UNIVERSITY OF EDUCATION, WINNEBA

HOW AND WHEN DOES DIGITAL INNOVATION CAPABILITIES

AFFECT FIRM PERFORMANCE

JOYCE ADU BOAFOWAA

2024

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A Dissertation in the school of Business,
submitted to the School of Graduate Studies,
in partial fulfilment of
the requirement for the award of
Master of Business Administration
(Procurement and Supply Chain Management)
in the University of education, Winneba

OCTOBER, 2024

DECLARATION

I, **Joyce Adu Boafowaa**, hereby declare that this thesis is the result of my original work towards my MBA and to the best of my knowledge, it neither contains material published by another person nor materials which have been accepted for the award of any other degree of the University, except where due acknowledgments have been made in the text.

Joyce Adu Boafowaa   ……………………   ……………..…

(7231740015)   Signature   Date

Certified by:

Dr. Ishmael Nanaba Acquah   ……………………   ……………..……

(Supervisor)   Signature   Date

DEDICATION

This thesis is dedicated to the Almighty God. I also dedicate this work to my husband

and my children.

ACKNOWLEDGEMENTS

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LIST OF ABBREVIATIONS

DCI   Digital innovation capabilities

RBV   Resource Based View

SCR   Supply Chain Responsiveness

FP   Firm Performance

SCV   Supply Chain Responsiveness

ABSTRACT

In the fast-paced, constantly-changing modern world, gaining and maintaining logistics excellence demands more effort. The main objective of the study is to examine when and how digital innovation capabilities influence firm performance. The quantitative research approach was adopted. Also, explanatory and descriptive research design was employed. Cross-sectional survey strategy was utilized with questionnaire serving as the instrument of data collection. The study adopted convenience sampling and purposive sampling techniques in sampling firms and respondents respectively. The quantitative data collected was analyzed descriptively and inferentially using statistical package for social sciences (SPSS latest version). The findings of the study indicated that digital innovation capabilities are very essential in firm performance. Also, the findings of the study indicated supply chain visibility mediates the relationship between digital innovation capabilities and firm performance. The findings of the study indicated that supply chain responsiveness does not moderate the relationship between digital innovation capabilities and firm performance. The study recommends that firms firm develop dynamic capabilities such as supply chain responsiveness to maximize the benefits of digital innovation capabilities in influencing firm performance.

CHAPTER ONE

INTRODUCTION

1.0 Background to the Study

Even in industrial-age industries, companies need to engage in digital innovation, that is, the creation of or change in market offerings that result from the use of digital technologies (Nambisan et al., 2017), as failure to do so risks losing customer bases and market positions to new digital competitors (Gregory et al., 2018).

Digital innovation is now a vital component of organizational performance and competitive advantage in today's corporate environment (Afuah & Tucci, 2012; Brynjolfsson & McAfee, 2014). Artificial intelligence (AI), big data analytics, cloud computing, and the Internet of Things (IoT) have all seen rapid advancements that have completely changed how businesses run, engage with their clients and oversee their supply chains (Westerman et al., 2014; Weill & Woerner, 2015). The ability of an organization to strategically use digital technology to generate value, increase productivity, and stimulate creativity across a range of business operations is referred to as digital innovation capabilities (Schallmo et al., 2017; Ransbotham et al., 2017). These skills allow businesses to improve their offerings in terms of goods and services, streamline internal operations, reach a wider audience, and remain flexible in the face of changing market conditions.

Considerable scholarly attention and empirical research have been focused on the relationship between digital innovation capabilities and firm performance (Cao & Zhang, 2011; Chen et al., 2014). The outcomes of strategic choices, operational effectiveness, and technological skills are reflected in firm performance, which includes financial measures, market share, profitability, and overall competitiveness (Teece et

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al., 2016; Rothaermel, 2019).

Whiles the discussion on the importance of digital innovation capabilities is important in improving firm performance is relevant, it is equally important to acknowledge the mechanism through which the relationship manifest. One of such mechanism is the supply chain visibility. Supply chain visibility is the extent to which actors within a supply chain have access to or share information which they consider as key or useful to their operations and which they consider will be of mutual benefit (Barratt and Oke, 2007). Empirical research has demonstrated how supply chain visibility significantly affects business performance. In contrast to those with lower supply chain visibility, companies with more visibility reported superior operational and financial performance, according to a study by Wong et al. (2015). Similarly, Mishra et al. (2018)'s research showed that supply chain visibility plays a critical role in maximizing returns on digital investments by mediating the relationship between technology adoption and firm performance.

Additionally, literature recognised the instrumental role of supply chain responsiveness in enhancing the firm performance (Baudier, Kondrateva, & Ammi, 2020; Peek et al., 2019). Supply chain responsiveness is described as how the supply chain can be prompt and the extent to which it addresses the changing needs of customers with regard to their demand as well as respond to other changes in the dynamic business environment (Gunnasekeran *et al.*, 2008; Danese *et al.*, 2013). A responsive company is the one that has a supply chain with the ability to respond to short-term changes of the customer

(Christopher, 2016). The moderating effect of supply chain responsiveness is supported by empirical research. For instance, a 2007 study by Stevenson and Spring discovered that companies reporting much higher performance outcomes were those with high supply chain visibility and responsiveness as opposed to those with visibility alone. Similarly, studies by Wong et al. (2011) showed that when the supply chain was extremely responsive, the benefits of supply chain visibility on operational performance were increased.

By empirically investigating the impact of digital innovation capabilities on business performance across several industries and organizational contexts, this study aims to add to the body of existing work. This research aims to identify key success factors, uncover the mechanisms through which digital innovation capabilities influences firm performance outcomes, and provide managers and policymakers with actionable insights for navigating the digital landscape.

1.1 Problem Statement

Firms have begun to optimize and improve their processes' efficiency through digital tools to ensure business continuity. Thus, digital innovation capabilities are gaining popularity due to a changing and turbulent environment (Zhen, Yousaf, Radulescu and Yasir, 2021). However, literature review indicates no consensus on the relationship between digital capabilities and firm performance (Martínez- Caro, Cegarra-Navarro and Alfonso-Ruiz, 2020). Some studies argue that digital capabilities positively affect a firm through reduced costs and increased flexibility (Drnevich and Croson, 2013; Heredia et al., 2022).

The more a firm is equipped with these resources and the more effectively it can use them, the more likely it is to develop a more complex and advantageous strategy (Wang,

2007). However, there is evidence that digital capabilities have little or no effect on firm performance. It appears that recent research is "hard-pressed" to present evidence for a positive relationship between digital innovation capabilities and firm performance (Tan, Pan & Hackney, 2010; Heredia et al., 2022). This shows that digital capabilities alone are insufficient for achieving a successful innovative performance.

There is still not enough empirical evidence that seeks to explain the relationship between digital innovation capabilities and firm performance (Baía & Ferreira, 2019) in the "new normal" context. Thus, a study argues that digital innovation capabilities are necessary but insufficient to achieve firm performance (Baia, Ferreira and Rodrigues, 2020).

The lack of evidence to establish a positive relationship between digital capabilities and firm performance is due to these limitations of these studies to explain their mechanisms. For instance, to date, it is unclear how digital innovation capabilities fosters firm performance. While emerging studies have reported that digital innovation capabilities have performance implications (Zhao et al., 2023; Hennelly et al., 2020), studies regarding the mechanism via which digital innovation capabilities fosters firm performance are still scarce, particularly in post COVID-19 era. In-part, this study responds to research calls by Refs. (Zhao et al., 2023, Zouari et al., 2020) to examine the mechanism through which digital innovation capabilities translates into performance enhancement in crisis scenarios. Therefore, our study fills this gap in the operations management literature. Somapa et al. (2018) described SCV as the extent to which supply chain members have timely access to information that is useful and necessary for enhancing supply chain activities. SCV aims to obtain relevant information promptly and effectively, while also monitor the movement of inventory,

raw materials and goods in the supply chain (Roh et al., 2009). Further, it has been argued that digital innovation via modern technologies such as IoT can address SCV issues concerning conflicts of interest because integrating IoT in the supply chain can enhance visibility by establishing proficient and intelligent supply chain (Balcik et al., 2010). This suggests that supply chain visibility coupled with a firm's objectives when suitably harnessed can result in enhanced firm performance (Tera et al., 2024). Despite the importance of visibility in in explaining performance, little is known about how it mediates digital innovation capabilities-firm performance relationship. Thus, study proceeds on the premise that supply chain visibility acts as facilitating mechanism in the digital innovation capabilities– supply chain performance relationship.

Furthermore, the adoption and effective implementation of supply chain visibility to improving firm performance are subject to a range of factors, one of which is the presence of a responsive supply chain. Supply chain responsiveness has also been described as the capabilities of the supply chain to efficiently and effectively respond to the dynamics that affect the customers of an organisation by reacting swiftly to the market requirements that keep on changing (Gunasekaran *et al.*, 2008; Asamoah et al.; 2021) and therefore cannot be ignored in the analysis of supply chain visibility and firm performance relationship. Many organizations realize that supply chain responsiveness is an important capability to possess (Al-Hawajreh and Attiany, 2014; Asamoah et al.; 2021). Today, supply chains are expected to react quickly and effectively to the diverse internal and external changes that businesses face. This is expected to grant them a competitive edge in what has become an interconnected global marketplace (Hohenstein *et al.*, 2015; Asamoah *et al*., 2020). Yet, the relevance of supply chain responsiveness, as a contingency factor in the direct link between supply chain visibility and firm performance has received limited empirical attention. Thus, this study

proceeds on the premise that supply chain visibility plays a contingency role in the supply chain responsiveness–firm performance relationship.

Thus, the study from the theoretical perspectives of dynamic capabilities theory, this study investigates the mechanism and boundary conditions influencing the relationship between digital innovation capabilities and firm performance in developing economy setting.

1.2 Research Objectives

In addressing the gap identified, the primary objective of this study is to examine when and how digital innovation capabilities on firm performance

The specific objectives are:

1. To examine the relationship between digital innovation capabilities and firm performance.
2. To examine the mediating effect of supply chain visibility on the relationship between digital innovation capabilities and firm performance.
3. To assess the moderating role of supply chain responsiveness the effect of digital innovation capabilities on firm performance.

1.3 Research Questions

1. What is the relationship between digital innovation capabilities and firm performance?
2. What is the mediating effect of supply chain visibility on the relationship between digital innovation capabilities and firm performance?
3. What is moderating role of supply chain responsiveness on the effect of supply chain visibility on firm performance?

1.4 Significance of the Study

The Effect of Digital Innovation Capabilities on Firm Performance Considering the Mediating Role of Supply Chain Visibility and the Moderating Role of Supply Chain Responsiveness on the Relationship Between Supply Chain Visibility and Firm Performance" plays a role in helping us comprehend the complex dynamics and mechanisms that propel organizational success in the digital age makes it noteworthy. This study holds several key implications and contributions:

The study adds to the body of theoretical and empirical knowledge in the areas of digital business strategies, innovation management, and performance assessment by examining the influence of digital innovation capabilities on company performance.

A more complex understanding of how digital innovation affects firm performance through improved supply chain operations visibility and the moderating effect of responsiveness to market dynamics is made possible by the inclusion of supply chain responsiveness as a moderating factor and supply chain visibility as a mediating factor.

In order to maximize firm performance outcomes, managers and executives can use the study's findings to guide their strategic decision-making processes. These processes can include helping to prioritize investments in digital innovation capabilities, improving supply chain visibility, and implementing agile responsiveness strategies.

In order to ensure successful digital integration and value creation, organizations undergoing digital transformation initiatives can benefit from the study's insights into the mediating and moderating roles of supply chain visibility and responsiveness, which can guide implementation strategies, resource allocation, and performance measurement frameworks.

Organizations can obtain a competitive edge by enhancing operational effectiveness, customer happiness, market reactivity, and financial success indicators by comprehending the connections between digital innovation, supply chain visibility, responsiveness, and firm performance.

Through the production of theoretical frameworks and empirical data that may be investigated and verified further, the study advances scholarly discourse. For practitioners, legislators, and industry stakeholders negotiating the difficulties of digital transformation and supply chain management, it also offers useful implications and doable recommendations.

1.5 Scope of the Study

The scope of a research can be defined as the delimitation of the study. The scope of research is aimed at setting exceptions, boundaries and reservations in research (Creswell, 2003). This section is purposed to delineate the scope and context of this research.
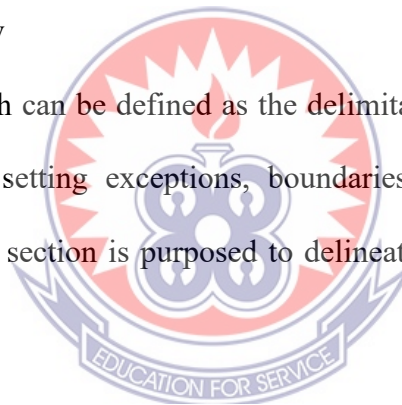
In an ideal situation, any assessment of supply chain must apply to several sectors rather than some of it. Due to the extensive nature of firms, this study concentrates on the effects of digital innovation capabilities on firm performance. The study will be conducted in Central region of Ghana. 150 respondents will be selected for the study to enable easy accessibility to data collection.

