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SUPPLY CHAIN DIGITALIZATION AND RESILIENT SUPPLY CHAIN PERFORMANCE: THE ROLE OF SUPPLY CHAIN FINANCING

BY

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DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma at Kwame Nkrumah University of Science and Technology, Kumasi or any other educational institution, except where due acknowledgment is made in the thesis.

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DEDICATION

I, first and foremost, dedicate this work to God Almighty, for seeing me through it all with strength and grace, and to my family for their unending support and love which kept me going.

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ABSTRACT

In a changing environment where supply chains are dynamic, it is important that firms increase capabilities in order to boost resilience and become competitive. The aim of this study is to assess the impact of supply chain digitalization on supply chain resilience with supply chain financing as the mediator. The study adopted a quantitative approach and employed survey questionnaires to collect data from two hundred and fifty (250) respondents in the manufacturing industries across Greater Accra, Ashanti, Central, Northern, Eastern and Volta Regions in Ghana. The study employed purposive sampling technique to select its sample size. Results were analysed in a descriptive and inferential design using Structural Equation Modelling – Partial Least Squares and Statistical Package for Social Sciences and results were presented in tables and figures. Results showed that digital tools use affects resilient supply chain performance significantly as the correlation amongst the variables were positive and significant. Secondly, it was revealed that, the adoption of digital tools in operations has a positive impact on resilient supply chain performance. Finally, the study revealed a full

mediation effect of supply chain financing between supply chain digitalization and supply chain resilience. The study suggested that organizations and governments should find creative solutions to enhance and extend their current resources to develop new supply chain competencies and capabilities and become resilient in changing environments.

LIST OF ABBREVIATIONS

AVE	**Average Variance Extracted**
SCR	**Supply Chain Resilience**
SCF	**Supply Chain Financing**
CFA	**Confirmatory Factor Analysis**
DTA	**Digital Tools Adoption**
SC	**Supply Chain**
DTU	**Digital Tools Use**
SMEs	**Small and Medium sized Enterprises**
AI	**Artificial Intelligence**
IoT	**Internet of Things**
IoS	**Internet of Services**
EFA	**Exploratory Factor Analysis**
PLS-SEM	**Partial Least Square Structural Equation Modelling**
SPSS	**Statistical Package for Social Sciences**
RBV	**Resource Based View**
DCV	**Dynamic Capability View**
SCM	**Supply Chain Management**

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Every firm relies heavily on logistics. It is a link in the supply chain that also includes transportation, inventory management, purchasing, and warehousing. For the majority of businesses, logistics expenses appear to account for between 10% and 15% of a product's final cost (Ghiani *et al.*, 2004). Utilizing cutting-edge innovative digitization tools like cloud computing, blockchain, smart contracts and industry 4.0 can be very beneficial for businesses in terms of effective operations management, elevated customer satisfaction, and increased employee satisfaction (Kshetri, 2018). One sector that has not been left out of this digitization era is the supply chain and logistics sector. According to Takahashi (2017), the penetration of digitization in the logistics sector led to an increase in investment of more than 80%, from 161 million in 2013 to more than $3 billion in 2019. Global supply chains are complex and susceptible to a variety of dangers, ambiguities, and disruptions (Manuj and Mentzer, 2008). Supply chain disruptions like the most recent corona virus pandemic, which affected supply chains and the economy adversely as a whole, were the catalyst for the need for digitization in supply chains (Barbieri *et al.*, 2020). These disruptions included anything from rising unemployment and high living costs to shortages of fast-moving consumer goods (FMCGs) and health supplies. To more effectively manage future disruptions and are ready for high-risk circumstances, our logistics and supply chain sector might tremendously benefit from adopting technology. These innovative solutions can improve the visibility of a supply chain, hence boosting its resilience. This increases our understanding of pandemic effects and lessens the likelihood of unexpected events occurring in the future when data are digitized. Digitalization also helps to lower costs and increase system performance by doing away with manual operations (Borgia, 2014). Tracking and tracing are essential for managing goods and products. Technological tools like the internet of things (IoT) and internet of services (IoS) which improve organizational performance, help supply chains' decision-making process (Ahumada and Villalobos, 2009). These technologies in general supply chains facilitate the management of variations in demand and supply, strict requirements for food security in the agricultural sector, and other sustainability concerns (Li and Wang, 2018).

A supply chain is a collection of connected businesses that converts inputs into finished goods for customers to consume. Supply chain issues have been highlighted by a number of global pandemic outbreaks, notably the current COVID-19 pandemic outbreak (Ozdemir *et al.*, 2022). These interruptions have a detrimental effect on every part of our lives, including healthcare, education, agriculture, business, and finance, as well as transportation. One of the major disruptions in the industrial industries is the equilibrium of supply and demand for perishable goods, particularly foods with shorter expiration dates (Golwelkar, 2020). Early on in the pandemic, certain food shortages caused customers to purchase more food than they needed, while other food scarcity were brought on by consumers' lower salaries as a result of job losses (Siche, 2020). These were the outcomes of supply chain disruptions rather than a lack of raw supplies. Due to restrictions on foreign travel and border closures, it was difficult to import perishable goods, which led to shortages in consumer supplies (Mahajan, 2020). The decline in labour, materials, and prices reduced producers' ability to create and income; some of these producers were unable to sell their goods and were thus forced to leave a variety of commodities to rot (Moritz, 2020).

Demand and supply-related risks and uncertainties exist in supply chains. Others of these risks are external, but others of them may be internal and straightforward to manage or control. Despite the fact that there are many risk variables, disruptions usually result from unpredictable events that happen outside of the supply network, including pandemics (Teece *et al.*, 2016). Because these risks could lead to notable losses in revenue, profitability, productivity, and competitive advantage if they are not controlled properly, a strong supply chain is essential (Sheffi, 2005). Global supply networks collapsed due to the COVID-19 pandemic's unique characteristics, which included its simultaneous catastrophic effects on a variety of supply and demand markets, geographies, and industries (Craighead *et al.*, 2020). The operations of the global supply networks were also hampered by governmental actions like border closures and lockdowns, which had detrimental short- and long-term effects on consumer spending and investment (Ivanov, 2020). The intensity of the crisis was unprecedented, with 94% of enterprises reporting supply chain disruptions due to COVID, and estimates showing a 32% decrease in global trade (Dib and Oulid, 2020). Supply chain resilience, which looks at a company's capability to foresee, recover from, and respond to unplanned supply network interruptions, has become a debate in academics as a result of the aforementioned experiences. Organizations with proper planning techniques and processes, which these organizations would use based on their capabilities, may be able to avoid interruptions even in the short term. Risks

are increased because supply networks are vulnerable as a result of their structural complexity and interdependencies (Dolgui and Ivanov, 2020). Some of these hazards can have long-term consequences for the entire supply chain.

Supply Chain Resilience (SCRes) refers to supply chains' capability to prevent, recover from, and mitigate disruptions so that they can perform as they did before the interruption (Hendry *et al*., 2019). An organization must make significant investments in resilience development if it wants to overcome disruptions, decrease vulnerability, and increase financial performance. Small and medium-sized enterprises (SMEs) are particularly vulnerable to the adverse effects of disruption if their financial positions are precarious. Depending on the impact of the disruption, different strategies are required to increase supply chain resilience - the firm's orientation in the supply chain, the type of disruption, and other factors. By assessing its risk, each company in a supply chain can strengthen its resilience, but doing so only works well when other chain members work together (Hendry *et al.*, 2019).

Early in the new millennium, proactive measures to increase supply chain resilience included human capacities, collaboration, localization or regionalization of sourcing, supply chain automation, digital connectivity, and a social supply network focus. Reactive approaches were used by firms in response to the pandemic, including real-time information and big data-driven systems, inventory management, reserve capacity, cooperation, decision-making closeness, virtual markets, simulations, and business continuity plans (Belhadi *et al.*, 2020). Some projects, like improving digital capacities and supply network coordination, can be both aggressive and conscious depending on the circumstance and application.

1.2 Problem Statement

The corona virus pandemic, which in late 2019 affected key emerging nations like the UK, US, Russia, France, Spain, Germany, and Japan, started in Wuhan, China. One of the most significant supply network disruptions in recent times, which has disrupted the operations and worldwide supply chain networks of numerous organizations. In an attempt to prevent the spread of the virus, the majority of governments imposed various degrees of quarantines, border closures, and human containment measures. This response has had a negative effect on how the global supply chain operates. In a report of its 558 US member organizations on the effects of COVID-19, the National Association of Manufacturers (NAM) found that majority (78%) of its members anticipated a major economic impact due to the unpredictability the

epidemic had on their organizations. In order to become more resilient in their supply chain operations, particularly during pandemics and other disturbances, organizations and businesses must employ a number of approaches (Craighead *et al.*, 2020).

The main forces behind regional and national socioeconomic progress, SMEs frequently struggle to find capital, which tends to limit their potential to expand. Due to the severe pressure on their cash flows caused by the COVID-19 pandemic, which struck in late 2019 and for the majority of countries in 2020, it is less likely that these small and medium-sized enterprises can survive (Kirschenmann, 2016). Banks are cautious when lending to and funding small and medium-sized enterprises due to unfavourable circumstances such as limited assets, an opaque financial state, an inefficient business system, and asymmetric information. Due to a lack of financial investments, these SMEs cannot grow.

Improving the efficacy and performance of SMEs is crucial because they play such an important role in the nation's economy. Guo *et al.*, (2021) emphasize the necessity of financial flow optimization in SMEs in order to promote resilience and sustainability. According to Soni *et al.*, (2022), these SMEs need to incorporate technology-led supply chains into their operations to improve their supply chain's productivity. Additionally, the cost of running the complete supply chain can be greatly decreased by coordinating and integrating capital, information, logistics, and trade movement throughout the chain. It is crucial to look into how the resilience of supply networks can be increased through technology-driven supply chains and supply chain financing.

According to Kumar and Managi (2020), one of the main causes of sustainable project failure is a lack of investments in resilience building. Due to this, money and investment are even more crucial for achieving supply chain resilience. The largest drop in stock index valuation resulted from the disastrous effects of the COVID-19 epidemic on the world economy. The relevance of blockchain in maintaining the viability of supply chain financing businesses has also grown in prominence. The analysis of the consequences of supply chain finance, blockchain technology, and smart contracts on resilient supply chain performance during pandemics like COVID-19 is a newly developing issue of interest in this context.

SMEs nevertheless require efficient resource allocation and management even if they typically lack the cash to invest in cutting-edge technologies. Over 70% of Ghana's GDP is generated by SMEs which play a vital role in the country's dynamic business environment. SMEs have

historically contributed significantly to the development of most emerging nations. It contributes significantly to Ghana's GDP growth and is a big source of employment. SMEs must operate more effectively and efficiently because of their critical role in sustaining an economy. The insufficient investment capital available hinders the expansion and development of SMEs. However, boosting the supply chain's financial flow efficiency can increase investment and productivity. Digitalization has a lot of potential to improve supply chain efficiency that SMEs operate in. Additionally, FinTech has aided in the acquisition of SCF by utilizing supply chain digitalization tools like information technologies (IT) to deliver financial services and expediting SMEs' loans and financial processes. Hence, Industry 4.0 technologies like cloud computing, IoT, supply chain analytics and big data play a significant part in the growth and influence of FinTech. SMEs can increase their business assets and competitiveness in this market by applying digital technology for sustainable supply chain finance (SCF) (Gunjan *et al.*, 2022). Despite the significance of supply chain financing, resource-based view theory-based research on its effects on supply chain resilience is scarce.

Because it enables quicker, more flexible, and more effective operations, digital technologies affect industries that produce, consume, and transfer data. The creation of numerous devices and the recent improvement of digital technology novelty are to blame for this. Contrary to conventional business environments, this resulted in the creation of digital business environments of value co-creation through the use of ICT, which represent a creative strategy for joint organizations spanning across various industries to support technological and service resources in order to productively meet market requirements (Senyo *et al.*, 2019). Due to the interconnectedness of the modern world, organizations have a digital compulsion to develop in technologically enabled ways, creating new opportunities for innovation.

Little research has been conducted, according to Bär *et al.*, (2018), on how firms may evaluate the potential advantages of digital technologies and their effects on supply networks. There is also a study deficit in execution techniques. From the perspective of data processing, digital tools are important for processing and managing the interchange of indicators for supply network operations. Due to their geographic dispersion and need for interconnectedness, coordination operations between wholesalers and end users are no longer self-sustaining in conventional supply chains (Büyüközkan and Göçer, 2018). Modern research has reinforced the relevance of digital tools, including AI, big data analytics and cloud computing in the operations of supply chains, in light of this.

Investments in cutting-edge technology have shown how much production costs may be reduced while yet maintaining competitiveness for businesses (Bär *et al.*, 2018). Businesses must therefore move away from functioning in disconnected silos and toward coordinated operational development focused on internal overall workflows and external consumer interlinkages. Operational and technological capabilities are required to be deployed in the proper ratio and sequence so as to have a complete and cumulative impact (Bollard *et al.*, 2017).

Despite the great interest in supply chain financing, there hasn't been much investigation into how it may improve the productivity and effectiveness of the supply network, particularly the performance of SMEs. There is also a lack of research on the functions and effective strategies for inter-business collaboration. These topics include the roles of big data and ICT in risk assessment and control, the involvement of different business types in supply chain financing, including producers, suppliers, distributors, retailers, banks, and logistics firms. These are all significant topics for academic researchers and business professionals. The interdisciplinary field of SCF may require knowledge of business analytics, finance, and supply chain management.

