.66 (adjust storage capacity if demand fluctuates). These figures indicate that the respondents feel most flexible in adjusting storage capacity and relatively less so in changing transport modes. Such differentiation in mean scores could imply that certain elements of logistics flexibility are more easily implemented or are deemed more critical than others in the practical setting.

4.4.2 Supply Chain Resilience

In this study, Supply Chain Resilience serves as the mediating variable and is defined as a firm's capability to resist disruptions and either revert to its initial state or advance to an even more favorable condition after experiencing disturbances, following the conceptualization by Gunasekaran et al. (2015). This construct is operationalized using five items, which are derived from the research of Pettit et al. (2019). Descriptive statistics pertinent to Supply Chain Resilience are presented in the ensuing section, designated as Table 4.6.

Table 4.5 Descriptive Statistics on Supply Chain Resilience

Latent variables	Mean	Min	Max	Std. Dev
Our firm can limit or mitigate the negative consequences of change by keeping resources in reserves, such as having safety stock, maintaining multiple suppliers and running operations at lowcapacity utilisation rates	5.69	1	7	1.39

Our firm can produce outputs with minimum resource requirements	5.4	1	7	1.43
Our firm's supply chain can resist change without adapting its initial stable configuration	5.23	1	7	1.58
Our firm's supply chain can speedily react to changes in demand, upwards or downwards	5.62	1	7	1.29
Our firm has adequate visibility of supply chain activities, up to the lower tiers	5.57	1	7	1.27
Composite Scale	**5.5**	**1**	**7**	**0.9**

Source: Field Study (2022)

The descriptive statistics for supply chain resilience, as depicted in Table 4.5, provide a comprehensive overview of how firms perceive their capabilities across multiple dimensions such as resource management, adaptability, and visibility within the supply chain. The composite scale indicates a mean value of 5.5 with a standard deviation of 0.9, signifying that the sample predominantly reports high levels of supply chain resilience. The mean value for the composite scale is situated well above the midpoint of the 1-to-7 scale. This reaffirms the notion suggested by RBV theory that internal capabilities like supply chain resilience contribute significantly to a firm's performance. A mean value of this magnitude signals an overall strong capability across firms to manage changes and disruptions in the supply chain. The standard deviation for the composite scale, recorded at 0.9, indicates low variability around the mean. This suggests that there is a commonality in the perception and enactment of supply chain resilience practices among the surveyed firms. They are more or less uniformly prepared to adapt to supply chain disruptions, which is a significant observation for the domain of supply chain management. Examining the individual aspects, the lowest mean value is 5.23 for the firm's ability to resist change without adapting its initial stable configuration, and the highest mean value is 5.69, associated with the firm's capacity to mitigate negative consequences by keeping resources in reserves. The lowest mean suggests that firms may find it more challenging to maintain a stable configuration in the face of change, whereas the highest mean indicates a strong inclination toward preventive measures like keeping safety stock or multiple suppliers.

4.4.3 Sustainability Performance

In the context of this research, Sustainability Performance serves as the outcome variable and is delineated as a company's performance across an array of dimensions and factors pertinent

to sustainability, adhering to the conceptual framework by Busse et al. (2017). To operationalize Sustainability Performance, fifteen items are employed, based on the scholarly work of Kamble et al. (2020). The descriptive statistics that illuminate this particular construct are exhibited in the subsequent section, identified as Table 4.7.

Table 4.6 Descriptive Statistics on Sustainability Performance

Latent variables	Mean	Min	Max	Std. Dev
Reduced costs of production	5.77	1	7	1.35
Improved profits	5.77	1	7	1.17
Reduced product development costs	5.63	1	7	1.21
Decreased energy costs	5.33	1	7	1.65
Reduces inventory costs	5.36	1	7	1.43
Improved working conditions	5.57	1	7	1.34
Improved workplace safety	5.56	1	7	1.42
Improved employee health	5.59	1	7	1.39
Improved labour relations	5.42	1	7	1.41
Improved morale	5.49	1	7	1.5
Reduction of solid waste	5.7	1	7	1.34
Reduction of liquid waste	5.54	1	7	1.31
Reduced gas emissions	5.52	1	7	1.48
Reduced energy waste	5.6	1	7	1.37
Improvement in the firm's environmental situation	5.58	1	7	1.41
Composite Scale	**5.56**	**1.2**	**7**	**0.85**