The study may use quantitative research approaches to investigate the connections between company performance, supply chain visibility, responsiveness, and digital innovation capabilities. These methods may include surveys, data analysis, regression modeling, and statistical techniques.

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With a particular focus on Ghana, the study takes into account the distinct business climate, market dynamics, legal framework, and cultural elements that affect the adoption of digital innovations, supply chain management strategies, and firm performance outcomes in Ghana.

1.6 Limitations of the Study

Every research is expected encounter some form of challenges and this study was not an exception. This study employed the use of quantitative data. There will be a cut off point for the sample and sample size due to time constraints. The results would be better and broader if data is collected from different parts of the country. Even though the data will be collected from selected firms, a greater understanding would be achieved if more firms will be selected across the country.

1.7 Organization of the Study

The study is organized into five chapters. Chapter one introduces the study which comprises of background to the study, problem statement, research objectives, research questions, justification of the study, research methodology, scope of the study, limitation of the study and organization of the study. Chapter two reviews literature of related work in the research area. The review includes definition of concepts and theory of the main components of the study. Empirical studies related to the research and the theoretical framework is reviewed. The conceptual framework of the study is presented including an explanation of the variables under study and hypothesis developed to test the relationship between the variables. Chapter three comprises of the research methodology and organizational profile. The chapter highlights the instruments used for data collection, the study population, sample size, sampling and sampling technique, research design, data collection procedure, ethical consideration and data analysis.

Chapter four presents result from data collected, analysis and discussion of the data. Chapter five presents summary of the research findings, conclusion and recommendations from the research findings to serve as a guide for future research.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter presents the review of related literature about the subject matter. The chapter includes a literature on supply chain management, digital innovation, supply chain visibility, supply chain responsiveness and firm performance. The purpose of these reviews was to assist the research understand the concepts of the topic under study.

2.1 Conceptual review

This section reviews the various concepts that have been employed in this study. The concepts include supply chain management, digital innovation, supply chain visibility, supply chain responsiveness and firm performance

2.1.1 Digital innovation Capabilities

Digital innovation is defined as the creation of new market offerings or changes in them that result from the use of digital technologies Prior research has shown how digital ventures successfully develop digital innovation (Huang et al., 2017). Much less is known about digital innovation by industrial- age incumbents. Existing research in this regard has pointed to the substantial challenges and concerns these firms experience when embracing digital innovation (Piccinini et al., 2015). Among the multiple challenges that industrial-age incumbents encounter, which include overcoming institutionalised thinking (Henfridsson & Yoo, 2014) as well as changing processes, structures or governance arrangements, capability concerns play a fundamental role (Svahn et al., 2017). Hurdles in this regard result from the peculiarities of digital innovation in industrial-age contexts. Here, digital innovation builds upon a layered

modular product architecture (Y. Yoo et al., 2010). While physical products such as cars build upon a modular architecture whereby interlocking components are assembled into a single physical entity and all innovating parties share product-specific knowledge, the layered modular architecture comprises loosely coupled layers of devices, networks, services, and contents, each following a different functional design hierarchy in which knowledge is product- agnostic (Lusch & Nambisan, 2015; Yoo et al., 2010). Accordingly, "the semantic distance of knowledge elements necessary for product innovation grows" (Lyytinen et al., 2016). For industrial- age incumbents, existing case studies illustrate that firms aim to close resulting capability gaps via internal measures (e.g., building new organizational units such as innovation hubs) and seek for external innovation partners (Svahn et al., 2017). However, besides occasional single case evidence, to date, we have no systematic, large-scale examination of the antecedents and consequences of particular approaches to closing capability gaps for digital innovation by industrial-age incumbents the consequences of the modular layered architecture.
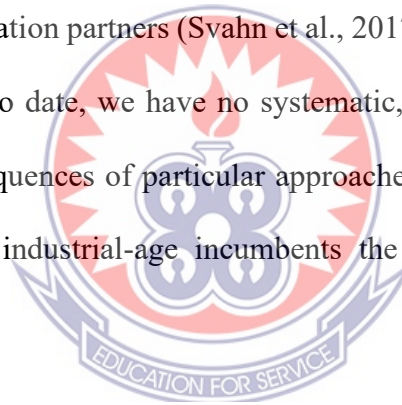
The various components in the different layers are exchangeable, offering ample (re)combination possibilities (Henfridsson et al., 2018). Thus, digital innovations are intentionally incomplete and enduringly enable the development of new modules, a trait called "generativity." Thereby, digital innovations also merge a variety of traditional industry segments and use contexts (such as driving and entertainment), a trait called "convergence." As to these traits, new knowledge creation involving heterogeneous knowledge bases is a constant in digital innovation (Yoo et al., 2012). However, while digital innovation has been described as building upon heterogeneous knowledge (Lyytinen et al., 2016), the consequences for knowledge bases of incumbent firms remain unclear. On the one hand, knowledge for digital innovation has been

conceptually described as distributed across actors (Yoo et al., 2012). On the other hand, it also is reported to be interwoven, increasingly inseparable (Yoo et al., 2010), and questioning the fault lines between established knowledge domains (Yoo et al., 2012). To date, the lingering question of where to locate knowledge creation and knowledge combination in digital innovation in industrial-age contexts remains unresolved.

Sebastian et al. (2021) define digital innovation capabilities as an organization's capacity to use data and digital technology to stimulate innovation in processes, business models, and products. Technical proficiency, a clear strategic direction, and organizational procedures that foster innovation and digital transformation are some examples of these qualities.

According to Fichman et al. (2019), a company's digital innovation capabilities are its capacity to integrate non-digital and digital resources in order to develop novel goods, services, or procedures. In an increasingly digital world, these competencies are essential for businesses to maintain their competitiveness.

According to Nambisan et al. (2019), organizational competencies that use digital technology to create new goods, services, and business models are referred to as digital innovation capabilities. These competencies include the knowledge, procedures, and systems that allow businesses to use digital platforms and technologies for innovation. According to Yoo et al. (2020), dynamic capabilities that let businesses combine and reorganize digital resources and talents to produce new goods and services are referred to as digital innovation capabilities. This definition emphasizes how crucial flexibility and agility are to utilizing digital technology for innovation.

According to Vial (2021), a company's overall capacity to leverage digital technology to improve consumer experiences, reshape corporate procedures, and develop new business models is known as its digital innovation capabilities. This capacity encompasses not just the technological element but also organizational flexibility and strategic alignment to promote innovation.

2.1.2 Supply Chain Visibility

Supply chain visibility is closely linked to the sharing of information within a supply chain (Messina et al. 2022). Sunmola et al. (2023) have defined SCV as the solution to help the supply chain achieve a comprehensive and transparent view of its operations, spanning from the initial stage to the final stage (Sunmola et al., 2023). This includes the effective dissemination of significant and valuable information among the various stakeholders involved in the supply chain, leading to improved supply chain performance (Gani et al., 2023; Qader et al. 2022; Sunmola et al., 2023). SCV is essential for enhancing efficient supply chain management because it enables businesses to respond to changes, reduce uncertainty, and enhance overall performance (Kamble et al. 2020; Qader et al., 2022).

Supply chain visibility (or SCV) is a part of the broader realm of supply chain management (or SCM) and is a concept centered around creating visibility throughout supply chains in order to improve internal decision making and operating performance. The study of supply chain visibility has been firmly brought into the scientific limelight over the recent years, as global megatrends towards globalisation has posed many challenges with regards to managing the existing supply chains of companies as they expand in accordance to the demands of the market (Caridi et al., 2014). At its core, supply chain visibility is centered around ensuring that the company has access to

accurate and current information regarding their supply chains, in regards to both internal and external processes (Francis, 2008). This is achieved by identifying which supply chain processes are most critically affected by lack of visibility and establishing means by which to gather and share relevant information between all affected parties (Caridi et al., 2014 Supply chain visibility is closely linked to the sharing of information within a supply chain (Messina et al., 2022). Sunmola et al. (2023) have defined SCV as the solution to help the supply chain achieve a comprehensive and transparent view of its operations, spanning from the initial stage to the final stage (Sunmola et al., 2023). This includes the effective dissemination of significant and valuable information among the various stakeholders involved in the supply chain, leading to improved supply chain performance (Gani et al., 2023; Qader et al. 2022; Sunmola et al., 2023). SCV is essential for enhancing efficient supply chain management because it enables businesses to respond to changes, reduce uncertainty, and enhance overall performance (Kamble et al., 2020; Qader et al., 2022). SCV constitutes a pivotal element in the recipe for successful supply chain collaboration, ensuring that all stakeholders engaged in the supply chain have access to pertinent information regarding its activities (Messina et al., 2022). The integration of intra-firm processes, such as the introduction of new products or innovations in the sales process in e-commerce through technology, can facilitate transparent operations across the entire chain (Roy, 2021). As a result, all partners can collaborate more effectively in planning and execution (Agrawal et al., 2022; Baah et al., 2022).

2.1.3 Supply Chain Responsiveness

Most modern-day markets have become highly competitive with customers generally becoming more demanding. It has therefore become imperative for organization to develop capabilities that will enable them effectively respond to market changes to meet

the needs of customers in an economical and effective manner. Supply chain responsiveness is described as how the supply chain can be prompt and the extent to which it addresses the changing needs of customers with regard to their demand as well as respond to other changes in the dynamic business environment (Gunnasekeran *et al.*, 2008; Danese *et al.*, 2013). A responsive company is the one that has a supply chain with the ability to respond to short-term changes of the customer (Christopher, 2016). Hallgren and Olhager (2009) considered responsiveness as the ability to achieve flexibility and performance in terms of delivery. Thatte (2007) categorized supply chain responsiveness measures into three categories, namely, logistics process responsiveness, operations systems responsiveness and supplier network responsiveness, which are adopted in the current study. *Operations systems responsiveness* involves the capability to swiftly configure and reconfigure equipment and processes of the manufacturing system to be reactive to the needs of customers (Wu, 2001; Lummus *et al.*, 2003).

This type of responsiveness looks at how an organization can quickly adjust its assets and operations systems to react swiftly to variations in the volume and the mix of products demanded by the consumers, as well as responding to emergency orders (Thatte *et al.*, 2013). *Supplier network responsiveness* on the other hand is the capability of an organisation's major suppliers to respond to and meet changes in the organisation's demand (Al-Hawajreh and Attiany, 2014; Thatte *et al.*, 2013). The presence of responsive and flexible upstream partners is crucial for the focal firm. Whenever there is lack of supplier network responsiveness, it negatively affects the company's ability to meet changing needs of its customers (Holweg, 2005). Finally, *logistics process responsiveness* is the capability of an organisation's distribution, transportation systems and warehousing systems to meet variations in customer

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demands. Creating value for an organization's customers means making sure that the logistics processes are flexible and the organization can reach its customers even in times of disruptions to regular routes and distribution channels (Duclos *et al.*, 2003; Lummus *et al.*, 2003). This type of responsiveness also looks at the speed with which the supply chain serves the various categories of customers.

2.1.4 Firm Performance

Richard et al. (2009) describes business performance as an indicator of a company's growth, profitability, market share, and customer happiness, among other non-financial outcomes. Metrics measuring operational and economic success are included in this comprehensive approach.

According to Hult et al. (2021), "firm performance" refers to how successfully and efficiently a company achieves its goals. This includes operational metrics like innovation, customer satisfaction, and internal process improvements in addition to financial results like revenue, profit margins, and return on assets.

Ramanujam and Venkatraman (1986): The idea of firm performance is divided into three main areas: organizational effectiveness (such as employee happiness and corporate reputation), operational performance (such as market share and productivity), and financial performance (such as profitability and return on investment. According to Zollo and Winter (2002), a firm's performance is determined by how well its resources and capabilities are deployed and used to gain a competitive advantage. This competitive advantage is demonstrated through financial metrics like revenue growth and profitability as well as strategic outcomes like market position and innovation. According to Wang et al. (2021), firm performance is the multifaceted assessment of a company's accomplishments concerning market performance (such as market share,

sales growth), financial performance (such as earnings, return on investment), and shareholder value (such as stock performance, dividends).

According to Neely et al. (1995), firm performance is an evaluation of all of a company's results, including financial metrics like revenue and profitability as well as non-financial metrics like employee engagement and customer satisfaction and strategic metrics like innovation rate and competitive positioning.

2.4 Empirical Review

This section reviews past studies in relation to this study.