1.3 Research Objectives

The research study's main aim is to investigate the effect of supply chain digitalization on resilient supply chain performance with supply chain financing as a mediator. Particularly, the research seeks to address the following:

1. To identify the supply chain digitalization tools and strategies adopted for resilient supply chain performance
2. To determine the association between supply chain digitalization and supply chain financing
3. To investigate the effect of supply chain financing on resilient supply chain performance
4. To assess the mediating role of supply chain financing on the association between supply chain digitalization and resilient supply chain performance

1.4 Research Questions

Motivated by the research gap elaborated in the problem statement, the following sub-questions would be useful:

1. What are the supply chain digitalization tools and strategies that can be adopted for resilient supply chain performance?
2. How does supply chain digitalization relate to supply chain financing?
3. How does supply chain financing affect resilient supply chain performance?
4. How does supply chain financing mediates the association between resilient supply chain performance and supply chain digitalization?

1.5 Justification of the Study

The significance of the study lies in improving knowledge and comprehension of supply chain digitalization tools and techniques in general as well as their value in supply chain resilience to guard against supply chain disruptors. The study also aims to throw more light on how supply chain financing affects digitalization of the supply chain and resilient supply chain performance. In response to worries about supply chains' ability to survive in the case of a disruption, the study offers knowledge on enhancing supply chain resilience on a global and local scale. Given the resource constraints on resilience development, managers can use the study to assess their prioritizing measures for the near future. A more specific level of this assessment and prioritization process will be feasible, specific to the field of practice of each practitioner. The research study aims to pinpoint key implementation difficulties that must be overcome for firms to increase supply chain resilience in the future. Practitioners will thus be able to fully plan their long-term predicament responses. Finally, the study aims to provide suggestions and more meaningful policy interventions to develop the optimum governance framework for improving supply chain resilience for SMEs.

1.6 Research Methods

Data from both secondary and primary sources have been used. The administration of questionnaires was the primary method used to collect most of the primary data. Secondary

data analysis was used for the literature review to examine articles and scientific publications from reliable databases including Jstor, Emerald, Science Direct, Springer Nature, and others.

To test the structural model and the predicted link between the variables, structural equation modelling was employed to examine the data. The partial least squares methodology (SEMPLS) for structural equation modelling was chosen over competing techniques due to its resilience. Using a random selection technique, 250 firms make up the study's sample size. This method has the benefit of finding actual data and selects a fair representation.

1.7 Scope of the study

Majority of the participants in this study were professionals and practitioners in various areas of logistics, procurement, planning, supply chain, operations, and production who were employed by small and medium-sized manufacturing firms in Ghana. Data will be gathered from Greater Accra, Eastern, Ashanti, Central, Volta, and Northern regions. The conceptual framework's scope explains how supply chain digitalization which was further conceptualized into two areas – digital tools use, and digital tools adoption (an independent variable) influences resilient supply chain performance (a dependent variable) and how the mediating role of supply chain financing affects the association.

1.8 Organisation of the Study

The organization of the study was in five chapters. The background of the study, the problem statement, the research objectives, the significance of the study, the scope of the study, its limitations, and the chapter organisation are all covered in chapter one. The literature review, conceptual framework, conceptual review, empirical review, theoretical review and research hypotheses development will all be covered in chapter two. The literature discusses the conceptual and operational definitions of the components of the study. The methodology utilised to carry out the study will be examined in Chapter 3, which explains the research design, research tools employed, population, sample, and sampling strategy, data analysis, data collection procedure, and profile of the case being studied. The results of the study and discussions are covered in Chapter 4 and the summary, conclusion, and recommendations for future research are covered in Chapter 5.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The literature review examines the body of information presently in existence as well as numerous research studies on supply chain digitalization (digital tools use and digital tools adoption), supply chain financing, and resilient supply chain. The various elements are summarised under the topical headings.

2.1 Conceptual Review

This section looks at the description, categorization, and outlining of concepts particular to the research study, including relevant empirical research and theory.

2.1.1 Overview of Supply Chain Management Practices

In order to produce, distribute, and transport goods or services from the initial procurement of raw materials to the final consumption by end consumers, a network of resources, organizations, activities, technologies, and people is described as a supply chain. It encompasses all of the procedures, actions, and movements required in turning raw materials into completed goods or services and providing them to customers (Chopra and Meindl, 2021). Suppliers, manufacturers, distributors, retailers, and customers make up the major parts of a supply chain. These parties are linked through a variety of interactions and connections. Together, these elements work to maintain a smooth flow of resources, data, and money along the supply chain with the ultimate objective of satisfying consumer demand while reducing costs, accelerating lead times, and raising service levels (Lambert and Cooper, 2000).

A number of interrelated processes are included in the supply chain, including as demand planning, order fulfillment, inventory management, transportation, and customer support. In order to improve overall performance, responsiveness, and profitability, effective supply chain management strives to combine and coordinate these activities (Handfield and Nichols, 2019). Modern supply chains are frequently global in scope, encompassing numerous geographical locations, regionally diverse suppliers, and intricate logistics networks. Supply chains have become more integrated and data-driven since the introduction of digital technology, allowing for real-time visibility, cooperation, and optimization across the whole network (Revilla and Saenz, 2017).

A well-managed and efficient supply chain can provide several benefits, such as cost savings, increased customer satisfaction, decreased lead times, increased agility, and a competitive edge in the market. On the other side, supply chain interruptions or inefficiencies can lead to stockouts, delays, increased costs, dissatisfied customers, and negative consequences on overall business performance (Sharma and Routroy, 2016). When a business wants to provide value to its customers, logistics services frequently play a key role (Mentzer *et al.*, 2001). One of the major goals of a successful logistics system within supply chain management is to deliver the goods in the best state, on time, and for the lowest cost (Flint, 2004). Performance measurement for supply chains is usually considered in terms of objectives including flexibility, speed, reliability, affordability, and quality (Rao and Holt, 2005).

Additionally, past studies have demonstrated the relevance of the sustainability of supply chain management; as a result, this subject has grown to be an essential area of study in supply chain management and marketing (Bowen *et al.*, 2001). One aspect influencing this is the increasing knowledge of customers on the sources of their beverages and food (Scott, 2017). In order to analyze retailers' sustainability practices in logistics, Quak and de Koster (2007) concentrated on environmental and social issues such those in relation to noise pollution, carbon dioxide emissions and traffic congestion. According to earlier research, supply chain sustainability issues are also harder to quantify since they usually involve societal and environmental issues (Linton *et al.*, 2007).

Global supply chains are becoming more complex and complicated (Manuj and Mentzer, 2008). Another one of supply chain management's primary goals is to lower threats. The many dangers that businesses confront include hazards like a business partner acting opportunistically (Baird and Thomas, 1991). According to Svensson (2000), there are two main categories of risk sources in supply chains: holistic and atomistic. To tackle atomistic sources of risk, a particular and confined area of the supply network must be investigated in order to analyse risk. With cheap, straightforward, and easily accessible materials and components, this system performs effectively. In another vein, the supply chain needs to be examined in order to assess risk from comprehensive sources of risk, holistically. This perspective is ideal for complex, expensive and rare components and resources.

2.1.2 Supply Chain Performance

The ability of a supply chain to foresee, prepare for, respond to, and recover from interruptions, shocks, or changes while continuing its fundamental operations is referred to as supply chain resilience. In the context of supply chains, resilience refers to the ability to adjust to unanticipated difficulties and interruptions, guaranteeing that the chain can successfully provide goods and services even in the face of difficulty. Effective management of supply chain is necessary to improve organization's efficiency, profitability, and competitive performance (Verma *et al.*, 2011). It is a crucial requirement for any business to be able to convey items from the point of origin to the consumer or from the supplier to the company. Many multinational firms attempt to create their goods in underdeveloped countries due to globalization because there are resources and inexpensive labor there. These businesses export their products to foreign countries, which necessitates very sophisticated logistics management. The supply chain is made up of planning, marketing, logistics, operations, and procurement. Logistics management is a vital part of the management of the supply chain which also includes inventory planning and transportation.

Transportation and storage of products and services are two topics that fall under the category of logistics (Mentzer, 2004). The ability to deliver items in their original condition and in the correct amount to the right person at the precise time and location is the concept of flawless logistics. Digitalization technologies are being used by supply chain and logistics companies to improve operations and provide resilience so they can handle interruptions. The capability of the supply network to anticipate unforeseen occurrences, respond to interruptions, and recover from them while ensuring sustainability at the required level of interlinkages and control over function and structure is known as resilience in the supply chain and logistics.

2.1.3 Resilient Supply Chain Performance

Despite the fact that there is still non-essential inventory on hand that is insufficient for the current demand, the spread of COVID-19 has caused severe delays in the delivery of essentials. To optimize supply chain operations, supply network managers must be informed of what is happening and where, including possible threats from COVID-19, the weather, and trafficrelated weather events. Supply network resiliency (Singh and Singh, 2019) enabled by location information integrates current geographical and business data in a common operational picture in order to boost productivity and reduce expensive disruptions. Despite the

fact that there is still non-essential inventory on hand that is insufficient for the current demand, the spread of COVID-19 has caused severe delays in the delivery of essentials. To optimize supply chain operations, supply network managers must be informed of what is happening and where, including possible threats from COVID-19, the weather, and traffic-related weather events.

Supply network resiliency (Singh and Singh, 2019) enabled by location information integrates current geographical and business data in a common operational picture in order to boost productivity and reduce expensive disruptions. Relationship theory was created to support the importance of business relationships. To put it another way, the earlier perspectives do not adequately address how businesses may gain from and in their connections to gain a competitive edge. In practice, the majority of organizations specialize in many fields, making it difficult to have all the essential resources on hand at once. By trading information and resources with other market participants, businesses must do this. Unwanted risks are a component of this transaction, and organizations regularly look for and build durable networks to get rid of these risks and other problems with the market-processing system. The advantages that help a company stand out from competitors in the same industry and sustain long-term growth in the view of continuous external business' change of environmental conditions are referred to as competitive advantages. According to Porter (1990), businesses need to have either low costs or distinctiveness based on valuable, scarce, difficult-to-find resources that are competitively irreplaceable or imitable so as to create a long-lasting competitive advantage. If there aren't enough valuable assets to generate profits, imitators and competitors will take their place and turn the assets into resources. Then, in order to protect their interests and develop a competitive edge for both parties' ownership and gain, businesses must form lucrative alliances with a network or a pair of partners in the market (Punniyamoorthy *et al.*, 2019).

According to Fiksel *et al.*, (2015), supply chain resilience is an organization's capability to adapt, survive and develop in times of turbulence. The ability to anticipate the impact will set high-performance companies apart from the competition and be a vital craft should they react and recover quickly before the next major event. Organizations that are resilient in their supply chains should be able to decrease their vulnerability to a variety of supply interruptions in addition to transportation issues when the next major crisis hits (Tukamuhabwa *et al.*, 2015).

The difference between risk and resilience is that risk is defined as the possibility that the undesirable may happen. As part of risk management, organizations must assess all feasible consequences of a project or process. The prospective advantages and hazards of the venture must then be balanced. Utilizing historical data, hazards may frequently be quantified, however analyzing threat entails making speculations based on random data. This perspective contends that risk varies from uncertainty in that the former can be quantified (Ho *et al.*, 2005).

2.1.4 Supply Chain Digitalization

Supply chain digitalization is a term that describes how different parts of the supply chain can be improved and optimized through the integration and application of digital technologies and data-driven solutions. It entails utilizing cutting-edge technology to enhance decision-making, cooperation, communication, efficiency, and transparency across the whole supply chain process. Utilizing technologies like cloud computing, blockchain, artificial intelligence (AI), Internet of Things (IoT), and data analytics are essential to supply chain digitalization. Numerous studies have demonstrated how value creation and data exploitation are supported in a variety of supply chain activities by big data technologies and data-driven innovation (Bueno *et al.*, 2020). It is also well known for enhancing global supply chain practices and resource consumption management for manufacturing sectors. According to the literature, SMEs could handle any unforeseen incident if they could develop their inventive technical talents (Luki'c *et al.*, 2017). Processes and products' innovation are significantly impacted by big data-driven processes and capabilities, which also give SMEs competitive benefits.

Several studies have demonstrated that if SMEs employ the appropriate technological strategies, they can become resilient in times of disruptions (Piccialli *et al.*, 2021). Other research works have also demonstrated how the use of modern technologies and digitalization may be used to solve the business practices of SMEs that are greatly affected by the COVID19 epidemic (Nandi *et al.*, 2021).

Research have shown that companies can quickly recover from a turbulence like the COVID19 pandemic if they adopt the right strategies, such as using IoT enabled technology and other tactics with active support SMEs' leadership for performance enhancement (Piccialli *et al.*, 2021). The COVID-19 pandemic may have a big effect on how SMEs conduct business. However, SMEs can address their supply chain disruptions by utilizing current technologies (Nandi *et al.*, 2021).

2.1.5 Digital Tools Adoption for Supply Chain Resilience

Over time, the strategic function of supply chain management has changed to provide businesses and the supply chain organizations that make up their network with competitive advantages. One of the keys to the success of firms is enhancing information flow management in the supply network (Christopher, 2016). Many businesses invest in the digitalization of their supply chain management procedures (customizable and of high quality) so as to fulfill the rising request for goods that meet customer expectations. The processes used in the supply chain must adjust to these changes and become more linked (Issa *et al.*, 2018). Digitalization has a significant effect on the overall supply chain processes (Richey *et al.*, 2016); traditional tracing techniques and order processing systems that rely mainly on paper are increasingly seen as antiquated. As a result, supply chains have become more dependent on data. As digital supply chains disrupt traditional supply networks, they may all have some defining characteristics. According to Buyukkan and Göçer (2018), these components include speed, adaptability, real-time inventory, intelligence, visibility, agility, innovativeness, proactiveness, global connectivity, scalability, and eco-friendliness. Generally speaking, established supply chain management aims to achieve these traits.

Training is crucial since success depends on having the appropriate digital skills (Petrillo *et al.*, 2018). One must be able to use a variety of digital technologies to obtain information, understand it, critically analyze it, and interact with others in order to be considered digitally competent (Stank *et al.*, 2019). Additionally, it appears that increased connectivity, along with the components required for transmission of data both within and outside of the organization and the information technology security requirements, promotes the use of digital supply chain solutions (Gunasekaran *et al.*, 2016). Businesses require frameworks so as to produce and extract value from data. Digital tools adoption indicates the extent to which digitalization is accessible to, embraced by, and utilized by all significant partners to enhance their operations (Colli *et al.*, 2019). As was earlier indicated, digital technologies are influencing conventional supply chains and facilitating the shift to digital supply chains. To encourage the use of digital tools, businesses must have the organizational and physical infrastructure needed.