Source: Field Study (2022)

The descriptive statistics presented in Table 4.6 offer an elaborate perspective on how firms rate their sustainability performance across diverse factors such as cost reduction, improved profits, environmental impact, and worker conditions. The composite scale reveals a mean value of 5.56 with a standard deviation of 0.85, indicative of generally high sustainability performance among the surveyed firms. The mean value for the composite scale comfortably surpasses the midpoint of the 1-to-7 scale. This could be interpreted as a validation of existing literature that connects internal capabilities and sustainability performance. A mean value of

this magnitude intimates that the firms in this study, on average, assert to have adopted sustainable practices that positively impact both their financial and non-financial performance metrics. The standard deviation of 0.85 for the composite scale suggests a rather low degree of variability around the mean. This low variability might be indicative of a common level of sustainability performance achievement among the surveyed firms, which is a promising sign for both stakeholders and policymakers focused on sustainability. In terms of individual latent variables, the lowest mean value is 5.33, corresponding to decreased energy costs, and the highest mean value is 5.77, associated with both reduced costs of production and improved profits. This suggests that firms may be finding it easier to implement sustainability measures that have immediate financial returns such as cost reductions and profit improvements, as opposed to those that may have longer-term implications like decreasing energy costs.

4.5 Descriptive Statistics and Correlation Results

The analysis of correlation provides compelling evidence that the variables posited in the theoretical paths are not only positively correlated but also exhibit statistical significance, with all P-values registering below 0.01. Specifically, Logistics Flexibility manifests a positive and significant correlation with Supply Chain Resilience, reflected by a correlation coefficient (r) of .770 and a P-value less than .01. Similarly, Logistics Flexibility is found to have a notable positive and significant relationship with Sustainability Performance, with a correlation coefficient of .653 and a P-value less than .01. Moreover, Supply Chain Resilience demonstrates a significant and positive correlation with Sustainability Performance, indicated by a correlation coefficient of .682 and a P-value that is also less than .01.

Table 4.7 Correlation and Descriptive Statistics Results

	Variable	1	2	3	Mean	Standard Deviation
1	Logistics Flexibility	1			5.44	1
2	Supply Chain Resilience	770**	1		5.5	0.9
3	Sustainability Performance	.653**	.682**	1	5.56	0.85

Source: Field study (2022) **Note: *p < .05, **p < .01; N = 149**

4.6 Structural Equation Modelling

The application of Partial Least Squares Structural Equation Modeling (PLS-SEM) served the purpose of assessing both the path coefficients, which signify direct effects, and the indirect effects to elucidate the mediating role between Logistics Flexibility, Supply Chain Resilience, and Sustainability Performance. A bootstrap resampling technique, employing 5000 bootstrap samples, was executed to compute the path coefficients within the framework of the research model. This robust methodological approach furnishes more precise and reliable estimates for path coefficients, thus enhancing the credibility of the study's findings.

Table 4.8 Structural Equation Model (SEM) Result

Path	Coefficients	T-value	P-value
	Direct Effects		
LF → SP	0.29	1.76	0.08
LF → SCR	0.77	16.65	0.00
SCR → SP	0.49	3.19	0.00
	Indirect Effects		
LF → SCR → SP	0.38	2.92	.0885-.4213

Source: Field Study (2022) Notes: LF (Logistics Flexibility); SCR (Supply Chain Resilience); SP (Sustainability Performance)

Table 4.8 elucidates the outcomes from the structural equation model that assess the direct, indirect, and mediating relationships among the variables under study. The findings suggest that logistics flexibility lacks a significant direct impact on sustainability performance, as evidenced by the path coefficient of $\beta = 0.29$, t-value of 1.76, and a p-value greater than 0.01. The t-value, being less than the threshold value of 1.96, fails to provide support for the relationship, thus refuting hypothesis H1, which posited a positive and significant effect of logistics flexibility on sustainability performance.