Ivanov (2021) assessed digital supply chain management and technology to enhance resilience by building and using End-to-End visibility during the COVID-19 Pandemic. In practice, an increased interest into end-to-end visibility as a future-oriented driver and capability of resilient supply chains can be observed. However, the research in this area is in its infancy. Even less is understood about resilience and the potentials of a digital supply chain in pandemic settings. Based on an analysis of the relevant literature supplemented with the multiple case studies constructed with the use of primary data, we build a framework that could be instructive for supply chain managers seeking to manage resilience during pandemic disruptions and using digital technology. Our main methodological contributions are unlocking the value and potentials of end-to-end supply chain visibility for resilience management in the face of pandemic disruptions and proposing an associated design and implementation framework containing multiple dimensions—management, organizational, and technological. The outcomes of our study offer a conceptual guideline concerning the potentials and implementation of end-to-end visibility in the management of supply chain resilience.

Heredia et al. (2022) examined how digital capabilities affect firm performance through the mediating effect of technological capabilities in the "new normal". This study proposes a model to explain the effect of digital capabilities on firm performance in the "new normal" context from a firm-level perspective. Moreover, it analyzes the mediating role of technological capabilities and the Human Development Index (HDI) in explaining firm performance. The study used data from the World Bank's Enterprise Surveys 2020, which included 999 firms from 27 countries. The study applied the methodological approach, partial least square structural equation modeling (PLS-SEM), to test the hypothetical model. The results show that digital capabilities positively influence firm performance only through technological capabilities. They also empirically demonstrate that digital skills in low HDI economies have a more significant indirect effect on firm performance than in high HDI countries. Finally, some promising avenues for future research and implications for managers and policymakers are suggested based on these findings.

Mwaiwa and Shale (2024) examined supply chain visibility and performance of distribution firms in nairobi city county, Kenya. The study aim was to determine the supply chain visibility on performance of distribution firms. Specifically, the study determined the effect of technological integration, and demand visibility on performance of distribution firms in Nairobi City County, Kenya. The study adopted the correlational research design. The target population was the 142 employees in the supply chain department in the distribution firms in Nairobi City County. The study sample size was 142 respondents. The study adopted the census method to select the respondents. Primary data was collected using a questionnaire. Quantitative data was analyzed using the descriptive and inferential statistics. Descriptive statistics that were used include frequencies, percentages, mean and standard deviation. Inferential

statistics that were used include correlational and regression analysis. The Pearson moment correlation was used to determine the relationship between the independent and dependent variables. Regression analysis was used to determine the association of supply chain visibility and performance. Data was presented in form of tables and figures. The study found that technological integration had a positive and significant relationship with performance of distribution firms in Nairobi City County, Kenya. The study revealed that demand visibility had a positive and significant relationship with performance of distribution firms in Nairobi City County. The study recommends that distribution firms should consider allocating resources to invest in and adopt advanced technologies that facilitate integration across the supply chain. The study recommends that the firms should invest in advanced demand forecasting tools and techniques. Utilize data analytics, machine learning, and predictive modeling to accurately forecast demand patterns. This enables distribution firms to proactively plan inventory levels, minimize stockouts, and optimize overall supply chain efficiency.

In Hong Kong, Choy (2020) investigated how IT affected the logistics sector's performance, using the Pearl Delta and Hong Kong. The study surveyed 210 logistics enterprises in Hong Kong and the Pearl River Delta region to assess technology use and its effect on the performance of logistics services. Interview were used to get data. Structural equation modeling was used to test the model. The results indicated that IT directly improves the logistics companies' service quality, and that IT impact on service quality raises competitiveness.

Somapa et al. (2018) investigated supply chain visibility characterization. The study's objectives were to review literature so that to shed light on the features and usefulness of SCV. A methodical examination of the SC literature was done to determine the

features and efficacy of SCV. The process-oriented technique, linking SCV effectiveness to enhanced performance, served as the foundation for evaluation. According to the study, information quality, utility, and accessibility may all be used to describe the traits of SCV. The advantages of SCV were discovered to go beyond raising an organization's strategic competences or operational efficiency of business processes.

Siror (2019) conducted research on how RFID technology affects Kenyan export commodities tracking. The study determined how RFID-based tracking would help with the problems caused by export items diversion into Kenya's local market. Products would be transported out of export centers under the pretense of overseas market destination, nevertheless, they are discarded and fake paperwork would be created to prove that the goods have been exported, allowing for an unfair advantage and a chance to avoid paying taxes. An RFID-based In-Transit Visibility solution was developed and tested in order to address the issues. The system tracked export shipments from the manufacturer to the port. The system's functioning, design, and pilot results were all discussed. The pilot's findings demonstrated that RFID-based tracking greatly reduced diversion and offered carriers and other stakeholders' substantial benefits by increasing output and reducing turnaround times.

The influence of improved demand insight on production and inventory control efficiency was studied by Sma and Lehtonen (2018). Discrete-event simulation was utilized in this study to investigate the influence on operational efficiency when traditional order data from non-VMI consumers is combined with sales data from VMI cosumers for production and inventory control. The simulation model makes use of genuine demand and product data, having been grounded in a real-world VMI

installation. The study discovered that, even for products with steady demand, a partial increase in demand visibility can boost the effectiveness of production and inventory control. However, visibility value is highly dependent on the rate of replenishment of the target products and the cycle for production planning.

Jemai and Karaesmen (2015) investigated how a make-to-stock queue in Turkey performed in relation to demand variability. The study examined how demand variability affects capacitated production locations and examined a make-to-stock queue that follows a base stock policy and has general demand arrival times. The findings showed that higher arrival time variability does, in fact, increase ideal base-stock levels and optimal inventory-related costs when demand inter-arrival distributions are organized in a stochastic fashion.

Lehtonen et al. Holmström (2018) investigated how product launches affected demand visibility. The purpose was to determine the variables influencing the usefulness of access to downstream demand data to manage product introductions. A comparison of the various forms of demand information and their utility to a producer was conducted using simulation based on real data on 19 product debuts. There were two new measures introduced. Bias shows whether demand data from two sources consistently differs from one another. The amount of time it takes for demand data from two sources to begin communicating correspondingly in a temporary scenario is measured by the delay in demand synchronization. The study discovered that, in the supply chain under investigation, distributors are mostly responsible for demand variability, whereas retail outlets—particularly for products with larger wholesale packages in relation to their sales—are primarily responsible for bias and delays in demand synchronization.

Mwangeka (2020) conducted study on the operational performance and supply chain

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visibility of logistics companies in Mombasa County, Kenya. The supply chain visibility and operational effectiveness of logistics companies in Mombasa County, Kenya, were the main subjects of this study. Descriptive cross-sectional survey approach was used in the study. The study's target group consisted of Mombasa County logistics companies. A closed-ended survey was used to gather data. Frequency tables were used to depict the data that was collected and analyzed using SPSS software. Calculations were made for frequencies, means, standard deviations, test findings, correlation, and regression coefficients. Conclusions showed a favorable correlation amid operational effectiveness and supply chain visibility. The study did discover, however, that operational performance was not much impacted by SCV. The results showed that businesses used SCV to a moderate degree. This suggested that companies would see higher operational performance if supply chain awareness was adopted more widely.
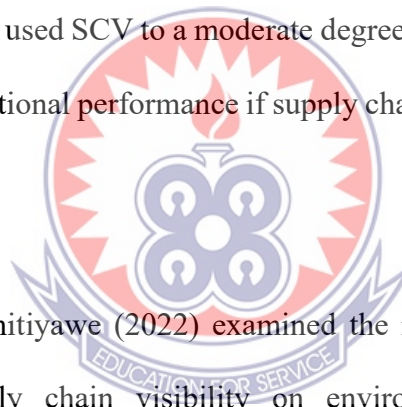
Patabandige and Galahitiyawe (2022) examined the mediating role of supply chain traceability and supply chain visibility on environmental performance led by sustainable supply chain collaboration. Business organisations have a significant role be attentive towards environmental friendliness throughout their core business activities, as there are harmful impacts on human lives and nature owing to environment-related issues. To ensure the environmental performance at the organisational level in the supply chain, the business organisations have to work with different parties, as mentioned in organizational information theory. Nevertheless, the achievement of environmental performance is not ensured via sustainable supply chain collaboration. Hence, as highlighted in the coordination theory, transparent information must be generated within the sustainable supply chain collaboration to clinch

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environmental performance. Thus, this study investigates the role of supply chain visibility and supply chain traceability in the form of transparent information on the achievement of environmental performance led by sustainable supply chain collaboration, based on the business organisations of Sri Lanka, which have obtained environmental compliance certifications.

Hanelt et al., 2021 examined Digital M&A, digital innovation, and firm performance. Aiming to support digital innovation endeavours, industrial-age companies increasingly acquire firms that heavily build upon digital technologies. Related research has raised serious concerns regarding the prospects of such plans, yet has not focused the particular context of digital mergers and acquisitions (M&A). Drawing on a knowledge-based perspective as well as the particularities of digital technologies and the context of digital innovation, we theorise the link between digital M&A, a digital knowledge base on the part of the acquirer, and the consequences for digital innovation and firm performance. We employ panel data regressions to a longitudinal dataset of the world's largest automobile manufacturers. Our findings suggest that executing digital M&A contributes to building the digital knowledge base of industrial-age firms, which in turn enables them to drive digital innovation. Our findings further indicate that digital innovation improves firm performance of industrial-age firms. We discuss implications for information systems research about M&A and digital innovation as well as recommendations for managerial practice.

Huang et al., 2023 examined The Impacts of Supply Chain Capabilities, Visibility, Resilience on Supply Chain Performance and Firm Performance. This study explores the significance of two determinants: Supply Chain Capabilities and Supply Chain Visibility, in the intricate interplay among Supply Chain Resilience, Supply Chain Performance, and Firm Performance. A dataset comprising 221 participants from

Vietnamese garment manufacturing firms was gathered and subjected to analysis using the PLS-SEM approach, revealing insights into the modeled complex relationships. The research findings reveal that visibility significantly influences supply chain resilience; while the hypotheses of a positive impact of supply chain visibility and supply chain resilience on firm performance have been rejected. Interestingly, these findings underscore the significant influence of indirect relationships mediated by factors, such as supply chain resilience and supply chain performance. Hence, this study bridges a gap in the existing body of literature and offers practical implications for supply chain management, particularly concerning performance measurement challenges in this sector. The article suggests that the Vietnamese garment supply chain could enhance supply chain and firm performance by focusing on supply chain capabilities and visibility.

Khin and Ho (2018) examined Digital technology, digital capability and organizational performance. Despite the growing importance of digital innovation conceptualized as innovative digital solutions that enable digital transformation of businesses across industries, empirical study of factors related to digital innovation is still scant, creating a knowledge gap. To fill this gap, this paper aims to examine the effect of digital orientation and digital capability on digital innovation, and also the mediating effect of digital innovation on the link between organizational performance and digital orientation as well as digital capability. This study tests a new conceptual framework using a survey data of 105 small to medium-sized IT firms in Malaysia and employing structural equation model (SEM) analysis from partial least square (PLS) approach. The results show that digital orientation and digital capability have positive effect digital innovation and also that digital innovation mediates the effect of technology orientation and digital capability on financial and non-financial performance. The findings

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encourage the firms to take the opportunity of emerging digital technologies and digitalization trend in industries by being committed toward embracing new digital technologies and upgrading their digital capabilities to become innovation leaders and also to boost firms' performance. Originality/value – This study is one of the first studies that explain how emerging digital technologies can be leveraged to create innovative digital products and services and subsequently boost their business performance. It also fills the literature gaps related to driving factors of digital innovation and mediating role of digital innovation on the link between its driving factors and performance.

Usai et al., 2021 assessed the impact of the adoption of digital technologies on firms' innovation performance. This study aimed to understand whether the increased use of digital technologies improves innovation performance of firms. Previous studies reveal that the more the firms use digital technologies, the more they can be potentially innovative. However, this is a myth. In fact, one of the main limitations of such studies is their undifferentiated approach toward the vast ocean of digital technologies. Yet, given the increasing pervasiveness of digital technologies at all levels, business and society, a question emerges: how they impact the capability of firms to be innovative? Counter-intuitively, we argue that most frequently used digital technologies have very low impact on innovation performance of firms as innovation is the result of creativity and of constant R&D efforts. By contrast, excess use of digital technologies may even deplete the long-run innovation capability of firms, for instance, by impoverishing the relational capital. We performed two different statistical analysis to understand whether this intuition was grounded and hypotheses would be confirmed. First, we used a principal component analysis to identify the digital technologies that are salient for innovation performance. Second, we conducted a multivariate analysis of variance to

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understand if the identified technologies predicted innovation performance. All tests were conducted on a large-scale sample of firms operating the European Union. The findings confirmed that digital technologies have very low impact on innovation performance, whilst R&D expenses are the most reliable predictor of innovation. These results challenge the false belief that digital technologies improve innovation performance. At a practical level, the results suggest that decision makers should debias themselves from considering digital technologies as the ultimate ingredient for a successful innovative firm, as this may backfire eventually.