The association between supply chain resilience and digital technologies has recently been studied by certain academics (Pettit *et al.*, 2019). In order to expand visibility, boost forecast accuracy, and more effectively activate backup plans, they reinforce the significance of using predictive and descriptive data analysis. In a manner similar to this, Zhang and Zhao (2019)

show how supply chain resilience is increased by big data by enhancing visibility. In order to use all of the supply network robust capabilities, it is necessary to simultaneously deploy numerous digital technologies, according to an examination of the aforementioned research (Pettit *et al.*, 2013).

Colli *et al.*, (2019) claims that value creation is one of the characteristics to consider when determining the digital maturity of a supply network. To be agile, it is vital to improve delivery competence, customer service and knowledge management (Tukamuhabwa *et al.*, 2015). Governance is also an essential factor in the digital maturity of the supply chain (Buyukozkan and Göçer, 2018), since it promotes the sharing of information effectively that provides prompt availability to suitable reserves required for recovery. Additionally, "connectivity" is a key consideration when evaluating the digital maturity of a supply chain (Akdil *et al.*, 2018), and this aids resilience capabilities such as collaboration and visibility which can identify potential disruptions and foster supply chain collaboration (Pettit *et al.*, 2013). These abilities promote supply chain resilience and improve the ability to predict unexpected disruptive occurrences.

Businesses presently employ a variety of automation methods in order to realize appreciable economic improvements (Al-Mashari, 2001). Supply chain specialists take keen interest in applying the digitalization supply chain tools to enhance their performance (Caniato *et al.*, 2016). Businesses are building their own digital supply networks in order to digitize their supply chain processes. SMEs are currently using well-managed, transparent online digital platforms because of the technology's rapid improvement (Fairchild, 2005). These platforms allow all supply chain stakeholders to ensure the visibility of company orders.

2.1.6 Digitalization and Firm Performance

Recently, there has been an increase in interest in researching the potential applications of blockchain technology to supply chains. Around 2011, the blockchain distributed ledger technology, which was created for peer-to-peer transactions, made its debut. Blockchain technology offers a lot of potential in supply chain management in the era of digital tools (Mathivathanan *et al.*, 2021). Distributed ledgers can assure accountability, transparency, and visibility while removing information asymmetry throughout the various supply chain phases in blockchain-based operations. Lohmer *et al.*, (2020) suggest the resilience approach as well as the cascading effects of the supply chain with blockchain using agent-based simulation.

In a research paper by Al-Talib *et al*., (2020), IoT has been discussed as a method of increasing supply chain resilience. They found that the fundamental components of supply chain resilience - visibility, flexibility, control, agility, and collaboration—can be successfully attained by integrating Internet of Things technology into supply chains. According to Marcusak *et al*. (2021) the food supply chain in specific regions of the United States of America can be strengthened to be more resilient during a pandemic. The study found that the adoption of novel, innovative distribution and logistics strategies, cooperation among partners in the food supply chain, and appropriate communication and information sharing allowed the regional food supply chains to increase their resilience and overcome the pandemic's long-term effects. Identifying supply chain partners, creating a process map that shows a transaction and its related information, classifying and evaluating supply chain vulnerabilities, and developing contingency plans for risk mitigation are a few benefits that block chain technology has, according to (Min, 2019). According to the study, it was possible for regional food supply chains to become more resilient and overcome the pandemic's long-lasting effects by implementing fresh, innovative logistics and distribution plans, working together with other food supply chain participants, and effectively exchanging information.

According to (Min, 2019), there are many benefits to using blockchain technology, including helping to identify supply chain partners, creating a process map that shows a transaction and its related information, classifying and evaluating supply chain vulnerabilities, and developing backup plans for risk mitigation. Blockchain technology (BT) is anticipated to significantly increase the level of transparency, traceability and transparency in the agricultural industry while maintaining information power symmetry among all supply chain participants (Bronson and Knezevic, 2016). The adoption of blockchain with other cutting-edge technologies, such as AI and IoT, can benefit the performance of supply chain (Dwivedi *et al*., 2019). The maximum level of online privacy and security is provided by applications using blockchain technology because they operate without the need for dependable middlemen (Kshetri, 2018). Ivanov *et al*. (2019) asserts that blockchain-driven supply networks assist in mitigation of risks by managing demand and supply efficiently, utilizing the assets offered by the supply chain, and reducing stock costs. Traditional supply chains, on the other hand, keep larger stockpiles and additional capacity in preparation for supply chain interruptions.

Adopting digitalization enables supply chain participants to more effectively use data, connect with potential customers directly, establish direct links between upstream and downstream

partners, as well as the final end user, and attract the right investors through crowdsourcing and crowdfunding (Elia *et al.,* 2020). Weill and Woerner's (2018) study found that supply chains that undergo digital transformation can boost their net revenue by 16% in comparison to conventional firms. In contrast to Australia, where digitalization has the potential to provide $315 billion in economic opportunities, it has been demonstrated that digitalization might add 1.25 trillion Euros to the creation of value of the European industry (Sahl and Schweer, 2017). Digitalization reduces transaction costs and helps supply chains develop effective communication between internal and external partners by enabling better and faster information access (Schilaci *et al*., 2017). It can significantly help supply chains merge with global markets by reducing the border operations and transportation cost (Elia *et al*., 2020). Supply network competition is aided by supply chain digitization's numerous uses, which reflect lower operational costs, economies of scale, and less information asymmetries. Additionally, it promotes creativity and increased productivity (Kahle *et al*., 2020).

However, because COVID-19 is a relatively recent occurrence, there is little data-driven proof to help the global supply network become resilient against the disruptions caused by it, so the long-term consequence is still unknown (Yoo and Managi, 2020). As a result, organizations would be able to create appropriate response and mitigation plans (Kochan and Nowicki, 2019). Due to the subjectivity and unlikelihood surrounding the consequences of the pandemic on the supply networks, particularly in the future, it is now complicated to adequately evaluate the risk scenarios and construct appropriate reaction strategies thereto (Ivanov and Dolgui, 2020).

The way businesses are run around the world has been significantly changed by information technology. According to Maiti and Kayal (2017), IT-enabled services have a significant effect on the service, trading, and manufacturing sectors of both advanced and emerging nations. Stemmler (2018) observed that digitalization has a substantial effect on the business framework sustainability of the manufacturing, commerce, and logistics industries, as well as their supply chains, after the cost of transportation and information exchange. Digitalization is transforming workplace dynamics and improving corporate performance, claim Brynjolfsson and McAfee (2011). Due to digitization, business tastes are shifting in order to boost firm value and competitiveness (Lusch *et al*., 2010). The digitalization of business processes enables the improvement of operations' efficiency and gives reliable data both within and beyond the company's borders (Kindstrom and Kowalkowski, 2014). According to Greenstein (2010),

digital services can replace traditional goods and increase the effectiveness of commercial transactions, both of which are positive for SMEs.

2.1.7 Supply Chain Resilience Capabilities

A company's capability to persevere through turbulence, grow, and adapt is defined as resilience (Fiksel, 2006). The environment surrounding the supply chain is full of uncertainty, which makes it vulnerable. The idea of resilience as it applies to supply chains seems to be highly helpful when analyzing the capacity for modification of interrelated informational and physical systems which are constantly exposed to risks. Christopher (2016) defines resilience as a person's ability to deal with unforeseen challenges. Thus, he explains that in order to adjust to an unpredictable business environment, a resilient supply chain must have the ability to recognize the following traits:

(1) Identification of the supply chain's most vulnerable areas across the network; and

(2) The understanding that keeping a reserve of strategic assets or spare capacity is imperative to be able to react to unforeseen circumstances.

Christopher (2016) only mentions two qualities of a strong supply chain, although Pettit *et al.*, (2010, 2013) research offers further details. The authors developed a categorization of the numerous competences factors a supply chain must have so as to be reliable.

2.1.8 Supply Chain Financing

A buyer (usually a larger company or a firm at a later level in the supply chain) works with financial institutions to help its suppliers acquire financing at more favourable terms. This financial arrangement is known as supply chain financing, sometimes known as supplier finance or reverse factoring (Rossiter and Schmitz, 2006). Under this arrangement, the buyer pays the supplier on behalf of the financial institution, which is subsequently repaid by the buyer at a mutually agreed upon date. Supply chain finance (SCF), a vital part of the modern global supply chain, is in charge of making sure that business operations go without a hitch. The size of the global supply chain finance market would have topped USD 46 billion by 2020 (Hofmann *et al*. 2018). Understanding how suppliers interact with one another and how banks and businesses interact when providing loans is essential to supply chain financing. When an upstream supplier (the seller) transacts with a downstream supplier (the seller), commercial credit is a representation of the level of trust between the purchaser and the vendor. In the

narrowest definition, commercial credit is when a vendor allows a purchase to delay payment from the time the goods are received to a later time. Numerous studies have shown how commercial financing reduces the financial constraints faced by buyers (Burkart and Ellingsen, 2004). However, some researchers have emphasized that the development of commercial credit might not be the consequence of companies purposefully giving credit, rather the coercive influence of focal companies due to their market position. While many SMEs upstream of the supply network are under pressure to acquire financing under the current credit sales framework, focal firms usually have bountiful cash flow (Tang and Moro, 2019). Consequently, the risk level of the whole supply network increases. To reduce the financial burden on SMEs, financial institutions must be brought in as a third party.

Supply chain financing is an innovative finance strategy; aiding SMEs in achieving their operational and financial goals demands in a digital manner to increase the transparency and adaptability of transactions through all supply chain cycles. A supply chain finance firm functions as a go-between for vendors and clients. In other words, the supply chain finance company gives financing options to the vendors via various financial institutions to address the limitation of cash flow of the vendors. Additionally, it provides buyers with choices about the credit period. The use of blockchain is a growing trend in supply chain finance organizations' business processes. SCF companies may gain from using blockchain technology in a variety of ways. The distributed ledger architecture of blockchain technology guarantees increased transaction security and transparency. A quicker and more economical credit clearing, and compensation process is also made possible by the usage of blockchain (Hofmann *et al.*, 2018).

SMEs have long suffered with the funding paradox of "high demand" and "poor trust," and financial constraints are strongly connected with manufacturing companies' production efficiency. As a result, managing the money issue is one of the top worries for the expansion of SMEs. Following years of expansion, supply chain finance has become a vital source of capital for SMEs.

2.1.9 Supply Chain Financing and Firm Performance

Globalization has had a tremendous impact on how the globe has changed. The impact of the pressure from globalization on SMEs is significant. It is difficult for SMEs to obtain financing for their ongoing operations because of the global financial crisis, credit constraints, and high borrowing costs (Lekkakos and Serrano, 2016). However, the growth of SMEs has grown to

be an essential part of the development of every nation's economy (Lawal and Akingbade, 2018). Supply chains are extremely dynamic as a result of globalization, severe capital restrictions, and fierce market competition (Kumar *et al.*, 2015). Entrepreneurs of SMEs are exploring new funding options to gain access to quick finance so they can be competitive and handle globalization challenges. This is done to enhance these businesses' performance and supply chain cycle. According to Caniato *et al.*, (2016), supporting the management of the information stream and the material stream does not enhance supply chain management.

Planning and maximizing cash flow are a supply chain executive's main responsibility in the modern world. As a result, financial institutions now provide a wider range of products. Supply chain financing has emerged as a serious topic in supply chain management. According to More and Basu (2013), supply chain finance is a unique type of financial instrument that organizes, coordinates, and controls all cash flows across supply network participants so as to boost working capital.

The significance of supply chain finance for the growth of SMEs cannot be overstated given the limited options available to them today for borrowing money to satisfy their daily financial requirements (Lekkakos and Serrano, 2016). Businesses can now borrow money from financial institutions and accomplish their objectives on time since supply chain finance solutions are readily available. Supply chain finance tries to maximize working capital at the interorganizational level by utilizing the techniques provided by financial institutions (Lamoureux and Evans, 2011). The mechanism of supply chain finance demonstrates how working capital is synchronized with information flow and product to provide excellent results from the current supply chain cycle, in accordance with the supply chain perspective (Wuttke *et al.*, 2013). To maximize the advantages of this method, which results in lower capital costs, minimum default risk, and innovative loan opportunities, supply chain finance depends on the participation of all pertinent supply chain partners. According to Randall and Farris (2009), supply chain finance increases interorganizational commitment, trust, confidence, and profitability across all supply chain players.

Generally speaking, supply chain finance is gaining popularity because of its adaptable capacity to satisfy the financial requirements of SMEs by catering for supply chain finance solutions tailored to their needs. Inventory financing, working capital, consignment stock and reverse-factoring are a few examples of supply chain finance solutions presented by financial institutions or technology firms (Klapper, 2006). For SMEs to operate better, owners or

executives can increase cash flow via supply chain finance and enhance transaction visibility through supply chain digitalization. Furthermore, because supply chain finance is a riskmitigation approach, it safeguards small and medium-sized businesses.

In this age of globalization, organizations are coerced to keep things running smoothly so they can provide premium services to their end customers (Kunday and Engüler, 2015). One of the key reasons for this is a lack of readily available, risk-free financing (Matamanda and Chidoko, 2017). For businesses to operate effectively and boost customer satisfaction, cash flow is essential. Businesses are not independent entities; rather, supply chain networks link them together. A novel strategy called supply chain finance enables companies to successfully meet their financial needs. Supply chain financing was first proposed by Stemmler in 2002, who also outlined how its central tenet is to link finance to the supply chain operation.