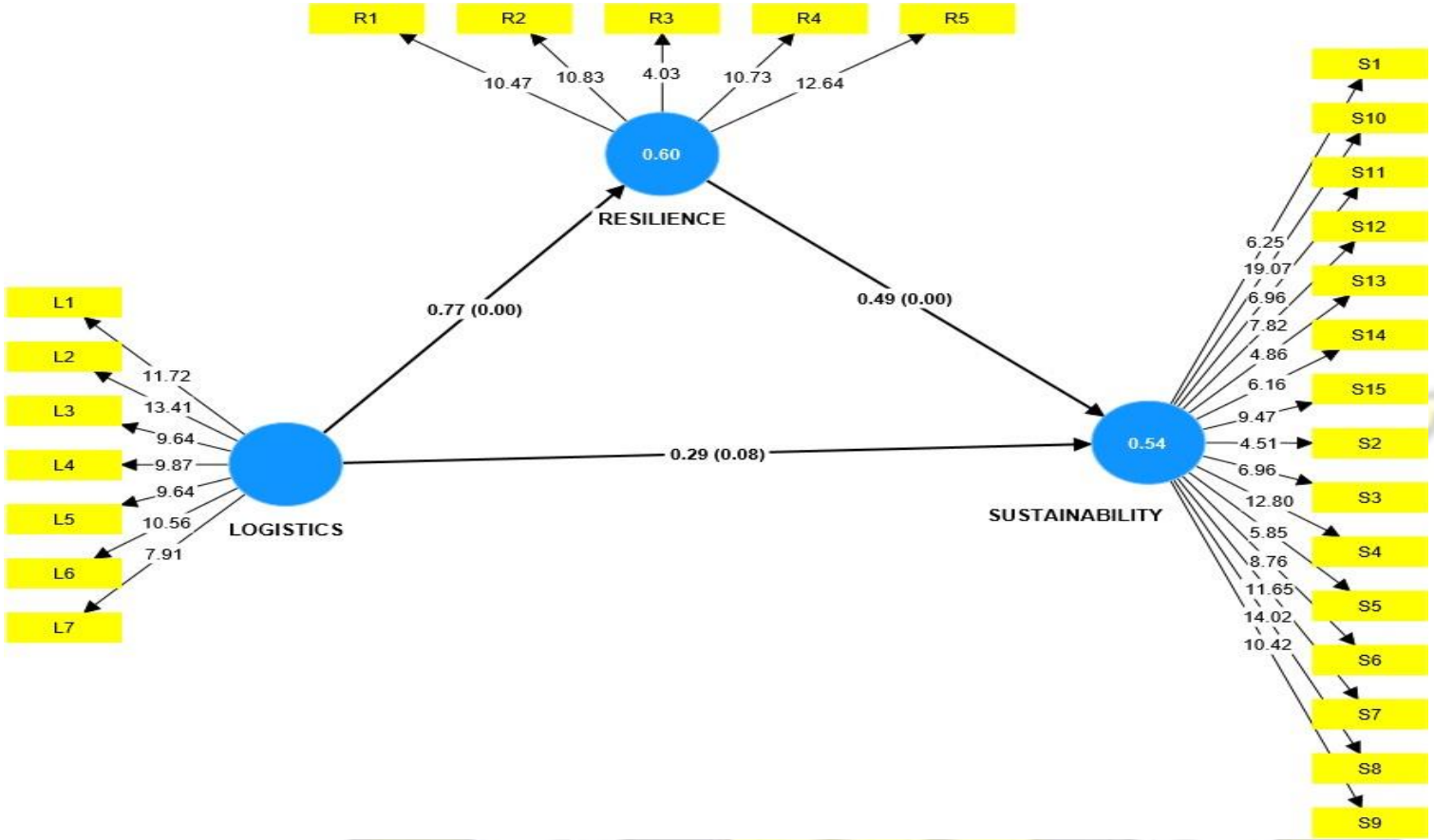
Conversely, logistics flexibility exhibits a strong and positive influence on supply chain resilience, substantiated by a path coefficient of $\beta = 0.77$, a t-value of 16.65, and a p-value less

than 0.01. The t-value substantially exceeds the 1.96 threshold, providing robust evidence for the existence of this relationship.

Similarly, supply chain resilience exerts a noteworthy positive impact on sustainability performance, supported by a path coefficient of $\beta = 0.49$, t-value of 3.19, and p-value less than 0.01. The t-value surpasses the 1.96 threshold, thereby strongly supporting hypothesis H2, which asserted that supply chain resilience positively and significantly affects sustainability performance.

The analysis further unveils a full mediation effect, signifying that supply chain resilience serves as a conduit for the influence of logistics flexibility on sustainability performance. This is validated by a path coefficient of $\beta = 0.38$, a t-value of 2.92, and a p-value less than 0.01. The t-value is well above the established threshold of 1.96, thereby strongly corroborating hypothesis H3, which postulated that supply chain resilience mediates the relationship between logistics flexibility and sustainability performance.