Shah et al. (2023) evaluated the role of digital technology and digital innovation towards firm performance in a digital economy. In this study, the researchers explored the roles played by digital technologies and digital innovation (DI) in Pakistan's Information, Communication and Technology (ICT) companies' firm performance (FP). The researchers used a quantitative study to gather cross-sectional data from employees working in Pakistan's ICT companies. The authors based this study's findings on 396 valid samples. The structural equation modeling (SEM) findings underline that digital capability (DC), digital orientation (DO) and digital transformation (DT) have positive and significant effects on DI and FP. Moreover, there is a positive and significant relationship between DI and FP. Finally, DI mediates DC's, DO's and DT's associations with FP. By committing to embracing new digital technologies and updating existing DCs to become innovation leaders and to improve FP, the findings will help sectors to take advantage of developing digital technologies and the trend toward digitalization. The results are also valuable for policymakers when considering if SMEs should be provided with more money for the digital up-skilling of their employees. Finally, this study's findings enrich the depth of literature about companies' use of digital technologies. This study's empirical findings confirm the

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roles played by DC, DO and DT in improving DI and FP in a developing country such as Pakistan.

Zhe and NorhHamid (2021) examined the impact of Digital Technology, Digital Capability and Digital Innovation on Small Business Performance**.** Nowadays, IT plays a key role for SMEs in boosting sustainable business performance. Unfortunately, Malaysian SMEs have been confronting some challenges such as failure to adapt to technology, rapid technology change, and high technology cost. It was claimed that Malaysian SMEs might be wiped out soon unless they master digital technology. To fill this gap, this paper aimed at identifying the level and examining the relationship between digital technology, digital capability, and digital innovation toward Batu Pahat's business by using the quantitative method focused on survey questionnaire to collect, analyze gather data and using SPSS software to test the hypotheses from the shops in Batu Pahat district. Some 120 online questionnaires were collected. The stratified sampling technique was used in this research. This research found a strong positive relationship between digital technology, digital capability, and digital innovation toward business performance. Digital has both tangible and intangible benefits that will help companies profit and deliver customer expected outcomes.

Tera et al. (2024) examined supply chain digitalization and performance: a moderated mediation of supply chain visibility and supply chain survivability. The COVID-19 crisis has notably impacted global supply chains as it has disrupted manufacturing operations. To recover from the aforementioned disruptions, supply chain digitalization (SCD) is increasingly being acknowledged to help the recovery process. Based on this, scholars have called for additional research on how SCD can enhance supply chain visibility (SCV)] and boost supply chain performance (SCP) in turbulent environments.

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Based on 399 valid responses collected through cross-sectional method from Turkish manufacturing firms and using a non-probabilistic sampling method (i.e., purposive sampling]) this research explores the effect of SCD on SCP. The mediating role of SCV and the moderating role of supply chain survivability (SCS) on the SCD-SCP relationship were also explored. The findings showed that SCD has a positive effect on SCP. SCD has a positive effect on SCV. SCV has a positive effect on SCP. The link between SCD and SCP is mediated by SCP. The results also revealed that SCS moderated the SCD-SCV link such that SCD has a stronger, positive relationship with SCV when SCS is high than when it's low. SCS moderates the SCD-SCP link, such that at low levels of SCS, the positive effect of SCD on SCP is weakened. The indirect positive effect of SCD on SCP via SCV is strongest when supply chain survivability is high. The findings suggest that SCD can improve cost-effectiveness, promote communication and information efficiency, and enhance supply chain resilience to improve performance after disruptions. This study provides insightful new implications for both supply chain literature and practitioners.

Huang et al. (2023) examined the impacts of Supply Chain Capabilities, Visibility, Resilience on Supply Chain Performance and Firm Performance. This study explores the significance of two determinants: Supply Chain Capabilities and Supply Chain Visibility, in the intricate interplay among Supply Chain Resilience, Supply Chain Performance, and Firm Performance. A dataset comprising 221 participants from Vietnamese garment manufacturing firms was gathered and subjected to analysis using the PLS-SEM approach, revealing insights into the modeled complex relationships. The research findings reveal that visibility significantly influences supply chain resilience; while the hypotheses of a positive impact of supply chain visibility and supply chain resilience on firm performance have been rejected. Interestingly, these findings

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underscore the significant influence of indirect relationships mediated by factors, such as supply chain resilience and supply chain performance. Hence, this study bridges a gap in the existing body of literature and offers practical implications for supply chain management, particularly concerning performance measurement challenges in this sector. The article suggests thatthe Vietnamese garment supply chain could enhance supply chain and firm performance by focusing on supply chain capabilities and visibility.

Asamoah et al., 2021 examined the effect of supply chain responsiveness on customer development. The study examines how supply chain responsiveness (logistics process responsiveness, operations systems responsiveness and supplier network responsiveness) impacts the ability of firms to attract, satisfy and retain customers. Using a quantitative approach, a total of 250 questionnaires were distributed to firms in the Kumasi metropolis in the Ashanti Region of Ghana, with 100 useable responses retrieved. The effect of supply chain responsiveness on customer development was analysed using partial least squares structural equation modelling. Findings – The findings showed that operations systems responsiveness and supplier network responsiveness drive the logistics systems responsiveness of firms as hypothesized. It was also revealed that operations systems responsiveness and logistics process responsiveness enhanced customer development, but supplier network responsiveness did not. Logistics process responsiveness additionally partially mediated the effect of operations systems responsiveness on customer development. To the best of the researchers' knowledge, no previous studies have empirically examined interrelationships between the dimensions of supply chain responsiveness. Additionally, no previous study has examined the effect of supply chain responsiveness on customer development.

2.3 Theoretical Review

This study is grounded on the RBV theory and the DCT. The RBV theory is very useful when examining the relationship between the resources and capabilities of an organization on one hand and performance on the other (Barney *et al.*, 2001). Resources are defined to include all the tangible and intangible assets that organisations use to plan and implement their various strategies (Wernerfelt, 1984; Barney *et al.*, 2001). Organizational capabilities on the other hand are bundle of aptitudes, skills, processes and technologies that are firm specific and are developed over time through complex interactions among the firm's resources (Coates and McDermott, 2002; Nkrumah *et al.*, 2020). Organisations can attain competitive edge in performance by having in their possession resources that are rare, valuable, imperfectly imitable and unique and deploying them in effective ways. The RBV has been used in previous supply chain responsiveness studies (Thatte *et al.*, 2013). The RBV has however been criticized for assuming that business environments and resources are fairly static over time, and failing to effectively account for how competitive advantage can be sustained in rapidly changing environments (Singh *et al.*, 2019).

The dynamic capability theory is believed to have developed out of the RBV in response to the above and other limitations of the RBV. Dynamic capabilities are defined as a firm's capacity to integrate, build and reconfigure internal and external resources using organizational processes to respond to changes in the competitive environment and to design new value creating strategies (Teece *et al.*, 1997; Eisenhardt and Martin 2000). In other words, dynamic capability examines the ability of firms to sense and seize opportunities and accordingly reconfigure resource bases for a sustainable competitive advantage in a turbulent environment (Eisenhardt and Martin 2000; Singh *et al.*, 2019). Dynamic capabilities thus go beyond the deploying of

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valuable, rare, imperfectly imitable and non-replaceable resources, but stress on the ability of organizations to develop competences to reconfigure resources and innovate continuously in response to dynamic environments. According to the dynamic capabilities view (DCV) theory, maintaining competitive advantage depends on a firm's capacity to integrate, develop, and reconfigure internal and external competencies in response to quickly changing circumstances. According to this theoretical framework, the relationship between firm performance and digital innovation skills is moderated by supply chain visibility (SCV), a crucial dynamic capability.

Businesses can collect and evaluate enormous volumes of data thanks to digital innovation capabilities, which offer insights into consumer preferences, market trends, and operational efficiency. However, supply chain visibility must be great in order to fully utilize these capabilities. By offering a thorough perspective of the complete supply chain, SCV improves the company's capacity to identify opportunities and hazards in real time (Wamba et al., 2020). According to Teece (2018), organizations can enhance their performance by promptly adjusting to changes and making well-informed decisions, all made possible by this visibility.

One of the main principles of DCV is the capacity to quickly reconfigure capabilities and resources in response to changes in the environment. The integration of digital innovation capabilities with supply chain visibility enables efficient reconfiguration by furnishing precise and prompt information regarding the state of materials, products, and processes (Ivanov & Dolgui, 2021). By improving resource allocation and cutting waste, this information enables businesses to realign their supply chain activities and improve operational performance and agility (Dubey et al., 2021).

2.4 Conceptual Framework and Hypothesis Development

This section presents the various steps involved in developing a conceptual model that aims to analyze the relates to when and how digital innovation capabilities influences firm performance. The model also aims to establish the influence of supply chain visibility and supply chain responsiveness. Figure 4.1 shows the model's evolution.
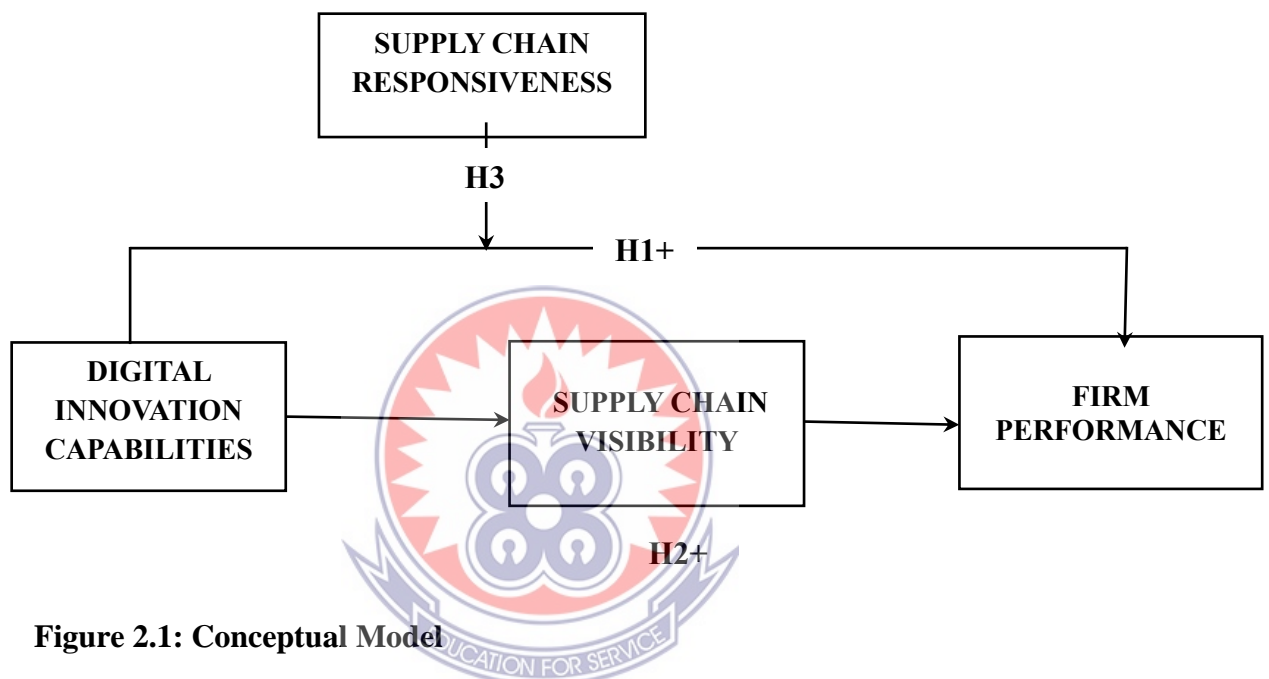
Figure 2.1: Conceptual Model

2.4.1 Digital Innovation Capabilities and Firm Performance

Through the automation of repetitive jobs, the optimization of supply chain processes, and the advancement of data analytics, digital innovation skills help businesses optimize their operations. For example, more accurate demand prediction with advanced analytics and machine learning can lower inventory costs and raise service standards (Wamba et al., 2021). Furthermore, real-time monitoring and maintenance can be improved by integrating Internet of Things (IoT) technologies into industrial processes, which will decrease downtime and boost productivity (Chong & Li, 2019). Businesses that use digital innovation to their advantage can provide more individualized services, quicker turnaround times, and better product options to their

customers. For instance, businesses can better understand consumer preferences and behaviors by utilizing big data analytics, which results in more specialized marketing plans and product recommendations (Huang et al., 2022). Furthermore, digital platforms facilitate smooth customer interactions by offering help and engagement across various channels, hence enhancing customer satisfaction and loyalty (Verhoef et al., 2021). Businesses can gain a competitive advantage by having digital innovation capabilities that allow them to quickly respond to changes in the market and take advantage of new opportunities. Businesses with a strong grasp of digital innovation can launch new goods and services ahead of rivals, taking market share and becoming leaders in the field (Nambisan et al., 2019). Moreover, digital innovation cultivates an environment of perpetual enhancement and flexibility, which is crucial for maintaining relevance in ever-changing markets (Vial, 2021). Better financial success is ultimately the result of increased market competitiveness, better customer happiness, and increased operational efficiency taken together. Businesses that invest in digital innovation frequently witness notable increases in market valuation, profitability, and revenue growth. Bharadwaj et al. (2022), for example, discovered that businesses possessing robust digital innovation capabilities had superior financial performance indicators, such as return on equity (ROE) and return on assets (ROA). Based on the argurments, it is hypothesized that;