SMEs in supply chains can obtain cutting-edge credit and trade finance services from financial institutions. According to Johnson and Templar (2011), supply chain financing is a promising strategy for addressing credit issues because it raises the partner companies' overall financial performance and lessens the risk of a disruption in the financial operations of the supply chain. Supply chain financing connects the financial system with inventory management, according to Chen's (2016) study. He divided supply chain financing into groups for trade credit (B2B) and crowdsourcing. A real-world constraint that regularly influences the company's operational decisions to boost performance is a scarcity of working cash. Therefore, it is not only vital but also necessary to look into the supply chain financing system so as to enhance supply chain efficiency and the profitability of the supply network partners (Chen, 2016). According to the idea of evolutionary economics, SMEs are getting better at acquiring specialized firm capabilities, which are made up of critical competencies essential to achieving organizational goals (D'Avanzo *et al.*, 2003). Complex supply chain techniques can result in supply chain excellence, claim D'Avanzo *et al.*, (2003). Additionally, financial service providers in the supply network have access to more pertinent data about borrowers than banks do. Therefore, maintaining relationships can enhance both customers' and suppliers' performance and their interdependence.

2.2 Theoretical Review

This section outlines the theories that explain the study. The two theories used are the resourcebased view theory and the dynamic capability theory.

2.2.1 Resource-Based View Theory

According to Barney (1991), Resource based view (RBV) is an essential viewpoint that offers a guided investigation into the factors that influence a firm's success. To address the use of the organization's resources for the accomplishment of improved performance, many scholars have adopted the RBV theory (Melville *et al.*, 2004). By utilizing RBV in SMEs, (Rivard *et al.*, 2006) investigated the connection between digital tools and performance. They discovered that the performance of SMEs is greatly improved by digital tools. Bakar and Ahmad (2010) integrated the resource-based perspective in the Malaysian setting to study the association between product innovation performance and firms' resources. They discovered that the primary predictors of the success of product innovation are intangible resources (Crook *et al.*, 2008). Resources are the tangible and intangible assets owned, controlled, or accessible to a firm. They can include physical assets (e.g., infrastructure, technology), financial resources, human capital (e.g., skills, knowledge, expertise), organizational capabilities, brands, patents, relationships, and reputation. Tangible resources refer to the physical and financial assets of a firm, such as equipment, facilities, land, inventory, cash, and financial reserves. These resources can be observed, quantified, and measured. Intangible resources are non-physical assets that contribute to a firm's competitive advantage. Examples include intellectual property, patents, trademarks, copyrights, brand equity, organizational culture, knowledge, and proprietary technology.

Numerous studies have demonstrated the crucial role that digital tools perform in managing supply chain activities that improve performance for various organizations (Laaper, 2017). The internal and external capabilities must be understood thoroughly and analyzed from all dimensions as the basis for digital transformation (Uhl *et al.*, 2014). Unfortunately, there hasn't been much research studies on why and how supply chain skills can be transformed and enhanced by digital tools to produce performance benefits. The capability to lower operating costs, improve the quality of products while increasing sales revenue through growing market shares, developing new products that better serve consumers, and gaining a strategic advantage that improves all business operations are capabilities that digital tools enhance (Gurria, 2017). Numerous have identified capabilities as a prime indicator in operational strength and competitive success of a company (Peng *et al.*, 2008). According to the proposed model, supply chain digitalization transforms supply chain capabilities to boost an organization's operational efficiency. The capability of a firm to recognize, use, and integrate both internal as well as external resources and data to aid the overall supply chain activities is referred to as supply

chain capability (Wu *et al.*, 2006). Recent supply chain research has used capability studies to reframe the discussion around how and why capabilities result in performance advantages for the company (Singh *et al.*, 2015).

In the aftermath of COVID-19, when numerous governments imposed protracted lockdowns and instructed the populace to maintain social isolation, this study has sought to investigate how SMEs may grow and preserve their supply chain capability. Supply chain digitalization tools like IoT-enabled devices and big data analytics aid in the implementation of such pandemic-related actions (Koot *et al.*, 2020). This notion contends that making use of the various SMEs' competencies is the best approach to endure any unforeseen circumstance. According to this notion, SMEs should employ resources that are priceless, uncommon, unique, and non-replaceable that may combine to create capabilities to determine its response to opportunities and risks both internally and externally. Thus, one of the key goals for businesses using a resource-based approach is to identify their strengths and enhance them (Day, 1994). Nonetheless, because of their complexity and dynamism, capabilities are frequently challenging to pinpoint. It is especially difficult because capabilities frequently cross over multiple functional domains. As a result, the key attributes of capability are resource integration and coordination.

SMEs must be technologically innovative for them to thrive. According to resource-based view, an enterprise's performance is variable not just due to its resources, but also due to the way those resources are used, with a number of strategic options for achieving enhanced performance particularly in dynamic times (Grewal and Tansuhaj, 2001).

2.2.2 Dynamic Capability Theory

The dynamic capability theory serves as the foundation for the current study - dynamic capability view (DCV) propounded by (Teece *et al.*, 1997). Theoretically, the idea is an extension of and response to the resource-based view's inability to account for interpreting to create and recreate the tools and abilities needed to fascinate in a dynamic setting (Bleady *et al.*, 2018). Similar to that, it is seen as an amplification of the resource-based view that illustrates how a company might maintain its competitive advantage. These skills give the people an advantage over competitors (Mukhtar *et al.*, 2019). When a company has the dynamic capacities for acquiring functional competencies, they can quickly achieve competitive advantage. The traits, skills, aptitudes, organizational procedures and technical

know-how that enable an organization to deliver exceptional performance and maintain an edge over competitors are known as capabilities or distinctive competencies (Pervan *et al.*, 2017).

The theory discusses the fundamental variables that may result in a resilient supply chain performance in addition to the factors that result in attaining a competitive advantage. As a result, supply networks experience more dynamic changes than informal markets do as a result of shifting consumer behavior or development agencies (Hall, 2000). As a result, the dynamic capability theory is also used in this study to support the existing research framework.

Supply chain digitalization has been considered in the study as a dynamic capability that helps a firm to recognize opportunities and take advantage of them. Managers, statisticians, trend analysts, and other experts can systematically analyse the incoming data thanks to digitalization, according to (Qwabe, 2020). Also, a firm's competencies enable the competitive and productive use of resources, both material and intangible. Therefore, the current study contends that the adoption of digital tools allows an organization to respond to disruptions, anticipate unexpected events and recover from them, which in turn enable resilient supply chain performance and lead to sustainable competitive advantage.

According to DCV theory, businesses must implement cooperative tactics by strengthening their range of capabilities in order to deal with any unanticipated dynamic event (Felix and Lamar, 2018). DCV theory asserts that in order to properly address any unpredictable event, such as the COVID-19 pandemic, firms must successfully build their various capacities, such as IoT, cloud computing, and other novel big data-driven capabilities. In the context of this study, it is suggested that these competencies are tools that SMEs can leverage on to boost firm performance and become resilient, together with their technological and financial capabilities (Basiouni *et al.*, 2019).

Based on its management strategy and market positioning, a business must develop and relocate its various resources and competencies, such as supply chain financing, in order to adapt to changing conditions. An organization needs to be able to implement the necessary strategies under unpredictable and changing situations (Liao *et al.*, 2010). Hence, supply chain financing is a crucial source of competitiveness and robust performance to ensure a strong competitive advantage in a changing context. This study proposes that a company may use its valued resources, such as supply chain financing, to mitigate supply chain resilience and gain a competitive edge in a market that is changing quickly.

2.3 Empirical Review

The empirical review looks at empirical works done on the variables employed in the study.

2.3.1 Identifying the supply chain digitalization tools and strategies adopted for resilient supply chain performance

Khan *et al.*, (2021) assessed the effect of COVID-19 on digitalization and supply chain performance sustainability in the Pakistani manufacturing industry. Data was obtained from Pakistani firms and SEM was employed for hypotheses testing. The results showed that digitalization positively contributes to sustainable supply chain performance. Balakrishnan and Usha (2021) also examined the role of digital technologies in supply chain resilience. According to the study, samples consisting of practitioners from automotive original equipment manufacturers, Tier-1 component manufacturers and lead logistics providers in Asia-Pacific (AP) emerging markets were analyzed using AMOS 26.0 to perform SEM. Results from the analysis indicate that digital supply chain technologies positively influence resilient supply chain performance. Empirical works from Zulqurnain and Bi (2018) revealed that data from the textile sector which was analysed using hierarchical linear regression model in SPSS 23 and CFA in AMOS 24 to measure the proposed hypotheses and model, respectively. Empirical studies have shown that supply chain digitalization can lead to improved operational efficiency, reduced costs, and enhanced supply chain visibility and transparency.

2.3.2 Determining the association between supply chain digitalization and supply chain financing

The study proposed by Cammarano *et al.*, (2022) to analyse three different scenarios of the Parmigiano Reggiano supply chain considering blockchain technology as an enabler for the use of other technologies such as RFID and the Internet of Things (IoT) and for the exploitation of the Vendor Managed Inventory (VMI) strategy. The results show how the combined adoption of these technologies improves the procurement process and customer satisfaction. Findings highlight the impact that the different scenarios have on the supply chain operations in a quantitative way and allows to evaluate the changes in supply chain processes. By employing emerging technologies, order management activities are more automated and time to order and lead time order preparation are reduced. An article by Peng *et al.*, (2022) analysed Chinese listed companies in Shanghai and Shenzhen A-shares from 2009 to 2020 as samples, this paper constructs corporate digitalization indicators by using “text analysis method” and empirically tests the impact of digitalization on corporate OFDI and its path. The study finds

that digitalization significantly promotes corporate OFDI. In terms of the influential mechanism, digitalization promotes corporate OFDI by improving total factor productivity and reducing financing constraints.

2.3.3 Investigating the effect of supply chain financing on resilient supply chain performance

Yuan and Li (2022) investigated the impact of supply chain risk (SCR) information processing capabilities and supply chain financing (SCF) on supply chain resilience. Data collected from 216 Chinese firms are used to test the theoretical model by employing structural equation modelling. The findings reveal that SCR information processing capabilities have a significant impact on both SCF and supply chain resilience. SCF plays a partial mediating role in the relationship between SCR information processing capabilities and supply chain resilience. A study by Vu *et al.*, (2021) revealed that supply chain finance has a statistically significant impact on supply chain financing performance and SMEs performance.

2.3.4 Assessing the mediating role of supply chain financing on the association between supply chain digitalization and resilient supply chain performance

A research work by Eko and Edi (2021) the results showed that there was an influence of supply chain finance on supply chain effectiveness in the Alfamikro program. Collaboration and digitalization affect supply chain financing, but negotiations do not influence the supply chain financing. The study also found that supply chain financing mediates in increasing the effect of collaboration and digitalization on supply chain effectiveness

Table 2.1 Empirical review table

Study	Key Findings
Cammarano *et al.*, (2022)	Findings show how the combined adoption of these technologies and financing improves the procurement process and customer satisfaction

Khan *et al*. (2021)	Digitalization has a positive impact on sustainable supply chain performance.
Balakrishnan and Usha (2021)	Digital supply chain technologies positively influence resilient supply chain performance.
Zulqurnain and Bi (2018)	Findings show that supply chain digitalization can lead to improved operational efficiency, reduced costs, and enhanced supply chain visibility and transparency.
Peng *et al*., (2022)	The study finds that digitalization significantly promotes corporate OFDI. In terms of the influential mechanism, digitalization promotes corporate OFDI by improving total factor productivity and reducing financing constraints.
Yuan and Li (2022)	The findings reveal that SCR information processing capabilities have a significant impact on both SCF and supply chain resilience. SCF plays a partial mediating role in the relationship between SCR information processing capabilities and supply chain resilience
Vu *et al.*, (2021)	Study showed that supply chain finance has a statistically significant impact on supply chain financing performance and SMEs performance
Eko and Edi, 2021	The results showed that there was an influence supply chain finance on supply chain effectiveness in the Alfamikro program. Collaboration and digitalization affect supply chain financing, but negotiations do not influence the supply chain financing. The study also found that supply chain financing mediates in increasing the effect of collaboration and digitalization on supply chain effectiveness

2.4 Conceptual Framework

The research was conducted using the conceptual framework which identified dependent variable (resilient supply chain performance), independent variable (supply chain digitalization, which was split into two sub dimensions - digital tools use and digital tools

adoption) and the mediating variable (supply chain financing). The framework model is conceptualised in Figure 2.1 below.