Figure 4.1 Structural Equation Model



Source: Field Study (2022)

4.7 Hypotheses Confirmation

Based on the extensive review of preceding literature, this study set forth three hypotheses. Subsequent data analysis aimed to either validate or negate these assumptions. Among the hypotheses postulated, all found empirical support except for H1. The summary encapsulating the verification or discrediting of each hypothesis is presented in Table 4.10. This table serves as a conclusive representation, providing an overview of the hypotheses and their corresponding empirical validation or lack thereof.

Table 4.9 Hypothesis Confirmation

Hypothesis	Path	T-value	Coefficient (P-value)	Decision
H_1	LF → SP	1.76	.0.29; p > 0.05	**Not Supported**
H_2	LF → SCR	16.65	.77; p < 0.01	**Supported**
H_3	SCR → SP	3.19	.49; p < 0.01	**Supported**
H_4	LF → SCR → SP	2.92	.38; p < .01	**Supported**

Source: Field Study (2022) Notes: LF (Logistics Flexibility); SCR (Supply Chain Resilience); SP (Sustainability Performance)

4.8 Discussion of Results

The findings of the study are deliberated in this section, contextualized within the scope of previously reviewed literature and the study's theoretical foundations. A thorough discussion of these results ensues, arranged in accordance with the objectives initially established for the study. This systematic approach facilitates a comprehensive understanding of how the empirical data aligns or diverges from existing theories and published works in the field.

4.8.1 Logistics Flexibility and Sustainability Performance

The empirical data does not validate the initial hypothesis stating a positive and significant correlation between logistics flexibility and sustainability performance (T-value 1.76, p > 0.05). This result is significant as it deviates from the prevailing academic discourse, which generally argues in favour of a beneficial relationship between logistics flexibility and performance metrics. Prior research, such as that conducted by Jain et al. (2017) and Birkmaier et al. (2021),

promotes the notion that logistics flexibility is crucial for enhancing both organizational performance and customer contentment. These studies generally align with the Resource-Based View theory, emphasizing the importance of a firm's internal assets in achieving competitive advantage. Logistics flexibility is considered such an internal asset, expected to positively affect sustainability performance. Contrarily, this study's outcomes are also inconsistent with the views of Jafari (2015) and Jafari et al. (2016), who suggest that a heightened focus on logistics flexibility could introduce complexities detrimental to performance. The inability to affirm the original hypothesis implies that the dynamics between logistics flexibility and sustainability performance are more complicated than previously assumed. This incongruence necessitates more in-depth research to explore the intricacies linking these variables.

4.8.2 Logistics Flexibility and Supply Chain Resilience

The finding of a strong positive relationship between logistics flexibility (LF) and supply chain resilience (SCR) aligns with prior empirical research. Singh et al. (2018) found agile capabilities like supply flexibility and logistic flexibility were critical enablers of supply chain resilience. Similarly, Maldonado-Guzman et al. (2021) established that higher logistics flexibility was associated with greater resilience in buyer-supplier relationships. The current results reinforce these studies in linking flexible logistics to resilient supply chain capabilities. Moreover, this finding is consistent with the theoretical reasoning drawn from Teece et al. (1997) that logistics flexibility represents a valuable dynamic capability. LF equips firms to rapidly reconfigure logistics resources and processes in response to disruptions and changing conditions. This theoretical lens helps illuminate why LF contributes to the capacity for resilience embodied in SCR. By developing adaptable logistics and transportation systems, firms can better cope with supply shocks and recover operations. Some academics like Vlajic et al. (2012) have contended flexibility could undermine resilience due to complexity tradeoffs. However, the current results disagree with this perspective, aligning instead with scholars like Clauss et al. (2021) who found versatility and flexibility improved resilience. Rather than a liability, this study provides empirical evidence that logistics flexibility serves as a distinct capability that enables firms to achieve SCR. This supports applying the RBV theory to position LF as a unique inimitable capability that is a source of competitive advantage through enabling resilience.