H1: Digital innovation capabilities have a positive and significant relationship with firm performance

2.4.2 Mediating role of Supply Chain Visibility

Supply chain information is now more accurate, timely, and easily accessible because to digital innovation capabilities like blockchain, big data analytics, and the Internet of Things. Achieving supply chain visibility requires this improved information flow

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(Caridi et al., 2019). IoT devices, for instance, may track the whereabouts and state of commodities in real-time, giving decision-makers access to thorough data that facilitates better decision-making. According to Gligor et al. (2021), having this degree of visibility guarantees that businesses can promptly detect and resolve problems, minimising disruptions and enhancing overall operational effectiveness. Businesses are able to make quicker and more informed decisions when there is greater visibility into the supply chain. By giving insights into future trends and potential hazards, digital innovation enhances SCV by supplying the instruments required for advanced analytics and predictive modeling (Bag et al., 2021). Improved visibility facilitates improved resource allocation, demand forecasting, and inventory management, all of which improve company performance by reducing costs and maximizing service levels (Dubey et al., 2021). Digital innovation has made supply chain visibility possible, which greatly improves a company's capacity to recognize and manage risks. Businesses can foresee possible supply chain problems and proactively build backup plans thanks to real-time data and analytics (Wamba et al., 2020). Blockchain technology, for example, ensures transparency and lowers the risk of fraud by providing immutable records of transactions. According to Ivanov et al. (2019), preserving operational continuity and ensuring consistent business performance depend heavily on this proactive risk management.

Capabilities for digital innovation encourage increased cooperation and integration between supply chain participants. Digital platforms and technology enable the smooth transfer of information throughout the supply chain network, improving SCV (Wong et al., 2020). By resulting in a more resilient and agile supply chain, this integration improves firm performance through synchronized operations, shorter lead times, and enhanced responsiveness to market changes (Chen et al., 2021).

Improved supply chain visibility guarantees that goods are delivered on schedule and in ideal condition, which improves customer satisfaction. Customers benefit from transparency offered by digital technologies such customer portals and real-time tracking systems, which improves their experience and increases their trust in the company (Gong et al., 2021). Good customer satisfaction levels encourage repeat business and customer loyalty, which have a direct positive impact on business performance. Based on the arguments, it is hypothesized that

H2: Supply chain visibility positively and significantly mediate the relationship between digital innovation capabilities and firm performance

2.4.3 Moderating effect of Supply Chain Responsiveness

Supply chain responsiveness has a major impact on the relationship between company performance and digital innovation capabilities (SCR). The ability of a supply chain to respond quickly and effectively to shifts in demand, interruptions in the supply chain, and market conditions is referred to as supply chain responsiveness. The degree to which the supply chain can effectively adjust to and capitalize on technology improvements will determine how much the moderating effect of SCR will magnify or lessen the impact of digital innovation on firm performance.

The supply chains' flexibility and responsiveness are improved by digital innovation capabilities including sophisticated forecasting models, IoT, and real-time data analytics. However, the supply chain's reactivity limits how much these improvements translate into better company success. In order to satisfy shifting market demands, a responsive supply chain can instantly modify production schedules, inventory levels, and logistical operations in response to insights received from digital technology (Gligor et al., 2021). Due to this flexibility, lead times are shortened, stockouts are kept

to a minimum, and resource usage is maximized, all of which improve company performance (Dubey et al., 2021). The response of the supply chain is also essential for risk management. Digital innovation equips businesses with the means to predict and recognize possible disruptions. Nonetheless, the supply chain's responsiveness determines how well we can address these risks. To lessen the effects of disruptions, responsive supply chains can swiftly reorganize their networks, find substitute suppliers, and modify their logistical routes (Ivanov et al., 2019).

This capacity lessens the detrimental effects of disruptions on business performance and guarantees the continuation of operations. Businesses can gain greatly from digital innovation capabilities, but only if the supply chain is responsive can these advantages be fully realized. For example, using robotics or 3D printing in advanced manufacturing can result in more productive production lines. The promised performance advantages, however, might not be realized in full without a responsive supply chain that can swiftly integrate new technologies and modify operations accordingly (Bag et al., 2021). As a result, SCR plays a critical moderating role in ensuring that digital advances result in noticeable performance gains.

To achieve greater company performance, supply chain responsiveness and digital innovation strategies must be in sync. Changes in supply chain architecture and procedures are frequently necessary for digital innovation projects. According to Tiwari et al. (2022), a supply chain that is responsive may promptly conform to these modifications, guaranteeing the successful execution of digital tactics and the optimization of their advantages. A unified strategy for innovation and performance enhancement is fostered by this strategic alignment. Based on this argument, it is hypothesized that;

H3: Supply chain responsiveness positively and significantly moderate the relationship between digital innovation capabilities

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter presents the methodology for the study. It looks at the research purpose, research design and strategy, study's population, the sampling technique and sample sizes, data gathering instruments and the operationalization of constructs. In addition, it discusses measurement of variables, data collection procedures, data analysis, quality of the study, ethical considerations and the profile of the study area.

3.1 Research Philosophy

The manner in which we think about research influences our research approach and our views on judgments in society suggest that we perceive some factors and events as more significant and relevant than others (Saunders et al., 2011). There are several research philosophies like the positivism, subjectivism, and pragmatism among other. However, this study adopts the pragmatism research philosophy.

According to Leavy (2017), pragmatism asserts that there is no allegiance to any set of rules instead rather suggest that any relevant tool can be crucial in different research context. The objective of this type of research philosophy is to reveal what works for a given research problem (Creswell, 2014). According to Creswell (2014), pragmatism concentrates on the findings of the research that is the actions or situations instead of antecedent conditions as in postpositivist. Therefore, for the purposes of this study, which explored and tested an already existing theory, positivists research philosophy views will be espoused.

3.2 Research Purpose

According to Cavana et al. (2001), any type of research can be grouped based on its purpose (exploratory, explanatory and descriptive). The study is aimed at obtaining new thoughts into happenings in and around the world. This type of study is quite flexible and easily adaptable to changes. Descriptive study on the other hand, seeks to disclose an accurate profile of objects, persons, situations and events. Explanatory research seeks to study situations and problems by trying to establish a causal relationship between the variables which is being studied.

The purpose of this study is to investigate supplier relationship management and how it customer loyalty. Thus, establishing a relationship among information sharing, supply chain collaboration and logistics performance, the research intends to address the issues of supplier relationship management among firms in Ghana. The study is explanatory research because it seeks to examine or explain whether or not if supply chain responsiveness influences the effect of digital innovation capabilities on firm performance.
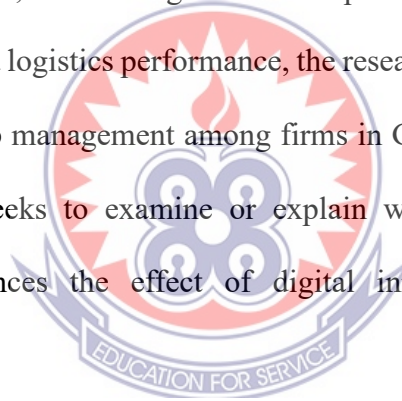
3.3 Research Design and Strategy

The type and nature of every study determine to a large extent the choice of design and the right strategy to be employed. Research design according to (Saunders et al, 2009) is a plan that determines the collection, measurement and how data would be analysed. Several types of research strategies are in place for researchers. Some of the strategies include experiment, case study, action research, grounded theory, survey, archival and ethnography.

With reference to this current study, the researcher has chosen to employ the use of the survey strategy. The survey approach is normally associated with the deductive

approach, it is commonly called and seen as a means that enables the collection of large quantitative data. A data collection instrument for instance is a questionnaire that makes it possible to use either descriptive or inferential statistics or both in analysing (Saunders et., 2009).

3.4 Population of the Study

Population is the whole group of people, elements or events of things that are of interest to the researcher (Cavana et., 2001). The study focuses on organisations in the Ashanti Region, specifically Kumasi with the aim of empirically testing the theoretical framework that has been proposed. As one of Ghana's wealthiest regions, Ashanti has a vibrant economy, largely driven by natural resources such as gold, cocoa, and timber. This makes it an attractive location for economic research, particularly in the areas of mining, agriculture, and trade. Additionally, Ashanti region is the second most industrialized region behind Greater Accra region and is therefore Ghana's second commercial hub. Thus, Ashanti Region has a sizable population of firms from which an adequate sample can selected to investigate the study objectives.

The proposed model is universal and therefore findings could be generalized. The population of firms in Kumasi is 5019 from which the simplified formula developed by Yamane (1970) will be utilized. Due to the kind of concepts which is being investigated, there will be the need to further narrow the population and make it more homogenous which will aid the researcher to get access to the relevant information or data required. This will help in addressing the objectives of the study due to the fact that the study concentrates on selected firms.

3.5 Sample Size and Sampling Technique

3.5.1 Sample Size

Saunders et al. (2009) posits that quality of every study is not only influenced by how appropriate the method and instrument is but also how suitable the strategy for sampling is. Every research is limited by some factors and this is a main challenge to the researcher as he/she is not able to study all the factors within the given target population. In such instances, the researcher is obliged to pass through a process which is systematic and this is called the sampling process with the aim of getting a representation of the entire population.

According to Singh (2006), there is no single acceptable rule for determining the sample size which is appropriate for a study. Several authors (e.g Pallant, 2007; Field, 2009; Hair et al., 2014) have suggested that the appropriateness of sample size should be influenced by the statistical analysis or tools to be used in the study. The calculation of the sample size was carried out using the simplified formula developed by Yamane in 1970. The calculation of the sample size was carried out using the simplified formula developed by Yamane in 1970. The sample size for this study using Yamane (1970) formula is 150 respondents.

$$n = \frac{N}{1 + N(e)^2}$$

where,

n: Sample size

N: Population size

e: The acceptable sampling error (0.5)

$$n = \frac{5019}{1 + 5019(0.05)^2}$$

$$n = 150$$

3.5.2 Sampling Technique

In this study, the researcher used convenience sampling technique to obtain the sample that is representative of the population. Hence the researcher employed the use of convenient sampling technique. Convenience sampling aims at targeting a small sample of a population that has been specially chosen by the researcher. This is because it is easier to get the data and easily accessible (Trochim and Donnelly, 2008; Bhattacherjee, 2012). The researcher chose this technique because it is less expensive and fast compared with other sampling technique.

3.6 Research Method

This part is aimed at examining the various sources of data and the processes that were used in collecting the data.

3.6.1 Sources of Data

There are two kinds of data for every research which are primary data and secondary data. Primary data refers to the information that is collected by the researcher by means of systematic observation, interviews, results of questionnaires and case study compiled. Secondary data refers to that kind of data that has already been collected and accessible from other sources. Looking at the flaws that can characterize the usage of secondary source of data, the researcher used the primary source of data. Hence a questionnaire would be used. The questionnaire will be used to solicit responses from the research respondents to obtain in order to help address the research objectives.

3.6.2 Data Collection Technique

The only instrument that was used in collecting the data was through a well-structured questionnaire with measures adopted from an already existing literature.

The items in the instrument were grouped into two parts (Part A-B). Section A looked at the respondent's background information and information regarding the organisations in which the respondents were employed. The part B looked at the constructs in the theoretical framework of the study. This includes supply chain disruption and supply chain performance. The purpose was to help respondents to provide responses to the questions and also help the researcher. This will help the researcher to easily code the responses for the analysis.

3.6.3 Data Gathering Procedure

Despite the fact that the instruments were adapted for various constructs, the study has been validated in previous studies, it was therefore important for the researcher to review them in order that they serve as manifest variables for their appropriate constructs. To assist this, the researcher's supervisor had to probe the instrument that was to be used. Corrections were made in order to make the questionnaire ready for administration.

In like manner, the targeted respondents for the study includes some selected firms in Ghana. This is because such people are believed to have enough knowledge about the firm's internal and external relationships and processes. Therefore, an individual respondent was made to represent the firms.

The researcher employed the use of two approaches in gathering the responses for the study. First of all, key firms who fall within the population and meet the criterion as a

respondent were approached and questionnaire will be given to them.