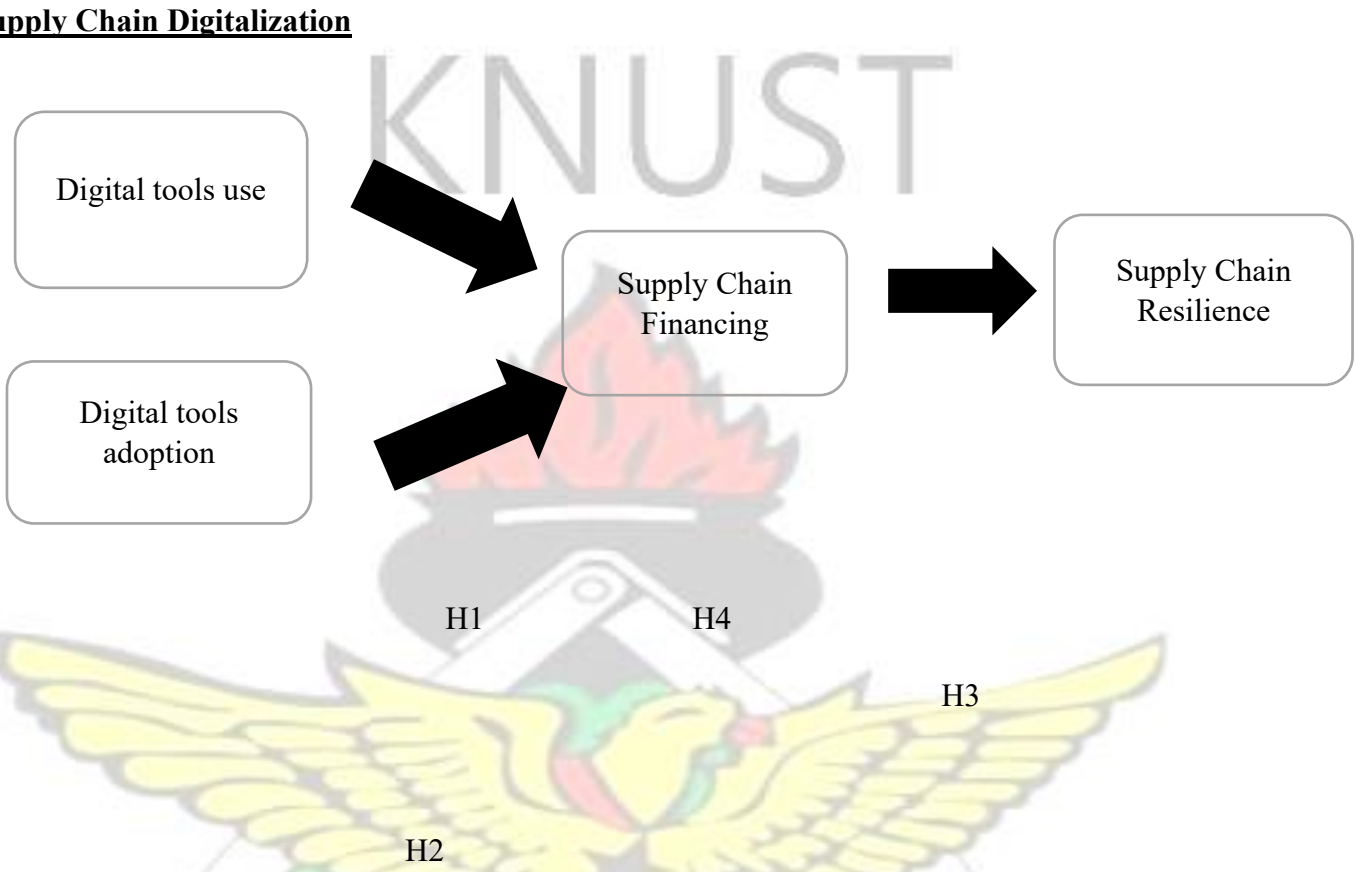

Fig 2.1 Proposed conceptual model with hypotheses relations

Source: Author's own construct (2023)

2.5 Hypothesis Development

2.5.1 Supply Chain Digitalization and Supply Chain Financing

In this study, supply chain digitalization can be conceptualized into two, digital tools use and digital tools adoption. The effect of the digitalization process on supply chain financing solution implementation has the most difficult solution implementation, according to Carnito *et al.*, (2016). It is well recognized that replacing paper-based trading processes with digital ones results in significant cost savings, adding value to the services offered to small businesses and consumers. By providing extra elements of payment flexibility, modern retail

organisations, through micro retailers, offer a type of re-serving or factoring in debt. According to Kurniawan *et al.*, (2020), internal business processes have a considerable effect on financial performance, and internal business processes have a great effect on IT strategy. Internal company processes have improved due to the use of IT, which has a favourable effect on financial performance. According to Khin and Ho (2019), digital orientation mediates the favourable effect of digital orientation and digital capabilities on digital innovation, which benefits both financial and non-financial performance. Digital innovation formally illustrates an essential function that can improve the supply chain financing performance in a resourcebased scenario. When compared to paper-based business, the digitalization process offers a substantial cost reduction (Perego and Salgaro, 2010).

Fairchild (2005) stated that trade process digitalization is known to result in significant cost savings when compared to a paper-based trade process. It also enables the provision of valueadded services, like the enhanced and quicker visibility of invoices, which gives suppliers (or distributors) more flexibility in the management of accounts receivables (or payables). Because it results from the digitalization process itself, this improved flexibility is practically cost-free. Thus, companies offering various types of reverse or captive factoring that are primarily - or exclusively - implemented to pursue net operating working capital improvement through longer payment terms, but based on the trade process digitalization, may also provide, in the end, the typical versatility features of strategic benefits for the entire supply chain, such as lowering the overall supply chain risk by supporting financially weak but valuable suppliers. This shows that conventional supply chain financing models are becoming less relevant as trade processes become increasingly digitalized.

Consequently, it can be hypothesised that:

H1: Digital tools use positively influence supply chain financing.
H2: Digital tools adoption positively influences supply chain financing

2.5.2 Supply Chain Financing and Supply Chain Resilience

The idea that businesses have a variety of resources and that management research on how to make the greatest use of those resources both supports and restrains business growth is the source of the resource view of the firm. Supply chain financing is a dynamic and cutting-edge financial solution that financial institutions offer to SMEs to address these difficulties. It enables them to maximise their cash flow while paying reduced capital costs and taking on less

risk (Lamoureux and Evans, 2011). Financial indicators are essential for evaluating the operational success of a firm. Different financial and non-financial measures might have direct or indirect effects on supply chain performance. According to Gunasekaran *et al.*, (2004), a firm's performance shows how it is finding new ways to meet its operational and financial objectives. The current study therefore suggests that supply chain financing, a risk-free financial solution, may optimise the organization's cash flow, which in turn aids in managing the firm's operations with ease and enhancing the performance of SMEs. Understanding and maximising the organization's working capital is crucial for entrepreneurs in order to manage the day-to-day operations of the business and achieve the company's objectives. Supply chain financing assists SMEs in meeting their financial requirements in order to achieve targeted performance.

In order to improve organisational performance, Caniato *et al.*, (2016) pointed out that organizations that embrace a higher level of trade digitalization tend to use more cutting-edge financial solutions (supply chain financing). Supply chain financing is more effective and flexible thanks to digitalization than traditional forms of funding, which boosts firm's performance. Historically, financial institutions have funded a company's inventory and other resources, which increased the risk for the company. It is assumed that the risk is more like a general threat to the organisation. An innovative financing strategy called supply chain financing is currently offered on the market to address the old threat (Gomm, 2010). According to Gao *et al.*, (2015), suppliers and customers constantly need credit to conduct business operations successfully. As a result, they look for risk-free financing options to meet their financial firms because doing otherwise would halt their company's growth. Supply chain financing lowers the supply chain's financial and operational risk. According to PrimeRevenue (2016), supply chain finance is the most effective strategy for increasing cash flow and reducing supply financial risk. The supply chain perspective and the financial perspective both focus on monetary and behavioural actions that are crucial to the growth of a company's performance. Theoretically, according to Hofmann and Belin (2011), the adoption of supply chain financing can be seen as an enhancement of working capital that lowers potential supply risk and enhances firm performance.

Based on the above, it can be proposed that:

H3: Supply chain financing positively influences supply chain resilience.

2.5.3 Supply Chain Financing as a Mediator between Supply Chain Digitalization and Supply Chain Resilience

As organizations adopt digital tools and enhance their digital capabilities within the supply chain, they are more likely to leverage these advancements to improve access to financing options, such as invoice financing, factoring, or supplier financing programs. The greater integration and visibility facilitated by digitalization enable better financial collaboration and support within the supply chain. By having access to appropriate and timely financing options, organizations can better manage working capital, address financial constraints, and build financial resilience. Supply chain financing mechanisms can provide the necessary liquidity and financial stability, allowing organizations to respond effectively to disruptions, recover quickly, and sustain operations during challenging times. SMEs are able to enhance their ability to sense and respond to disruptions, improve supply chain visibility, agility, and coordination, and strengthen risk management capabilities when they adopt digital technologies. These digitalization-driven improvements contribute to a more resilient supply chain, enabling these enterprises to withstand disruptions, adapt to changes, and maintain operational continuity. The positive impact of supply chain digitalization on resilient supply chain performance is partially or fully mediated by the presence and effectiveness of supply chain financing. Supply chain digitalization enhances access to financing options, which in turn improves financial stability and resilience, resulting in improved overall supply chain performance.

Based on the above, it can be hypothesized that:

H4: Supply chain financing mediates the positive relationship between supply chain digitalization and supply chain resilience

These hypotheses imply that the incorporation of supply chain digitalization and supply chain financing in operations can contribute to a more resilient supply chain performance. It emphasizes the importance of leveraging digital technologies and financial mechanisms to enhance the financial capabilities and adaptive capacity of supply chains, ultimately leading to improved resilience in the face of disruptions.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter entails the methodology used and the strategies adapted to achieve the specific objectives outlined in the study. This takes a look at the research design, population, sampling and sampling techniques, method of data collection, validity and reliability, method of data analysis and profile of the organisation being studied.

3.1 Research Design

A quantitative research methodology uses statistics to examine how the various constructs in conceptual frameworks relate to one another, including the potential influence of mediators and moderators using statistical methods. It also aids in testing hypotheses and measuring variables and helps in quantifying opinions and statistically justifying the influence of one variable over another. On the other side, qualitative research, which is non-numerical, helps in the deeper exploration of ideas and experiences. Interview guides are utilised in this scenario to gather respondents' open-ended responses, which are then recorded, transcribed, and the results are analysed. The mixed-method approach combines both quantitative and qualitative methodologies, and it involves interviewing respondents to explore relevant issues. The proposed constructs are further quantitatively tested with statistical methods. Based on the narration above, the study employed the quantitative research approach design which helps in statistically estimating the relationship between digital tools use, digital tools adoption and supply chain resilience followed by the mediating effect of supply chain financing.

A case study could be multiple where several groups of individuals or organisations are identified for the study. It can also be a single case study where an individual or organisation is used. A survey, on the other hand, gathers data from a larger population or sample size. The concept of longitudinal study looks at the behaviour patterns of the same group of people usually over a period of time. A cross-sectional study captures a snapshot of a group of persons across various industries at a point in time. The study, however, is a cross-sectional survey to assess the role of supply chain financing on the relationship between supply chain digitalization and supply chain resilience in SMEs across the nation.

Explanatory research helps to test and explain the effect of one variable on another. Exploratory research, as the name suggests seeks to explore relatively new phenomena within areas which have been understudied. Descriptive research also describes various phenomena outlined in an area of study. This research study is an explanatory and descriptive one where the variables are tested and their effects on another are explained using statistical tools. The various phenomena and tools are also described in this study.

3.2 Population

The population for this study targets mainly professionals and practitioners related in the field of supply chain, logistics, procurement, planning, operations, and production working for Ghanaian SMEs specifically in the manufacturing sector located in the Greater Accra, Eastern,

Ashanti, Central, Volta and Northern Regions of Ghana. According to data from the Ministry of Trade and Industry, there are about 400,000 registered SMEs in Ghana. This data represents the sampling frame.

3.3 Sampling and Sampling Techniques

Sampling is the process of choosing a subset of items, individuals, or units from a larger population for the purpose of conducting research (Shukla, 2020). It is mostly impossible and impractical to study an entire population, so researchers use sampling techniques to draw inferences and generalize the population based on the characteristics observed in the sample. The aim of sampling is to ensure that the chosen sample is representative of the population of interest, allowing researchers to make valid and reliable conclusions. The technique employed in this study is random sampling technique where every individual or item in the population has an equal chance of being chosen for the sample.

Slovin's formula for estimating sample size (S) (S = N/(1+N(e)2), where S is sample size, N is population size, and e is margin of error with 700 as the intended audience therefore S is equal to 700/ (1+700(0.05)2) = 250 units/firms) allows for a 5% margin-of-error assumption in the study to increase generalizability. The study's investigation of evenness used a sample size of 250 units. The respondents were selected randomly in order to avoid biased results.

3.4 Sources of Data

Primary sources are original, firsthand pieces of information that are collected directly from the source or event being studied. These sources are created at the time of the event or experience and are considered more reliable and accurate. Secondary sources of data provide analysis, interpretation, or summaries of primary sources. They are created after the fact and are often written by individuals who did not directly participate in the events or research. Both secondary and primary were employed. Primary data were obtained through administration of questionnaires. With regard to secondary data, gathering information techniques that were employed were the gathering of pertinent data from literature reviews, journal, and review articles. A combination of both types of sources were used to build a comprehensive understanding of the research topic.

3.5 Data Collection Methods

In this research study, the quantitative research design approach was employed; hence, primary data will be obtained from a survey through the administration of close-ended structured

questionnaires. An electronic survey option was used for data collection by posting the final questionnaire links using Google forms in various WhatsApp and Telegram groups developed and controlled by procurement, logistics, supply chain practitioners as well as manufacturing firms for their business activities. To respond to the questionnaire's items, a "five-point Likert scale" with a scale of 1 (strongly disagree) to 5 (strongly agree) was used.

3.5.1 Instrument Development

The study's operationalized constructs were first-order reflective constructs measured on a 5point Likert scale. Established scales were modified from published literature for each construct. Supply chain resilience is defined as the capacity to recover from disruptions. The Supply chain resilience scale was modified from (Golgeci and Ponomarov, 2013; Um and Han, 2021). The scale for the use and adoption of digital tools was modified from Tortorella *et al.*, (2019). Supply chain financing scale was modified from (Zhang, 2015) represented in Table 3.1.

The questionnaires for this study are subdivided into two parts. The first part includes the demography of potential respondents regarding the respondent and the respective company, such as gender, age, number of years in the organisation, age of the firm, job role or position of the participant, category of the firm's products and number of employees in the firm. The second part consists of close-ended questions relating to study's constructs - supply chain digitalization (conceptualized into two sub-dimensions; digital tools adoption and digital tools use), supply chain financing and resilient supply chain performance. Therefore, the selected items could be used to corroborate known associations, the items for each of these variables were obtained from existing literature that made use of structural equation modelling to guarantee content validity.

The recommendations for questionnaire design and instrument validity and reliability suggested by Saunders *et al.*, (2016) were followed in this study. In order to operationalize the study constructs, the measurement instruments were created from already published, pertinent literature.