4.8.3 Supply Chain Resilience and Sustainability Performance

The empirical data substantiates the second hypothesis, which argues for a positive and significant link between supply chain resilience and sustainability performance (T-value 3.19, $p < 0.01$). This outcome aligns well with existing academic research, which also supports the Resource-Based View theory. Studies such as those by Abeysekara et al. (2019) and Lee and Rha (2016b) have demonstrated the advantageous effects of supply chain resilience on diverse performance indicators, thereby confirming the conclusions of this research. Within the framework of the RBV theory, supply chain resilience is identified as an internal, distinct, and varied capability that, when effectively deployed, leads to enduring competitive advantages. It significantly shapes sustainability performance by enabling robust risk management and efficient adaptation to disruptions, thereby ensuring ongoing business operations with minimal adverse impact on stakeholders. These findings corroborate the idea that the internal strengths associated with supply chain resilience can be mobilized to achieve better sustainability performance. This not only validates the hypothesis but also provides empirical backing for the RBV theory that serves as the foundation of this study. The resilience of the supply chain, characterized by strong risk management strategies and best practices, seems to play a pivotal role in enhancing performance across economic, social, and environmental aspects.

4.8.4 The Mediating effect of Supply Chain Resilience

The findings validate the third hypothesis, which asserts that supply chain resilience serves as a positive mediating variable between logistics flexibility and sustainability performance (Tvalue 2.92, $p < 0.01$). This outcome is consistent with existing academic work, such as research by Tosun and Uysal (2015) and Birkmaier et al. (2021), which focus on the role of mediator variables in influencing performance metrics. These findings indicate that although logistics flexibility may not exert a direct effect on sustainability performance, its impact becomes meaningful when mediated by supply chain resilience. This is of significant theoretical importance because it highlights the nuanced ways in which various internal capabilities influence organizational outcomes.

The findings affirm the notion that logistics flexibility alone may not sufficiently predict sustainability performance. However, when synergized with supply chain resilience, an

inherent and unique organizational capability, it emerges as a substantial predictor of sustainability performance. From a practical standpoint, this suggests that organizations intent on improving their sustainability performance should consider fortifying their supply chain resilience to fully realize the benefits of logistics flexibility. Such an understanding augments the Resource-Based View theory by elucidating how a synergistic blend of different resources and capabilities—in this instance, logistics flexibility and supply chain resilience—can lead to superior sustainability performance. Therefore, these findings provide further empirical support for the RBV theory, which underpins this study, and shed light on the intricate interactions among different kinds of internal organizational capabilities.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

This chapter synthesizes the study's significant findings, offers comprehensive conclusions, presents actionable recommendations, and identifies avenues for future scholarly exploration. The investigation, grounded in the Resource-Based View (RBV) theoretical framework, set out to explore the mediating influence of supply chain resilience on the relationship between logistics flexibility and sustainability performance. The research encompassed data from 149 manufacturing firms operating within the Greater Accra Region.

5.2 Summary of Findings

The study's key findings are summarised in this section.

5.2.1 Logistics Flexibility and Sustainability Performance

The first objective was to examine the relationship between logistics flexibility and sustainability performance. The study indicates that while logistics flexibility shows a positive correlation with sustainability, the relationship is not statistically significant. This suggests that logistics flexibility alone does not drive improvements in economic, social, or environmental sustainability. The findings imply the need for a multifaceted approach to sustainability, where logistics flexibility might be a component but not the sole driver. Therefore, stakeholders should not rely solely on logistics flexibility as a strategy for achieving sustainable outcomes. Future research should explore other factors that could contribute to sustainability.

5.2.2 Logistics Flexibility and Supply Chain Resilience

The second objective was to examine the relationship between supply chain resilience and sustainability performance. The study found a significant positive relationship between logistics flexibility (LF) and supply chain resilience (SCR). This indicates that higher levels of LF are associated with greater SCR. The finding aligns with previous research linking flexible logistics capabilities to resilient supply chain outcomes. It also supports the theoretical reasoning that LF represents a valuable dynamic capability that enables firms to reconfigure resources and processes in response to disruptions, thereby enhancing resilience.

5.2.3 Supply Chain Resilience and Sustainability Performance

The third objective was to examine the relationship between logistics flexibility and supply chain resilience. The study reveals that supply chain resilience has a positive and significant impact on sustainability performance. This underscores the vital role that resilience, defined as the ability to recover from disruptions, plays in achieving economic, social, and environmental sustainability. The findings validate the emphasis on building resilient supply chains as a strategic approach to improve sustainability outcomes. Therefore, organizations and policymakers should consider bolstering supply chain resilience as a core component of sustainability initiatives.