In addition to the above, other responses were collected by personally going to the premises of the identified schools. Their consent will be sent and a letter of introduction from the department will be attached. Firms that accepted to participate in the study were given a maximum of two weeks to provide responses to the study. Out of 150 questionnaires, the researchers administered hundred and thirty within the study's time frame.

3.7 Data Analysis

This study employed quantitative data analysis techniques which is explained below. According to Cavana et al. (2001), several units of analysis exist and any of them can be used in a research work. They consist of individual, dyad (two-person interaction), group, organisations (organizational level) or cultures. The one to be used is dependent on the level of data gathered. This study employed organizational level as its unit of analysis. Due to this, individuals who were made to answer the questionnaire were key persons who represented the views of their various firms.

In the quest to analyse the data gathered, the researcher used the procedures indicated. First, there was generation of preliminary results (demographic information on the respondents and organization and addressing the study's objectives, followed by validity and reliability testing of the data collection instrument and lastly the model estimation and evaluation of hypotheses.

3.8. Validity and Reliability

Validity and reliability are two unique characteristics that every researcher must recognize in the process of designing, analyzing and judging the quality of a study or

research especially with regards to quantitative studies. It is therefore necessary that every design adopted, data gathered and assessment techniques that are used are reliable and valid or else the study is considered futile. Conducting several tests (eg internal consistency, discriminant validity, convergent validity etc), the researcher made sure that the data that has been collected was suitable for the intended study. See chapter 4 for more details.

3.9 Ethical Consideration

Ethical issues are of much significance in every research that is conducted and this study is not an exception. In making the respondents to understand and sign the consent form to this study, an introductory letter was obtained from the head of department. Copies of the introductory letter were given to the heads of various firms selected for this study. That being said the respondents were briefed about the purpose of the study and the time needed to complete the questionnaire before they endorse the consent forms. The respondents were assured of confidentiality in the data collection. By these arrangements, the rights of the respondents were respected. At any given time, the respondents were allowed to opt out of the process if one wanted to do so. The participants that were interviewed were allowed to do so voluntarily and were not forced in answering questions. Also, the researcher should not fill the questionnaire himself. The researcher did not also manipulate the data to suit the stated hypotheses and objectives. Uncompleted forms were not be filled by the researcher.

Due to the kind of concepts which is being investigated, there will be the need to further narrow the population and make it more homogenous which will aid the researcher to get access to the relevant information or data required. This will help in addressing the objectives of the study due to the fact that the study concentrates on selected firms.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION OF RESULT

4.0 Introduction

The purpose of this research is to examine the relationship between digital innovation capabilities and firm performance. In order to highlight the breadth and trends of the topics under discussion, this chapter starts with a descriptive statistic of the data. In addition, the chapter focuses on the validity and reliability of the instruments that were employed. Validity and reliability are crucial because they address concerns about the strength of the data acquired and the precision of the measurement instruments. In this chapter, statistical methods including exploratory factor analysis, regression analysis, descriptive statistics, and correlation are used to analyse data.

4.1 Demographics Characteristics of Respondents and Firms

This section provides insights into the demographic characteristics of the respondents and the firms that were sampled for the study. The demographic characteristics presented comprises of gender, age, educational background, position of respondents and ownership type.

Table 4.1: Demographic Characteristics of Respondents and Firms

	Frequency	Percent	Valid percent	Cumulative percent
Gender				
Male	63	63.0	64.3	64.3
Female	35	35.0	35.7	100.0
Total	**98**	**98.0**	**100.0**	
Age				
23 years and below	10	10.0	10.3	10.3
24-29 years	20	20.0	20.6	30.9
30-35 years	51	51.0	52.6	83.5
36-40 years	12	12.0	12.4	95.9
41 years and above	4	4.0	4.1	100.0
Total	**100**	**100.0**	**100.0**	
Educational Background				
Diploma	3	3.0	3.1	100.0
Bachelor's degree	39	39.0	39.8	63.3
Master's degree	33	33.0	33.7	96.9
Total	**100**	**100.0**	**100.0**	
Respondent's Position				
Procurement manager	45	45.0	45.5	31.7
Logistics manager	30	30.0	30.3	78.3
Operations manager	25	24.0	24.2	100
Total	**100**	**100.0**	**100.0**	
Firm Size				
4 – 20	12	12.0	12.0	12.0
21 – 100	45	45.0	45.0	45.0
101 – 500	33	33.0	33.0	33.0
Above 500	10	10.0	10.0	10.0
Total	**100**	**100.0**	**100.0**	
Ownership Type				
Fully locally owned	52	52.0	52.0	52.0
Fully foreign owned	21	21.0	21.0	73.0
Jointly Ghanaian and foreign owned	26	26.0	26.0	99.0
Total	**100**	**100.0**	**100.0**	

First, the gender of respondents revealed that the respondents engaged for the study are

male dominated as 65% of the respondents were males whereas the remaining 35%

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were females.

Second, in terms of the age category, age range 30 – 35 years constituted the majority with 51% followed by the age range 24 -29 which constituted 20%. Respondents between 36 – 40% constituted 12% of the respondents. The findings reveal that a significant majority of the respondents engaged are within the youthful age group and can deem appropriate for providing responses for a study involving digital innovation capabilities.

With regard to the position of respondents, 45% of the respondents are procurement managers, 30% are logistics managers and 24% are at the operations managers. This indicates that the right respondents answered the questions.

Again, with regard to firm size (number of employees), 12% of the firms had employees between 4 – 20. Firms with employees between 21 – 100 had the highest number of employees, specifically 45%, followed by firms with employees between 101 – 500 (33%) and lastly firms with employees above 500% employees had the least category of 10%. The firm age findings signal that majority of the firms engaged are either medium or large-scale firms and may potentially have the resources to invest in digital capabilities.

Lastly, based on their firms' ownership type, 52% are fully locally owned, 21% are foreign owned, 26% are jointly Ghanaian, and foreign owned. This indicates that there is fair selection of organisations based on the ownership type.

4.2 Test of Normality

This section presents item-by-item descriptive statistics of the study's constructs. All items were measured on a 7- point scale and details of the scale anchors have been

provided in the last row of each table. The descriptions here are the full list of items used in the questionnaire, before exploratory and confirmatory factor analysis. The main variables are from tables 5.7 to 5.10, followed by the control variables. All composite scores used in the OLS regression estimation were calculated after the EFA and CFA procedures, and may not reflect the means in the descriptive tables provided in this section (for constructs that have items dropped). The tables presented in this section indicate the minimum and maximum values on each construct and the mean and standard deviation per item.

Normality is one of the key assumptions of multivariate statistics, and it is important to check metric variables early for normality (Kline, 2011; Tabachnik and Fidell, 2013). Multivariate normality means that all variables are univariate normally distributed, the distribution of any pair of variables is bivariate normal, and all pairs of variables have linear and homoscedastic scatterplots (Harrington, 2009). Even though there are several aspects of normality and checking impractical to assess all aspects of multivariate normality, checking for univariate normality (skewness and Kurtosis) and outliers will detect most cases of non-normality (Harrington, 2009; Kline, 2011). Hair et al., (2014) argue that even though univariate normality does not guarantee multivariate normality, if all variables meet this requirement, then any departures from multivariate normality are usually inconsequential. A normality test for each item, using skewness and Kurtosis statistic generated using SPSS is also presented in the table below. Skewness is the tendency of the deviations from the mean to be larger in one direction than in the other, whiles kurtosis is a measure of the relative peakedness or flatness of the curve defined by the frequency distribution (Malhotra et al., 2017). Skewness, for instance, can cause r to underestimate the magnitude of relationships (Nunnally and Bernstein, 1994). To check for normality,

this study follows considers both item-by-item checks of skewness and Kurtosis and a check for composite scores. The results presented in the tables indicate that the distribution of scores on each item is satisfactorily normal as both the skewness and the kurtosis indices obtained are very much within the recommended thresholds of "less than |4|" and "less than |8|" respectively.

Table 4.2: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
DIC1	57	1.00	7.00	4.0000	2.35281	-.153	.316	-1.597	.623
DIC2	41	1.00	7.00	3.6341	2.00943	.046	.369	-1.362	.724
DIC3	58	1.00	7.00	4.4483	2.07890	-.325	.314	-1.342	.618
DIC4	57	1.00	7.00	4.3860	1.97985	-.304	.316	-1.166	.623
DIC5	57	1.00	7.00	4.2281	1.98222	-.428	.316	-1.197	.623
DIC6	57	1.00	7.00	4.2807	2.21806	-.165	.316	-1.477	.623
SCV1	56	1.00	7.00	4.1786	2.30499	-.134	.319	-1.559	.628
SCV2	56	1.00	7.00	4.6250	1.93120	-.433	.319	-1.149	.628
SCV3	55	1.00	7.00	4.2182	2.12299	-.309	.322	-1.305	.634
SCV4	56	1.00	7.00	4.4821	2.00899	-.419	.319	-1.042	.628
SCV5	56	1.00	7.00	4.4821	2.13193	-.313	.319	-1.281	.628
SCR1	57	1.00	7.00	4.4386	2.09606	-.357	.316	-1.283	.623
SCR2	57	1.00	7.00	4.4912	2.05394	-.429	.316	-1.185	.623
SCR3	57	1.00	7.00	4.3158	1.95629	-.210	.316	-1.156	.623
SCR4	57	1.00	7.00	4.3158	2.08016	-.266	.316	-1.280	.623
SCR5	57	1.00	7.00	4.0526	2.06520	-.111	.316	-1.417	.623
FP1	58	1.00	7.00	3.7759	2.39915	-.050	.314	-1.784	.618
FP2	58	1.00	7.00	4.1724	2.18558	-.333	.314	-1.486	.618
FP3	58	1.00	7.00	4.2241	2.15246	-.279	.314	-1.431	.618
FP4	58	1.00	7.00	4.5690	2.20933	-.490	.314	-1.227	.618
Valid N (listwise)	36								

4.3 Reliability Test of Measurement Scales

Two tests of reliability – Cronbach's Alpha and composite reliability have been used in this study. Results of the Cronbach's Alpha test are presented in table 5.17 below, whereas the composite reliability is reported in the CFA table in the later parts of this section. The alpha values for all constructs are above the threshold of 0.7, indicating that the constructs demonstrate good internal consistency.

Table 4.3: Reliability Analysis

Construct	Number of items	Cronbach's alpha
1. Digital innovation Capabilities	6	0.928
2. Supply chain visibility	5	0.889
3. Supply chain Responsiveness	5	0.914
4. Firm Performance	4	0.880

4.4 Exploratory Factor Analysis

Given that most of the indicators in the study were adapted from extant literature and through interviews with key informants, I first used exploratory factor analysis (EFA) to understand the underlying structure and one-dimensionality of the data (Hair et al., 2019). I performed EFA on all multi-item indicators using principal component and Varimax as factor extraction and rotation methods, respectively (Hair et al., 2019). Bartlett's test of sphericity reached a statistically significant level ($\chi 2 = 5065.953$, df = 325, p < 0.00) while Kaiser–Meyer–Olkin (KMO) index was 0.87, suggesting that factorability and sample size are not concerns in the study (Hair et al., 2019). As shown in Table 3, the EFA extracted six factors that correspond to the number of latent constructs in the study. The Eigenvalues ranged from 1.79 to 8.41 while the percentage of variance explained values ranged from 5.98% to 28.03%. Importantly, the indicators

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load high (above 0.60) only on their theoretical constructs, with the highest cross-loading being 0.32. These results offer initial evidence of one-dimensionality, convergence, and discriminant validity.

Table 4.4: Exploratory Factor Analysis

	1	2	3	4
DC1			.649	
DC2			.699	
DC3			.693	
DC4			.672	
SCV1	.663			
SCV2	.637			
SCV3	.614			
SCV4	.638			
IS5	.729			
FP1		.827		
FP2		.820		
FP3		.817		
SCR1				.631
SCR2				.633
SCR3				.724
SCR4				.674

The KMO value should be greater than or equal 0.70. hence the sample is adequate for the analysis. Barlerts must be significant at 0.05. this means that the variables are unrelated.

Table 4.5: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.870**
Bartlett's Test of	Approx. Chi-Square	5065.953
Sphericity	Df	325
	Sig.	**.000**

4.5 Key Descriptive Statistics and Inter-construct Correlation

The key variables in the study are digital innovation capabilities, supply chain visibility, supply chain responsiveness and firm performance. This section examines the means scores of these items and their correlation with other variables. Details are provided in the table below

4.5.1 Digital Innovation Capabilities

From the table below, the average scores on the digital innovation capabilities scale is slightly above the moderate level on the scale (mean = 4.2276, standard deviation is 1.39350). Considering the standard deviation of 1, it can be inferred that there are firms in the sample that pursue a high level of digital innovation capabilities. From the table, digital innovation capabilities positively correlate with the other main variables, Correlation with firm-level control variables (firm size and age) was not found significant.