Finally, the firm size was considered a control variable and measured using the firm's age (the number of years in operation) and staff count (number of employees) (Essuman *et al.*, 2020). It is suggested that firm size has an impact on a firm's operations, experience with handling shocks, and resilience (Wong *et al.*, 2020). All questionnaires' items included can be found in Appendix 1.

Table 3.2 Constructs, Measures used and Sources

Constructs	Sub-dimension	Measures/ items	Sources
Supply Chain Digitalization	Digital tools use	• DTU1. We incorporate digital services into products (Internet-of-Things or Product Service systems)	Tortorella *et al.*, (2019)
		• DTU2. We use digital automation with sensors for products and operating conditions identification as well as flexible lines	
		• DTU3. We use remote monitoring and control of production through systems such as Manufacturing Execution and System and Supervisory Control and Data Acquisition	
		• DTU4. We collect, process and analyse large quantities of data (Big Data)	

		• DTU5. We use simulation/analysis of virtual models (finite elements, computational fluid dynamics, etc.) • DTU6. We use cloud services associated with the product	
	Digital tools adoption	• DTA1. We have the technical ability to integrate product development and manufacturing through computer-based systems • DTA2. We have the ability to use advanced processes that are related to Industry 4.0 technologies (3D-printing, big data, additive manufacturing, Internet-of-Things, sensor technologies, virtual models and cloud services) • DTA3. We have the ability to engage in process automation programs (e.g. automated	Tortorella et al., (2019)

	machine tools and handling/transportation equipment, and robots) • DTA4. We have the ability to engage in product/part tracking and tracing programs (bar codes, RFID) • DTA5. We have the ability to integrate digital tools and techniques that detect failures • DTA6. We have the ability to develop towards "the factory of the future" (e.g. smart/digital factory, adaptive manufacturing systems)	
Supply Chain Resilience	When affected by factors such as COVID-19 pandemic, our firm's supply chain . . . • SCR1. is able to adequately respond to unexpected disruptions by quickly restoring its product flow • SCR2. can quickly return to its original state after being disrupted	(Golgeci and Ponomarov, 2013; Um and Han, 2021)

- SCR3. can move to a new, more desirable state after being disrupted
- SCR4. is able to cope with changes brought by the supply chain disruption through collaboration with partners to minimise uncertainty
- SCR5. is able to adapt to the supply chain disruption easily through information sharing and technology
- SCR6. is well prepared to deal with financial outcomes of supply chain disruptions

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- SCR7. has the ability to extract meaning and useful knowledge from disruptions and unexpected events

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Supply Chain Financing	•	SCF1. Supply chain finance is a risk avoidance strategy (Zhang, 2015)
	•	SCF2. Supply chain finance increases the capital flow of coordination in the supply chain
	•	SCF3. Supply chain finance brings a high level of overall supply chain efficiency
	•	SCF4. Supply chain finance improves the performance of my firm
	•	SCF5. Supply chain finance brings high level of coordination in supply chain business streams
	•	SCF6. Supply chain finance requires a high degree of technology for its application
	•	SCF7. Supply chain finance is considered as a high-risk prevention capability of my firm

3.5.2 Validity and Reliability

An instrument's validity is determined by how much it measures, what it is intended to measure, and how successfully the measuring instrument carries out its intended function. Reliability, on the other hand, is the extent to which an observation or survey continues to produce the same results over time. Briefly, it is the stability, repeatability, and consistency of scores over time. The questionnaire will be examined by professionals and experts in the Department of Supply Chain and Information Systems, KNUST, to determine its validity and reliability. The questionnaire was finalised and used for primary data collection after taking experts' opinions into consideration.

3.6 Methods of Data Analysis and Presentation

The quantitative methods of data analysis will be used in analysing the data collected from respondents. The software which will be employed for this is SmartPLS4 that utilises PLSSEM procedures, which uses advanced multiple regression methods to measure the strength and relevance of the hypothesised associations. The study model will be examined in two phases in accordance with requirements outlined by Hair *et al.*, (2017). The measurement model will be analysed in the first phase so as to determine the model's validity and reliability. The path model will be evaluated for hypothesis testing in the second phase. Factor loadings, composite reliability, and Cronbach's alpha will be used to verify the measurement model's reliability; conversely, discriminant and convergent validity tests will be used to confirm the model's validity. Hypothesis testing will be done for the path model when the measurement model has been validated and its reliability has been established.

3.7 Research Ethics

The researcher is expected to treat participants with respect so as to carry out ethical research. This implies that respondents should be well educated about how they contribute to the study and the time commitment required to participate (Hair *et al.*, 2019). The aim of the study was explained in detail, along with the steps involved in gathering the data and the amount of time needed to complete the questionnaire. Respondents were also given the chance to ask any questions they had prior to consenting to join owing to the personal contact over the phone.

This study treats all participant data anonymously, as stated in the texts that prospective respondents received. In order to ensure that their participation in the survey is voluntary and to improve the study's ethical environment, participants must also have the freedom to decline

to participate (Hair *et al.*, 2019). Prospective participants in this study had the option to decline answering the questionnaire after getting the text containing the link to the online survey.

3.8 Organisational Profile

SMEs, corporate bodies, and multinational corporations make up Ghana's economy. Together, they create the framework for the economy's growth and commercial activities. The SME sector is primarily responsible for driving the nation's objective to make the private sector the engine of growth and development. Almost 70% of the country's GDP is generated by the SME sector. SMEs have over the years played a major role in the economic growth of most emerging nations. It is a significant form of business that employs many citizens, contributing significantly to Ghana's GDP growth.

The major concern of the relationship between banks and their small business clients has recently attracted significant academic attention in addition to being discussed on a number of occasions, which has resulted in the establishment of significant government support to supplement already existing support (Bodenhorn, 2003). Additionally, Hernandez-Canovas and Martinez-Solano (2007) contend that strong ties to financial institutions may result in positive benefits. Yet, SMEs face numerous difficulties that make them inefficient and unproductive. According to Banaeianjahromi and Smolander (2016), the majority of Ghanaian SMEs complain about limited funding options, which has restricted their growth. Other SMEs also bemoan the lengthy banking processes and challenges they face when applying for bank loans. Others also voiced their displeasure with the banks' exorbitant interest rates. According to Kusi *et al.*, (2015), 38% of SMEs in Ghana questioned identified credit as a barrier. Moreover, Aryeetey (2010) noted that only about half the number of SMEs in Ghana who applied for formal financing (loans) had any chance of being accepted. He also noted that approximately 70% of SMEs loans' applications are likely to be rejected. However, most SMEs lack professional training in their fields of endeavour.

According to UNCTAD experts, banks view SMEs as high-risk borrowers because of their lack of capitalization, insufficient assets, sensitivity to market changes, and high failure rates. High information asymmetry caused by SMEs' incomplete financial statements and absence of accounting records, which makes it challenging for creditors and investors to assess the credit worthiness of possible SME proposals, is also of utmost importance among these issues. Additionally, it has been reported that the lack of collateral to support these facilities as required

by the financial institutions is the main reason why SMEs are unable to obtain financing from them.

It is practically universally acknowledged that SMEs are crucial to the social and economic growth of Ghana and even Africa. SME promotion is a top priority in the policy agendas of the majority of African nations since it is well-known throughout the continent. With no need for a doubt, SMEs serve as the breeding ground for the next wave of African entrepreneurs.

In an effort to speed up the growth rate in an economy like ours, SMEs have been one of the main priorities for many policy makers. These businesses have been recognized as the key to achieving the growth objectives of emerging middle-income countries like Ghana.

A sizable share of the urban labour force gains employment and income from SMEs, which also contribute significantly to overall output (Aryeetey, 2010). Moreover, SMEs often use locally available raw resources that might otherwise go wasted and generate less foreign exchange. SMEs actively promote local expertise through their operations.

CHAPTER FOUR

RESULTS, DATA ANALYSIS AND DISCUSSION OF FINDINGS

4.0 Introduction

The present chapter deals mainly with the analysis of the data collected. All questionnaires are administered by posting Google form links in various WhatsApp and Telegram groups. Descriptive statistics on demographics of respondents will be analysed using SPSS while

inferential statistics such as reliability and validity test, correlation, and regression analysis to find the relationship among variables will be performed using PLS-SEM.

4.1 Response Rate

A total of 203 usable questionnaires were obtained from respondents, making up a high response rate of 81.20%. The responses obtained were analyzed to estimate the significance and strength of the hypothesized relationships using PLS-SEM procedures that use advanced multiple regression techniques.

4.2 Demographic Data

The demographic data show that quite a number of the firms (14.78%) belonged to the Food and Agriculture industry, with Rubber and Plastics comprising 14.29% of firms, and Textiles constituting 12.32%. This was followed by Chemicals with 10.84%. However, 15.27% of respondents indicated that they were from other industries.

Table 4.1 Demographic Data of Respondents

Characteristics		Frequency	Percent (%)	Cumulative Percent
Gender	Female	108	53.20	53.20
	Male	95	46.80	100.00
Age (years)	20-24	1	0.49	0.49
	25-29	23	11.33	11.82
	30-34	37	18.23	30.05
	35-39	81	39.90	69.95

	Above 40	61	30.05	100.00
Number of years in the organization	Less than 1	6	2.96	2.96
	1-5	42	20.69	23.65
	6-10	84	41.38	65.03
	Above 10	71	34.98	100.00
Age of the firm (years)	Less than 5	9	4.43	4.43
	5-10	20	9.85	14.28
	10-15	69	33.99	48.27
	Above 15	105	51.72	100.00
Job role	Junior Manager	39	19.21	19.21
	Middle manager/ Head of Department	89	43.84	63.05
	Senior Manager/ Director	71	34.98	98.03
	Other	4	1.97	100.00
Job scope	Procurement	43	21.18	21.18

	Production	36	17.73	38.91
	Supply chain	33	16.26	55.17
	Logistics	29	14.29	69.46
	Planning	36	17.73	87.19
	Operations	26	12.81	100.00
Category of firm's products	Machinery and Hardware	18	8.87	8.87
	Textiles	25	12.32	21.19
	Chemicals	22	10.84	32.02
	Packaging	19	9.36	41.38
	Food and Agriculture	30	14.78	56.16
	Packaging	29	14.29	70.45
	Food and Agriculture	18	8.87	79.31
	Electrics and Electronics	11	5.42	84.73
	Others	31	15.27	100.00

Firm size (employees)	Less than 50	29	14.29	14.29
	50-100	75	36.95	51.24
	Above 100	99	48.77	100.00

Source: Field Survey (2023)

Majority of respondents were in the Procurement, Planning and Production sectors of their firms (about 56.64% of total responses received). Finally, 14.29% of organizations indicated firm size of less than 50, with 36.95% of organizations indicating an employee size range of 50 to 100. In total, 48.77% of the respondents had more than 100 employees as shown in Table 4.1.

Utilizing IBM SPSS software, an exploratory factor analysis (EFA) statistical method was adopted to ascertain the link among the items in the data set. Kaiser-Meyer-Olkin (KMO) statistics (0.934) were used to verify the data's accuracy, and Bartlett's test of sphericity was found to be significant ($p<0.001$). It was discovered that four factors accounted for around 63% of the variance.

4.3 Descriptive Statistics of the Study

4.3.1 Descriptive Statistics on Digital Tools Use

Table 4.2 below provides descriptive statistics results in relation to the extent to which respondents agree or disagree with the construct "Digital Tools Use". It is observed that respondents agree with a mean score of {4.330, (SD 0.732)} that they adopt digital services into products. Respondents agree to the statement they employ digital automation with sensors for products and operating conditions identification with a mean of {4.291, (SD 0.824)". An average response of {4.251, (SD 0.877)} indicated that respondents agree to the use of remote monitoring and control of production through systems Supervisory Control and Data Acquisition. A mean response of {4.429, (SD 0.836) shows that collect, process, and analyse large quantities of data. The statement "we use simulation/analysis of virtual models" was agreed upon with a mean value of 4.246 and a SD of 0.903. Respondents from various firms

agreed that they use cloud services associated with their products in a mean value of {4.325, (SD 0.861)}.

Table 4.2 Descriptive statistics on Digital Tools Use

Statements	Min	Max	Mean	Std. Deviation
DTU1. We incorporate digital services into products (Internet-of-Things or Product Service systems)	2.0	5.0	4.330	0.732
DTU2. We use digital automation with sensors for products and operating conditions identification as well as flexible lines	1.0	5.0	4.291	0.824
DTU3. We use remote monitoring and control of production through systems such as Manufacturing Execution and System and Supervisory Control and Data Acquisition	1.0	5.0	4.251	0.877
DTU4. We collect, process and analyse large quantities of data (Big Data)	1.0	5.0	4.429	0.836
DTU5. We use simulation/analysis of virtual models (finite elements, computational fluid dynamics, etc.)	1.0	5.0	4.246	0.903
DTU6. We use cloud services associated with the product improve our supply chain	1.0	5.0	4.325	0.861

Source: Field Survey (2023)

4.3.2 Descriptive Statistics on Digital Tools Adoption

An average response of {4.374, (SD 0.858)} revealed that firms of respondents expressed they have the technical ability to integrate product development and manufacturing through computer-based systems. Respondents from various firm approved the statement that they have the ability to use advanced processes that are related to Industry 4.0 technologies with a mean

of {4.345, (0.915)}. The third statement “we have the ability to engage in process automation programs” was agreed upon with a mean value of 4.414 and a SD of 0.866. Various firms have the ability to engage in product/part tracking and tracing programs had a mean of {4.448, (SD 0.831) indicating a fair agreement to the above statement. A mean response of {4.389, (SD 0.866) shows that respondents have the ability to integrate digital tools and techniques that detect failures. Finally, is a mean value of {4.384, (SD 0.865)} indicating a fair agreement by respondents with regard to their team possessing the ability to develop towards "the factory of the future".