5.2.3 Mediation Effect of Supply Chain Resilience

The last objective was to examine the mediating role of supply chain resilience on the relationship between logistics flexibility and sustainability performance. The study demonstrates that logistics flexibility indirectly influences sustainability performance through the mediating effect of supply chain resilience. In this model, logistics flexibility enhances the resilience of the supply chain, which in turn positively impacts sustainability performance. This suggests that while logistics flexibility may not directly improve sustainability, it contributes to building a resilient supply chain that does. Therefore, organizations should focus on both logistics flexibility and supply chain resilience as interlinked strategies to achieve better sustainability outcomes.

5.3 Conclusion

This research, underpinned by the Resource-Based View (RBV) theory, offers comprehensive insights into the dynamics between logistics flexibility, supply chain resilience, and sustainability performance within the manufacturing sector in the Greater Accra Region. The study encompasses data from 149 manufacturing firms and arrives at several pivotal conclusions. Firstly, the investigation establishes that logistics flexibility does not exhibit a direct, significant impact on the multi-faceted aspects of a firm's sustainability—social, economic, and environmental. This observation prompts a re-evaluation of the traditional notion that logistics flexibility alone could serve as a catalyst for enhancing sustainability metrics. Secondly, the study elucidates the compelling role of supply chain resilience in

advancing a firm's sustainability objectives across social, economic, and environmental dimensions. This finding corroborates the tenets of the RBV theory, emphasizing that internal capabilities like supply chain resilience can serve as strategic resources that confer competitive advantage and, in this case, contribute to sustainability performance. Lastly, the research unveils an intriguing indirect relationship between logistics flexibility and sustainability performance, mediated by supply chain resilience. Despite the absence of a direct impact of logistics flexibility on sustainability, supply chain resilience magnifies the effects of logistics flexibility on sustainability outcomes. This amplification underscores the synergistic interaction between these internal organizational capabilities. In summary, the study substantiates the RBV framework by demonstrating that supply chain resilience serves as a mediating variable capable of enhancing the impact of logistics flexibility on sustainability performance.

5.4 Recommendations

The researcher, based on the findings of the study, makes the following recommendations

5.4.1 Recommendations for Managers

The study uncovers several noteworthy findings and implications concerning logistics flexibility, supply chain resilience, and sustainability performance. One significant result indicates that while the relationship between logistics flexibility and sustainability performance is positive, it is statistically insignificant. However, the research unveils an indirect effect whereby supply chain resilience mediates this relationship, making it salient. Accordingly, it is recommended that supply chain managers prioritize the enhancement of supply chain resilience as an integral part of their logistics flexibility strategies. Effective avenues for such improvement include robust collaboration with supply chain partners and leveraging technology to amplify visibility across the supply chain.

Furthermore, the study demonstrates a significant and positive correlation between supply chain resilience and sustainability performance. This points toward the critical role that resilience plays in augmenting a firm's sustainability metrics across social, economic, and environmental dimensions. Consequently, it is advised that supply chain managers place a heightened focus on bolstering resilience within their operations. By doing so, firms can

enhance supply chain visibility, thereby facilitating a more comprehensive ability to identify, assess, and mitigate vulnerabilities related to sustainability.

Overall, the findings validate the importance of integrating supply chain resilience into logistics flexibility initiatives for the ultimate objective of achieving higher sustainability performance. It advocates for a concerted managerial approach that leverages the interplay between logistics flexibility and supply chain resilience to foster a more sustainable and resilient supply chain. Through such efforts, organizations stand to gain not only in terms of enhanced operational performance but also in fulfilling broader sustainability goals.

5.4.2 Suggestions for Future Research

Though this study provides valuable insight into how supply chain resilience enhances the relationship between logistics flexibility and sustainability performance, there are still limitations which set the tone for future studies.

First, the model for the study examined the mediating role supply chain resilience on the relationship between logistics flexibility and sustainability performance. However, the study's model is still limited as there are other interesting variables that could be introduced to examine the relationship between logistics flexibility and sustainability performance. This would help address gaps in literature and advance the literature on logistics flexibility. Such variables could include dynamic capability, absorptive capacity, and supply chain agility.

Secondly, the study focused on one hundred and forty-nine employees from the manufacturing firms operating within the Greater Accra region. The geographical and contextual scope of this study limits the generalisation of the study's findings to other industries and regions in Ghana. Future studies are therefore encouraged to take a much broader perspective by increasing the geographical scope of their study to include other regions in Ghana such as the Ashanti and Eastern Region. Other relevant industries such as the retail, construction and financial service could also be considered.