4.5.2 Supply chain Visibility

The average score on the supply chain visibility construct is 4.3983 with a standard deviation of 1.7586. Once again, the responses indicate that some firms reported supply chain visibility below moderate value and some reported above the moderate value. The supply chain visibility construct correlates positively with digital innovation capabilities, supply chain responsiveness and firm performance.
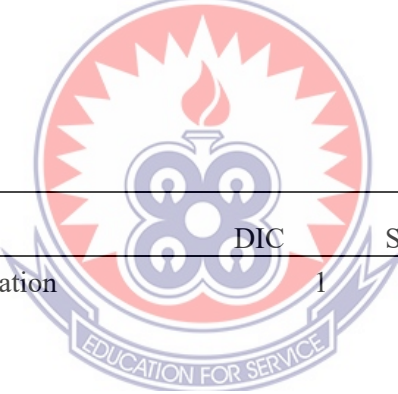
4.5.2 Supply chain Responsiveness

The average score on the supply chain visibility construct is 4.3228 with a standard deviation of 1.7682. Once again, the responses indicate that some firms reported supply chain responsiveness below moderate value and some reported above the moderate value. The supply chain responsiveness construct correlates positively with digital innovation capabilities, supply chain visibility and firm performance.

4.5.3 Firm performance

On the firm performance construct, a mean value of 4.9420 was recorded with a standard deviation of 1.80611. There is a significant, positive correlation between the firm performance construct and other main variables.

Table 4.6: Correlation

		DIC	SCV	SCR	FP
DIC	Pearson Correlation	1	.817**	.760**	.843**
	Sig. (2-tailed)		.000	.000	.000
SCV	Pearson Correlation	.817**	1	.785**	.873**
	Sig. (2-tailed)	.000		.000	.000
SCR	Pearson Correlation	.760**	.785**	1	.815**
	Sig. (2-tailed)	.000	.000		.000
FP	Pearson Correlation	.843**	.873**	.815**	1
	Sig. (2-tailed)	.000	.000	.000	

4.6 Test of Hypotheses

An analysis of the research model and the testing of the hypotheses are presented in this section.

Regression analysis was performed to test the hypotheses using the Ordinary Least Squares (OLS) estimation method and PROCESS macro (Hayes, 2013). Specifically, SPSS was used for the regression and PROCESS macro analysis. Moderation and mediation analysis were carried out using the PROCESS macro.

The use of PROCESS macro has gained pervasive acceptance among researchers because it is able to probe moderating, mediating in addition to conditional process models. The PROCESS macro is utilized to estimate 10000 samples bootstrapping 95% bias-corrected confidence intervals for estimating the model's coefficients. In addition, the PROCESS macro is used in estimating the conditional values of the predictor at the differing levels of the moderators and is additionally to implement the Johnson-Neyman technique for investigating interactions.

The results of the analysis revealed that all the hypotheses were supported. Digital innovation capabilities had a positive and significant effect on firm performance ($\beta = 0.806$, $t = 22.927$, $p < 0.000$) which indicates that higher levels of digital innovation capabilities lead to an improved firm performance. Digital innovation capabilities likewise had a positive and significant effect on supply chain responsiveness ($\beta = 0.582$, $t = 4.021$, $p < 0.00$) which also indicates that higher digital innovation capabilities result in a better supply chain responsiveness. Also, that higher levels of supply chain responsiveness results in a better firm performance

Moreover, one mediating path was investigated using the PROCESS macro. The PROCESS macro analysis found support for the mediation paths. For there to be a significant path in terms of PROCESS macro analysis, a zero must not lie in between the lower limit and upper limit confidence interval. Primarily, the sign of the relationship for both the lower limit and upper limit confidence intervals must be in the

same direction to signify mediation. On one hand, the mediation analysis reveals that supply chain visibility has a positive and significant mediating role in the relationship between digital innovation capabilities and firm performance (LLCI = 0.3100, ULCI = 0.7336) thereby providing support for hypothesis 2.

Table 4.7 Mediation analysis result

Direct effect of X on Y					
Effect	**se**	**T-value**	**P-value**	**LLCI**	**ULCI**
.3858	.1139	3.3862	.0013	.1573	.6143
Indirect effect(s) of X on Y:					
	Effect	BootSE	BootLLCI	BootULCI	
SCV	.4976	.1077	3100	.7336	
Completely standardized indirect effect(s) of X on Y:					
	Effect	BootSE	BootLLCI	BootULCI	
SCV	.4717	.0910	.2976	.6655	

4.7 The interaction effects of Digital Innovation Capabilities

This section provides insights into the interaction between digital innovation capabilities and supply chain responsiveness on firm performance. The results indicate that the interaction between digital innovation capabilities and supply chain responsiveness on firm performance is insignificant and not supported. This is reflected in the following; (β = .0394, ULCI = -.0555, LLCI = .13440). Since a zero does not lie in between the ULCI and LLCI, it signals the insignificant moderating role of supply chain responsiveness on the link between digital innovation capabilities and firm performance.

Additionally, the conditional impact of digital innovation on firm performance at different levels of supply chain responsiveness is examined. A low value of -1.3188 (one standard deviation below the mean), a moderate value of.0000 (the mean of the

mean centered variable), and a high value of 1.3188 (one standard deviation above the mean) are assigned to supply chain responsiveness. The table indicates that digital innovation capabilities will have a negative association with firm performance when supply chain responsiveness is minimal (β = -.2175, t = -3.1169, p <.05). Nevertheless, this relationship reached statistical significance.

Digital innovation capabilities improve firm performance at a moderate (mean) level of

Study's hypothesis	Path coefficient	T-statistics	P-value	Decision
DIC → FP	.806	22.927	0.000	Supported
DIC → SCV→FP	.582	4.021	0.000	Supported
DC x SCR →FP	.039	.8333	.4084	Not Supported

supply chain responsiveness, although the association is negligible (β = -.0781, t = -1.3921, p >.05). Digital innovation capabilities has a significant impact on firm performance when supply chain responsiveness is at a greater degree (β =.1862, t = 2.8190, p <.05). Digital innovation capabilities improve firm performance at high levels of supply chain responsiveness.

Table 4.7: Results of Hypothesized Relationships

Table 4.8 Model Summary

	coeff	SE	T-value	P-value	LLCI	ULCI
Constant	.3783	.7566	.5001	6191	-1.1391	1.8958
DC	.3724	.2520	1.4782	.1453	-.1329	.8778
SCR	.3275	.1870	1.7514	.0857	-.0476	.7025
DC x SCR →FP	.0394	.0473	.8333	.4084	-.0555	.1344

4.8 Discussion of Results

This study assessed the when and how digital innovation capabilities influence firm performance. among selected firms in the Ashanti Region. A total of 100 firms were sampled for this work. The motivation for the study was on the premise that although some studies have been conducted looking at digital innovation capabilities and firm performance, very few have looked at when and how mediates the relationship between information sharing and supply chain performance especially among manufacturing firms.

4.8.1 The impact of Digital Innovation Capabilities on Firm Performance

The finding of a strong and positive correlation between digital innovation capabilities and firm performance is consistent with a large body of recent research that highlights the transformative power of digital innovation in raising overall performance and firm competitiveness.

Teece (2018) posits that companies that effectively incorporate digital innovation into their operations likely to achieve competitive advantages through the creation of distinctive value propositions and cost savings. In a similar vein, Sambamurthy et al. (2003) contend that companies possessing robust digital capabilities can be more adaptable, enabling them to react to market developments more skilfully and producing superior performance results.

According to a 2019 report by Vial, digital innovation capabilities transformation helps businesses make better decisions, engage customers more effectively, and develop data-driven strategies—all of which have a favourable impact on business success. In a similar vein, Zeng et al. (2020) discovered that digital innovation enhances business performance by increasing supply chain visibility and operational efficiency, which

results in more adaptable and durable business models.

Businesses with strong digital innovation skills frequently launch new or enhanced products to fulfil changing consumer demands. According to Nambisan et al. (2017), open innovation is made possible by digital platforms, which helps businesses co-create value with outside stakeholders and improves business performance.

Digital innovation makes supply chains more agile and visible, which helps businesses better handle challenges. According to Iansiti and Lakhani (2020), digital transformation increases a company's capacity for crisis management and anticipation, resulting in increased operational resilience and long-term performance.

The literature currently in publication provides strong evidence for the conclusion that digital innovation capabilities and company success are positively and significantly correlated. Firm competitiveness is increased by digital innovation because it improves responsiveness, efficiency, and creativity. Success, though, frequently hinges on how effectively these skills mesh with the broader strategy and culture of the company.
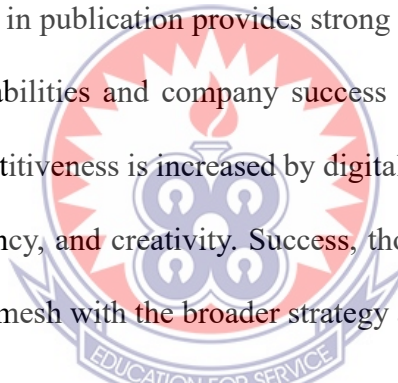
4.8.2 The mediating role of Supply Chain Visibility

The finding that supply chain visibility plays a positive mediating role in the relationship between digital innovation capabilities and firm performance is consistent with an increasing amount of research highlighting the vital role visibility plays in attaining resilience, efficiency, and overall success for supply chains. The ability of a business to observe and monitor goods, inventories, and information flows in real time across the supply chain is known as supply chain visibility, or SCV.

The idea that supply chain visibility plays a mediating function suggests that while digital innovation capabilities by themselves might not have a direct impact on a company's performance, they can have a greater positive impact when combined with

increased visibility. According to Dubey et al. (2020), SCV serves as a facilitator, maximizing the advantages of digital technologies like big data, cloud computing, and the Internet of Things (IoT), by supplying real-time data that facilitates proactive decision-making.

Barratt and Oke (2007) state that companies with higher visibility can better align their supply chain partners, which will increase operational efficiency, save costs, and boost customer satisfaction. This shows that SCV is an important mechanism that enables the conversion of digital innovation capabilities into observable improvements in business performance.

Real-time data collection, analysis, and sharing throughout the supply chain are made possible by digital innovation, which improves supply chain visibility. According to Ghosh (2020), end-to-end visibility is enhanced by technologies such as RFID, blockchain, and AI, which helps businesses satisfy consumer needs more successfully, react quickly to disturbances, and optimize inventory levels. All of these factors eventually contribute to a company's performance.

According to Li et al. (2018), companies that possess robust capabilities in digital innovation can utilize sophisticated analytics to obtain practical insights into their supply chain operations. These revelations enhance operational effectiveness, inventory control, and forecasting accuracy—all of which lead to better company success. They also point out that when a company has a high SCV, the impact of these digital technologies is greater since real-time information facilitates better decision-making.

The research provides substantial support for the beneficial mediation effect of supply chain visibility on the relationship between digital innovation skills and business performance. Because SCV offers real-time, actionable information into supply chain

processes, it plays a crucial enabler role in enabling businesses to fully leverage their digital innovation potential. Nevertheless, achieving these advantages is contingent upon the organization's capacity to efficiently handle and apply the information given by heightened visibility.

4.8.3 The moderating effect of Supply Chain Responsiveness

The findings that responsive supply chains positively moderate the association between digital innovation capabilities and firm performance is consistent with recent research that highlights the importance of responsiveness in adjusting to shifts in market dynamics, supply interruptions, and demand. The ability of a business to promptly respond and adjust to modifications in the environment of its supply chain, whether brought about by shifts in client demand or supply chain interruptions, is referred to as supply chain responsiveness.

According to the supply chain responsiveness (SCR) moderating effect, organizations that are able to react swiftly and effectively to environmental changes are better able to benefit from digital innovation skills. In other words, when a company has a responsive supply chain that can quickly adjust to changes both inside and outside the company, its potential to use digital technology to improve performance is increased.

According to Tachizawa et al. (2015), companies that exhibit high responsiveness are better able to integrate digital breakthroughs like AI, IoT, and real-time analytics, enabling them to make decisions more quickly and intelligently. Consequently, better performance results including lower costs, higher service standards, and larger market shares are boosted by this responsiveness.

Capabilities for digital innovation allow supply chains to become more adaptable and responsive. Digital technologies like blockchain, cloud computing, and advanced

analytics, according to Qi et al. (2017), increase the transparency and adaptability of supply chain operations. This improves a company's capacity to respond to disturbances in the supply chain or changes in demand, which raises overall performance.

Blome et al. (2013) state that in unstable and uncertain contexts, supply chain responsiveness becomes even more important. In situations like these, businesses can gather and evaluate data in real time thanks to digital innovation capabilities, which facilitate quick decisions and flexible reactions. Better firm performance follows from a more resilient and competitive posture.