Table 4.3 Descriptive statistics on Digital Tools Adoption

Statements	Min	Max	Mean	Std. Deviation
DTA1. We have the technical ability to integrate product development and manufacturing through computer-based systems	1.0	5.0	4.374	0.858
DTA2. We have the ability to use advanced processes that are related to Industry 4.0 technologies (3D-printing, big data, additive manufacturing, Internet-of- Things, sensor technologies, virtual models and cloud services)	1.0	5.0	4.345	0.915
DTA3. We have the ability to engage in process automation programs (e.g. automated machine tools and handling/transportation equipment, and robots)	1.0	5.0	4.414	0.886
DTA4. We have the ability to engage in product/part tracking and tracing programs (bar codes, RFID)	1.0	5.0	4.448	0.831
DTA5. We have the ability to integrate digital tools and techniques that detect failures	1.0	5.0	4.389	0.866
DTA6. We have the ability to develop towards "the factory of the future" (e.g. smart/digital factory, adaptive manufacturing systems)	1.0	5.0	4.384	0.865

Source: Field Survey (2023)

4.3.3 Descriptive Statistics on Supply Chain Resilience

The table below presents items used in measuring supply chain resilience of firms. Respondents fairly agreed that their firms able to adequately respond to unexpected disruptions by quickly restoring its product flow with a mean of {4.433, (0.729)}. A mean value of {4.502, (0.711)} indicates that respondents' firms can quickly return to its original state after being disrupted. Respondents were objective to the statement that 'firms can move to a new, more desirable state after being disrupted' with a mean response of {4.502, (0.704)}. Responses from respondents indicates that their firms are able to cope with changes brought by the supply chain disruption through collaboration with partners to minimise uncertainty. This was indicated by a mean score of {4.488, (0.704)}. Various firms have the ability to adapt to the supply chain disruption easily through information sharing and technology had a mean of {4.517, (0.697) indicating a fair agreement to the above statement. Respondents from various firms agreed that they are well prepared to deal with financial outcomes of supply chain disruptions in a mean value of {4.458, (0.744)}. Finally, 'has the ability to extract meaning and useful knowledge from disruptions and unexpected events' was fairly agreed upon revealing a mean of {4.498, (0.704)}.

4.3.4 Descriptive Statistics on Supply Chain Financing

Table 4.5 below presents items used in measuring supply chain financing. Respondents fairly agreed that supply chain finance is a risk avoidance strategy with a mean of {4.365, (0.868)}. A mean value of {4.483, (0.668)} indicates that supply chain finance increases the capital. Respondents were objective to the statement that 'Supply chain finance brings a high level of overall supply chain efficiency' with a mean response of {4.498, (0.683)}. Responses from participants indicates that supply chain finance improves the performance of their firms. This was indicated by a mean score of {4.547, (0.621)}. Various firms affirmed that supply chain finance brings high level of coordination in supply chain business streams had a mean of {4.502, (0.638) indicating a fair agreement to the above statement. Respondents from various firms agreed that supply chain finance requires a high degree of technology for its application in a mean value of {4.414, (0.733)}. Finally, 'Supply chain finance is considered as a high-risk prevention capability of my firm' was fairly agreed upon revealing a mean of {4.419, (0.811)}.

Table 4.4 Descriptive statistics on Supply Chain Resilience

Statements	Mini	Max	Mean	Std. Deviation
SCR1. is able to adequately respond to unexpected disruptions by quickly restoring its product flow	1.0	5.0	4.433	0.729
SCR2. can quickly return to its original state after being disrupted	1.0	5.0	4.502	0.711
SCR3. can move to a new, more desirable state after being disrupted	1.0	5.0	4.502	0.704
SCR4. is able to cope with changes brought by the supply chain disruption through collaboration with partners to minimise uncertainty	1.0	5.0	4.488	0.704
SCR5. is able to adapt to the supply chain disruption easily through information sharing and technology	2.0	5.0	4.517	0.697
SCR6. is well prepared to deal with financial outcomes of supply chain disruptions	1.0	5.0	4.458	0.744
SCR7. has the ability to extract meaning and useful knowledge from disruptions and unexpected events	1.0	5.0	4.498	0.704

Source: Field Survey (2023)

4.4 Measurement of Model Validity and Reliability

The measure constructs' validity and reliability were assessed using the SmartPLS4 software. Table 4.6 below indicates Cronbach alpha, composite reliability (rho_c and rho_A), average variance extracted (AVE), and R square. According to Bentler and Huang (2014), the SRMR index for the measurement model is 0.068, which is below the cutoff point of 0.08. As a result, the model has a good fit with the data.

The measurement model's validity was assessed so as to explore the hypothesized associations between Digital tools use, Digital tools adoption, Resilient Supply Chain Performance and Supply Chain Financing. Item loadings were examined to ensure that they were sufficiently

high (0.7 or higher) and that all items loaded higher on their own constructs than on other constructs (Hair et al., 2010). Eight items (DTA1, DTU1, SCF4, SCF5, SCF6, SCF7, SCR1 and SCR4) did not meet this criterion and were eliminated from further analysis.

Table 4.5 Descriptive statistics on Supply Chain Financing

Statements	Mini	Max	Mean	Std. Deviation
SCF1. Supply chain finance is a risk avoidance strategy	1.0	5.0	4.365	0.868
SCF2. Supply chain finance increases the capital	2.0	5.0	4.483	0.668
SCF3. Supply chain finance brings a high level of overall supply chain efficiency	2.0	5.0	4.498	0.683
SCF4. Supply chain finance improves the performance of my firm	3.0	5.0	4.547	0.621
SCF5. Supply chain finance brings high level of coordination in supply chain business streams	3.0	5.0	4.502	0.638
SCF6. Supply chain finance requires a high degree of technology for its application	1.0	5.0	4.414	0.773
SCF7. Supply chain finance is considered as a high-risk prevention capability of my firm	1.0	5.0	4.419	0.811

Source: Field Survey (2023)

The psychometric characteristics of the constructs were also measured in order to test their attributes. By evaluating the average variance extracted (AVE), Cronbach alpha, and composite reliability for acceptable quality, convergent validity was examined. With the exception of supply chain financing, all of the constructs had AVEs higher than 0.5 as required (Barclay et al., 1995). The recommended 0.7 threshold was exceeded by the composite reliability values, which were quite high (higher than 0.8) (Chin, 1998). Last but not least, Cronbach alpha values also went over the cutoff point of 0.7 (Hair et al., 2010). This demonstrates that the study model

has adequate convergent validity. Table 4.6 provides a summary of the constructs' psychometric characteristics.

Table 4.6 Psychometric Properties of The Research Constructs

Constructs	**Cronbach alpha**	**AVE**	**Composite Reliability (rho_c)**	**Composite Reliability (rho_A)**	**R square**
Digital tools adoption	0.917	0.651	0.917	0.926	-
Digital tools use	0.857	0.513	0.859	0.876	-
Supply Chain Financing	0.859	0.460	0.855	0.862	0.440
Resilient Supply Chain Performance	0.885	0.522	0.882	0.891	0.548

Source: Field Survey (2023)

The discriminant validity was examined by comparing the square root of the AVE of each latent construct to the correlation of that construct with other latent constructs. The square root of AVE is higher than the correlation coefficients, according to the conventional FornellLarcker's criterion (Table 4.7). According to Fornell and Larcker (1981), it is attained when the AVE for each construct is higher than 0.50 and the square root of the AVE for a given construct is higher than the correlation between that construct and other constructs.

The R square (effect size) is computed to assess the overall influence of all independent variables. The values of R-square (0.548) provided in Table 4.6 demonstrate a significant impact of Digital tools use and supply chain financing on supply chain resilience. The diagonal values are the square rooted values of AVE.

Table 4.7 Fornell-Larcker Criterion

Constructs	Digital tools adoption	Digital tools use	Supply Chain Financing	Resilient Supply Chain Performance
Digital tools adoption	0.807			
Digital tools use	0.796	0.717		
Supply Chain Financing	0.572	0.659	0.679	
Resilient Supply Chain Performance	0.711	0.688	0.740	0.722

Source: Field Survey (2023)

Table 4.8 HTMT Test Criterion

Constructs	Digital tools adoption	Digital tools use	Supply Chain Financing	Resilient Supply Chain Performance
Digital tools adoption				
Digital tools use	0.779			
Supply Chain Financing	0.563	0.649		

Resilient Supply Chain Performance	0.713	0.683	0.724	

Source: Field Survey (2023)

Last but not least, the HTMT criterion was applied, and Table 4.8 demonstrates that all HTMT ratios are below the cutoff of 0.90 (Henseler, Ringle, & Sarstedt, 2014). By proving that the study constructs are discriminant or not significantly connected, this proves the discriminant validity of the measuring model.

4.5 Correlation Matrix

Table 4.9 outlines the results of correlation between variables. Digital tools adoption has a positive relation with Digital tools use (0.109), Supply chain resilience (0.347) Supply chain Financing (0.280). A positive correlation exists between Supply chain financing and Supply chain resilience at a value of (0.280). Supply chain financing positively correlates with digital tools use with a value of (0.198). Finally, is a correlation between Supply chain resilience and digital tools use with a value of (0.166).

Table 4.9 Results of Correlation Matrix

Correlation		DTU	DTA	SCR	SCF
DTU	Pearson Correlation	1	.109**	.166	.198**
	Sig. (2-tailed)		.121	.018	.005
DTA	Pearson Correlation	.109**	1	.347**	. 280**
	Sig. (2-tailed)	.121	.001	.001	
SCR	Pearson Correlation	.166**	.347**	1	.280**
	Sig. (2-tailed)	.018	.001		.001
SCF	Pearson Correlation	.198**	.280**	.280**	1
	Sig. (2-tailed)	.005	.001	.001	

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Field Survey (2023)

4.6 Regression Analysis

Based on table 4.10 below, it could be seen that the CMIN/ DF (1.887) from the CMIN table was within the acceptable range of 1 and 3 which indicates model has a good fit.

Secondly is Baseline comparison. According to Gaskin and Lim (2018), the minimum acceptable range value for CFI should be greater than 0.95. From the table, CFI is 0.951 accounted for by NFI= 0.838, RFI= 0.805, IFI= 0.952 and TLI= 0.940, therefore the model has a good fit.

The third factor is RMSEA, which represents the degree of variance between the estimated covariance matrix and the observed covariance matrix, which represents the model. The acceptable range for RMSEA is between 0.05 to 0.08, whereas the ideal range is less than or equal to 0.05. According to the calculated value (0.064), the model fit is satisfactory.

Table 4.10 Model fit

CMIN					
Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	84	552.822	293	0	1.887
Saturated model	377	0	0		
Independence model	26	3404.340	351	0	9.699
Baseline Comparisons					
Model	NFI	RFI	IFI	TLI	CFI
	Delta1	rho1	Delta2	rho2	
Default model	0.838	0.805	0.952	0.940	0.951
Saturated model	1		1		1
Independence model	0	0	0	0	0
RMSEA					
Model	RMSEA	LO 90	HI 90	PCLOSE	
Default model	0.046	0.055	0.072	0.06	

Independence model	0.199	0.193	0.205	0

Source: Field Survey (2023)

4.7 Confirmatory Factor Analysis (CFA)

Factor analysis is designed to assess a set of variables' covariance structure and to provide an explanation of the relationships among those variables in terms of a smaller number of unobserved latent variables called factors (Daniel, 1988). It includes both confirmatory and exploratory factor analyses. CFA was used in accordance with the study's format. CFA verifies theories, as opposed to exploratory factor analysis which develops theories. The researcher develops a hypothesis before beginning the investigation in a CFA. This hypothesis or model identifies the elements that will be correlated with one another. The concept has solid empirical and theoretical foundations (Stevens, 1996). Additionally, CFA provides the researcher a more useful technique for assessing construct validity. The researcher can specifically test hypotheses regarding the data's factor structure because the predefined model specifies the composition and number of the components (Stapleton and Texas, 1997).

After establishing the a priori factors, confirmatory methods seek to evaluate the goodness of fit of the pre-established factor model by seeking to optimally match the theoretical and observed factor structures for a specific data set, according to Stapleton and Texas (1997). With a chi square of 522.822 and a degree of freedom of 293, the goodness of fit values are as follows. CMIN/DF =1.887, RMSEA= 0.046 and PCLOSE =0.006; Baseline {CFI= 0.951, NFI=0.838, RFI=0.805, IFI=0.952, TLI=0.940}. All modification indices revealed a good model fitness (Hair and Alamer, 2022).

4.8 Measurement of Structural Model Validity

Once adequate measurement model validity is confirmed, the structural model validity was explored by investigating the association between Digital tools use, Digital tools adoption, Resilient Supply Chain Performance and Supply Chain Financing. The results of the hypothesis test are outlined next.

4.8.1 Results of Direct Effects

The PLS analysis of the direct impact of DTU on SCF showed a statistically significant relationship (β= 0.557; t = 4.012; p = 0.000), thus Hypothesis 1 was supported. That is, higher

levels of DTU will result in higher SCF. The direct effect of DTA on SCF was statistically significant (β = 0.128; t = 0.775; p = 0.029), thus Hypotheses 2 was supported, and the direct effect SCF on SCR was statistically significant (β = 0.740; t = 15.918; p = 0.000) supporting Hypotheses 3.

Based on the summary of hypothesis testing in Table 4.9, a structural equation model is depicted in Fig. 4.1. The results showed significant direct relationship between DTA and SCF, DTU and SCF, and SCF on SCR. This raises the possibility of an indirect (mediating) effect of DTU and DTA on SCR through SCF. This possible mediating role of SCF is explored next.

As the measurement model has been established, the structural model to examine relations among the latent variables was depicted in Figure 4.1.