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APPENDIX A

SURVEY QUESTIONNAIRE

Dear respondent,

I am a student at Kwame Nkrumah University of Science and Technology's School of Business, Department of Supply Chain and Information Systems. I am working on a research project titled " Logistics flexibility and sustainability Performance: The mediating role of supply chain resilience." Your answers are needed for the researcher to accomplish the study's objectives. Any information provided would be handled with the greatest discretion.

SECTION A: RESPONDENTS' DEMOGRAPHIC INFORMATION

Please respond to the following questions about yourself by checking the relevant boxes.

(1) How long has your company been in operation?

☐ 1-5 ☐ 6-10 ☐11-15 ☐ above 15 years

(2) Respondents' gender

☐ Male ☐ Female

(3) Respondents' age

☐ 20-29years ☐30-39 years ☐ 40-50years ☐ Above 50years

(4) Respondent's highest level of education

☐ HND ☐ 1st degree ☐ Masters ☐ PHD ☐ Professional ☐ Others

(5) Respondent's working experience with the firm

☐ 1-5 years ☐ 6-10 years ☐ 11-15 years ☐ above 15 years

(6) Position at the Firm ☐ line manager ☐ Supervisor ☐ Senior Manager

SECTION B: LOGISTICS FLEXIBILITY

The following assertions are relevant to your company's logistics flexibility. Indicate your agreement or disagreement with the following statement using a seven-Likert scale of 1=strongly disagree and 7=strongly agree.

1 Strongly Strongly disagree	2 Disagree	3 Somewhat disagree	4	5 Neutral agree	6 Somewhat agree	7 Agree

Our organisation has the ability to……..	**1**	**2**		**3**	**4**	**5**	**6**	**7**
Ability to shift transport routes quickly based on customer changes								
Ability to change transport modes (air, marine, road, rail) based on legitimate commercial traffic flows for improved logistics flow								
Rapid location changes in warehousing and distribution facilities (stash houses) due to changes in customer demands								
Flexible logistical solutions to accommodate unique customer requests								
Adjust storage capacity if demand fluctuates								
Adjust delivery capacity to meet volume for delivering								
Make flexible use of multiple transportation modes to meet the schedule for delivering								

Source: (Basu, 2014; Yu et al., 2017)

SECTION C: SUPPLY CHAIN RESILIENCE

The following assertions are relevant to your company's supply chain resilience. Indicate your agreement or disagreement with the following statement using a seven-Likert scale of 1=strongly disagree and 7=strongly agree.

1 Strongly Strongly disagree	2 Disagree	3 Somewhat disagree	4 Neutral	5 agree	6 Somewhat agree	7 Agree

	Supply Chain Resilience	1	2		3	4	5	6	7
1.	Our firm can limit or mitigate the negative consequences of change by keeping resources in reserves, such as having safety stock, maintaining multiple suppliers and running operations at low-capacity utilisation rates								
2.	Our firm can produce outputs with minimum resource requirements								
3.	Our firm's supply chain can resist change without adapting its initial stable configuration								
4.	Our firm's supply chain can speedily react to changes in demand, upwards or downwards								
5.	Our firm has adequate visibility of supply chain activities, up to the lower tiers								

Source: (Pettit, Croxton and Fiksel, 2019)

SECTION D: SUSTAINABILITY PERFORMANCE

The following assertions are relevant to your company's sustainability performance. Indicate your agreement or disagreement with the following statement using a seven-Likert scale of 1=strongly disagree and 7=strongly agree.

1 Strongly disagree	2 Disagree	3 Somewhat disagree	4 Neutral	5 Somewhat agree	6 Agree	7 Strongly agree

ECONOMIC DIMENSION	1	2	3	4	5	6	7
Reduced costs of production							
Improved profits							
Reduced product development costs							
Decreased energy costs							
Reduces inventory costs							
SOCIAL DIMENSION	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Improved working conditions							
Improved workplace safety							
Improved employee health							
Improved labour relations							
Improved morale							
ENVIRONMENTAL DIMENSION	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Reduction of solid waste							
Reduction of liquid waste							
Reduced gas emissions							
Reduced energy waste							
Improvement in the firm's environmental situation							

Source: Kamble et al. (2020)