The extant literature provides substantial support for the claim that supply chain responsiveness positively moderates the association between digital innovation skills and firm performance. By allowing businesses to quickly adjust to shifting market conditions and disruptions, responsiveness boosts the effectiveness of digital innovation and improves overall performance. To fully reap the rewards, businesses must manage the possible trade-offs between cost-efficiency and responsiveness.
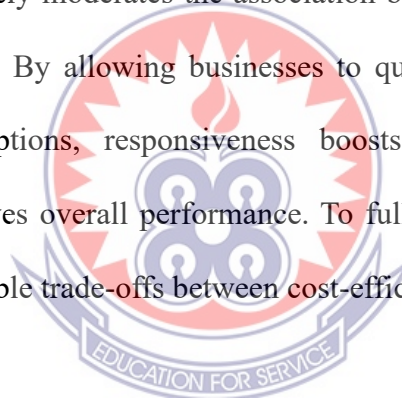
CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter is a summary of the research findings regarding the research objective and specific research question as a guide. The findings provided the basis for the recommendations and are also presented with the shortcomings of the study.

5.1 Summary of Findings

The purpose of this work is to examine how and when digital innovation capabilities influence firm performance. A total of 100 firms were sampled for the work. At the end of the study, the following findings were revealed and summarized based on the objectives of the research.

5.1.1 The impact of Digital Innovation Capabilities on Firm Performance

It was found that statistically digital innovation capabilities has a positive impact (effect) on firm performance among selected firms. Hence, digital innovation capabilities among the supply chain function drives firm performance.

5.1.2 The mediating role of Supply Chain Visibility

It was found that statistically supply chain visibility mediates the relationship between digital innovation capabilities and firm performance among selected firms. Hence, it can be concluded that supply chain visibility is a crucial factor in digital innovation capabilities and firm performance relationship.

5.1.4 The moderating effect of Supply Chain Responsiveness

The findings of the study also revealed that supply chain responsiveness moderates the relationship between digital innovation capabilities and firm performance. Hence it can be said that supply chain responsiveness influences the relationship between digital

innovation capabilities and firm performance.

5.2 Conclusion

An empirical analysis of the when and how digital innovation capabilities influence firm performance. A total of 100 firms in the Ashanti Region were employed for this work. The work was aimed at filling three main gaps in literature; does digital innovation capabilities affect firm performance? Second, what is the mediating effect of supply chain visibility on the relationship between digital innovation capabilities and firm performance? Finally, does supply chain responsiveness moderates the relationship between digital innovation capabilities and firm performance?

The above questions have been carefully investigated and results have been obtained. Based on the study results, certain conclusions of significant management and theoretical implications can be inferred. Generally, it can be concluded that digital innovation capabilities generate some benefits in terms of firm performance. Also, the study indicates that supply chain visibility mediates the relationship between digital innovation capabilities and firm performance. Finally, the findings indicate that supply chain responsiveness moderate the relationship between digital innovation capabilities and firm performance.

5.3 Managerial Implication

The study on the effect of digital innovation capabilities on firm performance, with the mediating role of supply chain visibility (SCV) and the moderating role of supply chain responsiveness (SCR), has significant implications for managers aiming to enhance their organization's competitive advantage and operational efficiency. The key takeaways for managers are as follows:

In order to maximize the return on investment, firms must ensure that their digital innovations are integrated effectively across supply chain operations. A holistic approach to digital transformation, encompassing not only technology but also processes and people, will ensure that the full potential of digital innovation is realized. Digital innovation capabilities, such as advanced data analytics, artificial intelligence (AI), Internet of Things (IoT), and blockchain, play a critical role in enhancing firm performance. Managers should prioritize investments in these technologies.

The relationship between digital innovation and business performance is considerably mediated by supply chain visibility, emphasizing the necessity of real-time information exchange and transparency across supply chain partners. Using technology that offer real-time product, inventory, and information tracking, managers can work to enhance SCV. Improved visibility facilitates improved supplier and customer collaboration, resulting in supply chains that are more responsive and efficient. In the end, this will lead to better demand management, shorter lead times, and increased operational efficiency. Investing in technologies like blockchain, cloud computing, and RFID can aid in increasing this visibility. Additionally, in order to guarantee that increases in visibility result in actionable insights that boost performance, managers need to cultivate a culture of information sharing with partners both within and externally.

According to the study, organizations that have more responsive supply chains benefit more from digital innovations in terms of performance increases. This is because supply chain responsiveness has a moderating influence. Managers should concentrate on enhancing supply chain agility and flexibility so they can respond swiftly to interruptions, shifts in demand, and volatility in the market. Businesses can respond to unforeseen issues more successfully by implementing agile supply chain methods, such as dynamic logistics, flexible production processes, and

just-in-time inventory systems. Furthermore, this responsiveness will be improved by cutting-edge technology like automated decision-making systems and AI-driven demand forecasts.

Managers should be proactive in creating an adaptable supply chain that can change resources, production schedules, and distribution routes in real time. Being responsive shouldn't just be reserved for handling crises.

5.4 Theoretical implication

The study makes a substantial contribution to the body of knowledge in a number of fields by analyzing the relationship between supply chain responsiveness (SCR) and supply chain visibility (SCV) as mediators and moderators of the impact of digital innovation capabilities (DIC) on firm performance. The results provide insightful information on how supply chain management, digital transformation, and company performance interact, with various theoretical implications:

According to the resource-based view (RBV) of the firm, superior performance and competitive advantage are largely determined by a firm's skills and resources. By highlighting the importance of digital innovation capabilities as a special kind of intangible resource that can improve a firm's performance, the study broadens this approach. This implies that DIC—which includes blockchain, IoT, and AI—is essential for creating a long-lasting competitive advantage.

Moreover, this framework's mediating function for supply chain visibility emphasizes that the value of digital innovations is achieved through their integration into operational procedures rather than in isolation. According to the report, DIC is an essential but insufficient tool for performance enhancement; to realize its full potential, supply chain activities must be made public and transparent. This implies that the RBV

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must evolve to account for how modern digital capabilities integrate with operational processes like SCV to affect firm outcomes.

According to the dynamic capabilities' idea, businesses need to constantly develop, integrate, and reorganize their resources in order to adjust to their changing surroundings. This viewpoint is supported by the study's findings on supply chain responsiveness (SCR) as a moderator, since SCR is a dynamic capability that amplifies the impact of digital innovation on performance.

The study suggests that a critical dynamic competence that supports digital innovation capabilities is the capacity to quickly adjust to changes in the environment, whether via flexible production schedules, agile logistics, or real-time decision-making. Therefore, responsiveness enables businesses to take full use of their digital innovations by promptly responding to real-time data and modifying their processes as necessary. This study makes the case that theories of dynamic capabilities ought to consider the idea of digital innovation as a fundamental facilitator of supply chain flexibility and responsiveness.
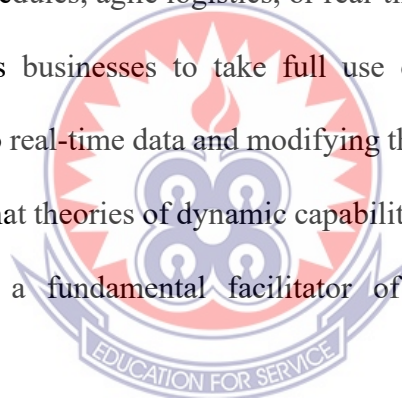
5.5 Limitations and Future Research Directions

The study has a number of limitations. The actual data collection was restricted to Ghana businesses, while it investigated the when and how digital innovation capabilities drives firm performance in Ghana. However, future studies by considering data from other country and regions should increase the scope of the study. The study revealed some fascinating results about digital innovation capabilities and firm performance among businesses in Ghana. However, some questions are left unanswered by this study. Future studies should explore other aspects of digital innovation capabilities and supply chain visibility on firm performance. Also, future studies should

consider the role that top management might play in the relationship between digital innovation capabilities and firm performance.

5.6 Recommendations

Based on the findings of the study, the following recommendations were made;

The study recommends that firms formulate policies that stress on a responsive digitalization of the supply chain since it has been found to have an impact on firm performance as it will help in customer development.

Firms must commit enough resources and capabilities to into enhancing digital innovation capabilities on the part of the suppliers; if they want to enhance their firm performance. Resource commitment is necessary for effective and efficient supply chain especially among service and manufacturing firms. It is also recommended that as practically as possible, players and firms must make sure that the right type of mechanism is applied in the supply chain to ensure responsiveness and visibility from the suppliers which will intend affect their firm performance. This will ensure that there is widespread benefit within the chain.
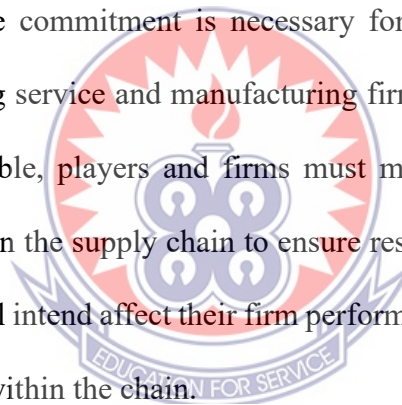
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APPENDIX

SURVEY QUESTIONNAIRE

I am a postgraduate student at University of Education, Winneba, Department of Procurement and supply chain management. This survey instrument has been designed to enable me carry out research on the topic: **WHEN AND HOW DOES DIGITAL INNOVATION CAPABILITIES INFLUENCES FIRM PERFORMANCE"**. Any information provided will be used for academic purposes ONLY.

SECTION A: RESPONDENT'S BIOGRAPHY AND COMPANY PROFILE

When completing this questionnaire, please tick **[√]** in the applicable box or provide an answer as applicable.

1. Gender: [ ] Male   [ ] Female

2. Age: [ ] 23 years and below   [ ] 24–29 years   [   ] 30–35 years
    [ ] 36–40 years   [ ] 41 years and above

3. Educational Background:
    [ ] No formal education [ ] Basic/Primary   [ ] Secondary
    [ ] Bachelor's Degree   [ ] Master's Degree   [ ] Ph.D./Doctorate

4. Number of years the firm has been in operation:
    [ ] Less than 1 year   [ ] 1-5 years   [ ] 6-10 years
    [ ] 11-15 years   [ ] 16-20 years   [ ] 21 years & above

5. Number of employees in the firm:
    [ ] Less than 6 employees   [ ] 6-9 employees   [ ] 10-29 employees
    [ ] 30-50 employees   [ ] More than 50 employees

6. Type of ownership:
    [ ] Fully locally owned   [ ] Fully foreign owned   [ ] Jointly Ghanaian & foreign owned

7. Position of respondent
    [ ] Procurement manager   [ ] logistics manager   [ ] warehouse officer

SECTION B: Digital innovation capabilities (Source: **Miocevic & Crnjak-Karanovic, 2012**)

Indicate the extent to which you agree or disagree with each statement by checking the appropriate number from 1 to 7, using the following scale:

1 = Strongly Disagree		*2 = Disagree*		*3 = Somewhat Disagree*		
4 = Indifferent/Not Sure		*5 = Somewhat Agree*	*6 = Agree*			
7 = Strongly Agree						

Item	**Statement**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Digital innovation capabilities								
DIC1	The quality of our digital solutions is superior compared to our competitors' The features of our digital solutions are superior compared to our competitors'							
DIC2	The applications of our digital solutions are totally different from our competitors'							
DIC3	Our digital solutions are different from our competitors' in terms of product platform							
DIC4	Our new digital solutions are minor improvements of existing products							
DIC5	Some of our digital solutions are new to the market at the time of launching							
	SOURCE:							
Supply chain visibility								
SCV1	Main suppliers inform our firm of their inventory availability							
SCV2	The frequent updating of our supplier inventory information is significant.							
SCV3	Our vendor stock reports are reliable.							
SCV4	Our firms receive shipment alerts in advance from our suppliers							
SCV5	The information our firm receives from vendors regarding advance shipments is timely and accurate.							
Supply chain responsiveness								
SCR1	Our supply chain system rapidly adjusts warehouse capacity to address demand changes							
SCR2	Our supply chain system rapidly varies transportation carriers to address demand changes							
SCR3	Our supply chain system rapidly accommodates special or non-routine customer requests							
SCR4	Our supply chain system effectively delivers expedited shipments							
SCR5	Our supply chain system responds rapidly to							

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	unexpected demand change							

SECTION C: Firm performance

Indicate the extent to which you agree or disagree with each statement by checking the

appropriate number from 1 to 7 using the following scale:

1 = Strongly Disagree		*2 = Disagree*		*3 = Somewhat Disagree*				
4 = Indifferent/Not Sure		*5 = Somewhat Agree*		*6 = Agree*				
7 = Strongly Agree								
Item	**Statement**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
FP1	Our firm has cut down operating costs							
FP2	Our firm has enhanced the company's overall competitive position							
FP3	Our firm has increased product sales growth rate							
FP4	Our firm has increased its market share of products							

Thank you for participating in the survey