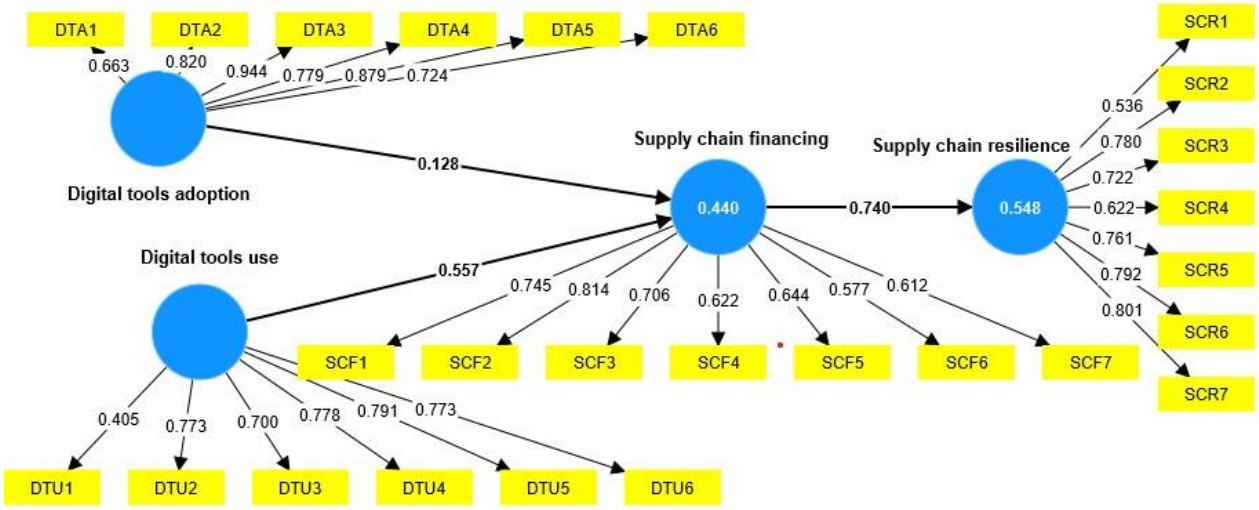

Fig 4.1 The estimated structural equation model.

4.8.2 Test of Mediating Effect

Utilizing the mediation test methodologies outlined by Baron & Kenny (1986), the potential mediating impact of supply chain financing was examined. If (i) the explanatory variables (DTU, DTA) predicts the predictor variable (SCR), (ii) the proposed mediator (SCF) is predicted by the independent variable (DTU, DTA), and (iii) the direct effect of the predictors (DTU, DTA) on the dependent variable (SCR) is either no longer significant (for full mediation) or is diminished in strength (for partial mediation), then there is a mediating effect. The findings of the path analysis are shown in Table 4.11 in order to have an in-depth examination of DTU, DTA, SCF and SCR.

Table 4.11 Summary of Hypothesis Testing

Hypothesis	Relationship	Standardized coefficient	T value	P<0.05	Decision
H1	DTU ➡ SCF	0.557	4.012	0.029	Supported
H2	DTA ➡ SCF	0.128	0.775	0.000	Supported
H3	SCF ➡ SCR	0.740	15.918	0.000	Supported
H4	Standardized Indirect effect of SCF between SCR and Digital tools use and adoption	0.412	0.107	0.000	Partial mediation

Source: Field Survey (2023)

4.9 Discussion of findings

The direct effects of DTU in the absence of the mediating factor was positive and significant at p = 0.000 as depicted in Table 4.11 above from the mediation test results. The direct effect between DTU and SCR is significant with a positive path coefficient with the introduction of the mediating factor. The behaviour of the SCF construct corroborates a partial mediating effect of SCF on the association between DTU and SCR (Baron and Kenny, 1986).

First of all, the study's findings confirm the widely held view that DTU and DTA enhance SCR. Beyond this however, the study highlights on the nature of this positive effect. The study suggests that DTU enhance supply chains by improving resilience within and across the supply chain. This supports the vital role digitalization plays in improving supply chain management and enhancing SCR. The partial mediation of supply chain financing on the association

between DTU and SCR also suggests that firms in a supply chain can enhance their SCR is to seek funding opportunities from downstream and upstream supply chain partners to the suppliers through various financial institutions. SCF supports SMEs in meeting their financial requirements in order to achieve targeted performance (More and Basu, 2013). In this study, digitalization was evaluated from two angles (the usage of digital tools and the adoption of digital tools) in order to take a more comprehensive look at supply chain activities of SMEs. The findings demonstrated a favourable relationship between both dimensions, SCF and SCR. It suggests that the supply chain's resilience is decreased by the lack of digital technology use in operations.

The findings on the relationship between DTU and SCR emphasizes the importance of the former in enhancing the latter. Digital tools' effectiveness in enhancing supply chain performance relies on their proper utilization. Huq and Stevenson (2018) highlighted the importance of assessing the depth and breadth of digital tools usage within supply chains. Furthermore, Moon *et al*. (2021) conducted research on the relationship between digital tools use and supply chain agility.

Overall, the study's findings support previous research that claims that supply chain financing improves a firm's performance by strengthening its capacities and resilience. As supply chains become more complex and global, managing finances is paramount to maintaining resilience. Supply chain financing, including mechanisms such as supplier financing and dynamic discounting, helps improve cash flow and strengthens relationships between supply chain partners. Liu *et al*. (2020) explored the mediating role of SCF in the relationship between supply chain integration and firm performance.

Consistent with existing studies (Li *et al*., 2020), the study's results propose that DTU and DTA positively affect SCR. Digital technologies, including IoT, big data and analytics, are quickly becoming popular and being used by businesses across a variety of industries. The collective effects of digital tools on resilience, particularly in the context of COVID-19, have not been adequately studied, nevertheless. Due to the increased supply and demand side uncertainties brought on by the epidemic, businesses have needed the backing of digital tools to become more resilient to these interruptions of uncertainty. Several studies have emphasized the significance of digital tools adoption in supply chain management. Digital tools, such as cloud-based platforms, Internet of Things (IoT) devices, and advanced analytics, enable realtime data

sharing, process automation, and improved decision-making. Chen and Paulraj (2004) explored how digital supply chain technologies affect firm performance.

SCF acts as a mediator between the DTU and DTA and SCR by addressing financial constraints and risks associated with technology adoption. This is particularly important in the context of SMEs, which may face difficulties in accessing capital to invest in digital technologies. By offering financing options, organizations can overcome these barriers, enabling the adoption of digital tools that contribute to improved supply chain visibility, demand forecasting, and risk management (Chofreh *et al*., 2020).

CHAPTER FIVE SUMMARY OF FINDINGS, MANAGERIAL IMPLICATIONS, LIMITATIONS AND

RECOMMENDATIONS FOR FURTHER STUDIES

5.0 Introduction

The chapter outlines a summary on the content of this study, limitations of the study and outlines conclusions obtained from the analysis as well as recommendations for future studies based on data analysis, for the improvement of SMEs in the country.

5.1 Summary of Findings

This study reveals the positive and negative aspects of digitalization by empirically testing a mediation model about the association between supply chain digitalization and supply chain resilience, which is based on the literature on supply chain digitalization and actual SCM practices in the age of digital transformation.

5.1.1 Identifying the supply chain digitalization tools and strategies adopted for resilient supply chain performance

First, the empirical findings further demonstrate the facilitative role that supply chain digitalization plays in modifying SCM processes by proving how it promotes a resilient supply chain performance.

5.1.2 Determining the association between supply chain digitalization and supply chain financing

According to the study, digital tools use, and adoption has a positive impact on supply chain financing. Transparency and efficiency in the supply chain can be increased by digitalization. This can therefore have a favourable effect on the evaluation of the creditworthiness of the supply chain partners, increasing the accessibility of supply chain finance. Real-time gathering and analyzing of information is made possible by digitalization. This information can help financial institutions make more informed and swifter choices on supply chain finance.

5.1.3 Investigating the effect of supply chain financing on resilient supply chain performance

Supply chain financing affects resilient supply chain performance as well as overall firm performance positively. Supply chain financing plays an important role in minimizing financial risks and improving supply chain resilience. It also gives businesses financial flexibility,

allowing them to respond rapidly to unanticipated circumstances. Financial management agility can help to the overall resilience of the supply chain.

5.1.4 Assessing the mediating role of supply chain financing on the association between supply chain digitalization and resilient supply chain performance

Lastly, through the adoption of supply chain financing, the study's results support the direct benefits of supply chain digitalization on supply chain resilience. Supply chain financing increases the beneficial direct effect of supply chain digitalization on supply chain resilience. These findings imply that supply chain financing is still useful for improving supply chain resilience in the era of digital transformation, but they need to be developed carefully. In conclusion, the study's findings help to shed light on how the governance of interorganizational relationships in supply chains is affected by digital transformation and have management ramifications for modern business operations. The rapid advancement of technology has transformed the business landscape, particularly in the context of supply chains. The use of digital tools in operations have become essential for improving supply chain efficiency, resilience, and responsiveness. Hence, understanding the relationships among the variables is crucial for organizations seeking to strengthen their supply chain capabilities in an increasingly dynamic environment.

5.2 Managerial Implications

Based on the findings of the study, the researcher implores top managers and Chief Executive Officers (CEOs) to seek creative solutions through research and development training programs so as to enhance and extend their current resource to develop new supply chain competencies and capabilities and become resilient in changing environments such as, supply chain digitalization and supply chain financing.

5.3 Limitations of the Study

The study has limitations, much like many previous studies. Despite the extensive labour put into gathering the data, the study's scope was only expanded to include six out of the sixteen regions it was intended to cover, namely Greater Accra, Eastern, Ashanti, Central, Volta and Northern Regions, as well as other sectors. Additionally, data were only collected from one nation, which in some way restricted generalization. Also, the majority of respondents' hesitation made it challenging to gather information as quickly as possible. Nevertheless, this

did not ultimately harm the findings because they may be applied to manufacturing companies in Ghana and other developing nations.

5.4 Recommendations for Further Studies

The study was conducted with manufacturing companies as its primary focus. It is possible to compare manufacturing and service enterprises while taking supply chain financing into account. Additionally, based on the variable employed in the current study, future research can use firm size and age as a control variable to focus on supply chain visibility as a moderating variable to the relationship between supply chain digitalization and supply chain resilience.

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APPENDIX

KNUST School of Business

COLLEGE OF HUMANITIES AND SOCIAL SCIENCES
KWAME NKRUMAH UNIVERSITY OF SCIENCE AND

TECHNOLOGY, KUMASI

University Post Office, Kumasi-Ghana West Africa

SUPPLY CHAIN DIGITALIZATION AND RESILIENT SUPPLY CHAIN

PERFORMANCE: THE ROLE OF SUPPLY CHAIN FINANCING

Introduction

"I wish to introduce myself to you as a Master of Science in Logistics and Supply Chain Management student of the Kwame Nkrumah of Science and Technology. I am required to write a thesis titled "Supply Chain Digitalization and Resilient Supply Chain Performance: The Role of Supply Chain Financing". You have been chosen by reason of your experience and knowledge in my field of study. All information provided will be used solely for the purpose of the study. Your anonymity and confidentiality are fully assured. This may take 10 minutes of your time to complete. I am grateful for the time taken to complete this as your feedback could help in policy formation."

SECTION A - USE OF SUPPLY CHAIN DIGITALIZATION TOOLS **Kindly indicate the extent to which you agree or disagree with each statement by checking the appropriate number from 1 to 5, using the following scale:** ***SCALE: 1= "strongly disagree" to 5= "strongly agree"***					
The relevance of using the following digitalization tools within our supply chain operations….					

We incorporate digital services into products (Internet-of-Things or Product Service systems)	1	2	3	4	5
We use digital automation with sensors for products and operating conditions identification as well as flexible lines	1	2	3	4	5
We use remote monitoring and control of production through systems such as Manufacturing Execution and System and Supervisory Control and Data Acquisition	1	2	3	4	5
We collect, process, and analyse large quantities of data (Big Data)	1	2	3	4	5
We use simulation/analysis of virtual models (finite elements, computational fluid dynamics, etc.)	1	2	3	4	5
We use cloud services associated with the product	1	2	3	4	5

SECTION B – ADOPTION OF SUPPLY CHAIN DIGITALIZATION **Kindly indicate the extent to which you agree or disagree with each statement by checking the appropriate number from 1 to 5, using the following scale:** ***SCALE: 1= "strongly disagree" to 5= "strongly agree"***					
With the adoption of supply chain digitalization tools within our supply chain operations….					

We have the technical ability to integrate product development and manufacturing through computer-based systems	1	2	3	4	5
We have the ability to use advanced processes that are related to Industry 4.0 technologies (3D-printing, big data, additive manufacturing, Internet of Things, sensor technologies, virtual models and cloud services)	1	2	3	4	5
We have the ability to engage in process automation programs (e.g., Automated machine tools and handling/transportation equipment and robots)	1	2	3	4	5
We have the ability to engage in product/part tracking and tracing programs (bar codes, RFID)	1	2	3	4	5
We have the ability to integrate digital tools and techniques that detect failures	1	2	3	4	5
We have the ability to develop towards "the factory of the future" (e.g., smart/digital factory, adaptive manufacturing systems)	1	2	3	4	5

SECTION C – SUPPLY CHAIN RESILIENCE **Kindly indicate the extent to which you agree or disagree with each statement by checking the appropriate number from 1 to 5, using the following scale:** ***SCALE: 1= "strongly disagree" to 5= "strongly agree"***					
When affected by factors such as COVID-19 pandemic, our firm's supply chain….					

is able to adequately respond to unexpected disruptions by quickly returning its product flow	1	2	3	4	5
can quickly return to its original state after being disrupted	1	2	3	4	5
can move to a new, more desirable state after being disrupted	1	2	3	4	5
is able to cope with changes brought by the supply chain disruption through collaboration with partners to minimise uncertainty	1	2	3	4	5
is able to adapt to supply chain disruption easily through information sharing and technology	1	2	3	4	5
is well prepared to deal with financial outcomes of supply chain disruption	1	2	3	4	5
has the ability to extract meaning and useful knowledge from disruptions and unexpected events	1	2	3	4	5

SECTION D – SUPPLY CHAIN FINANCING **Kindly indicate the extent to which you agree or disagree with each statement by checking the appropriate number from 1 to 5, using the following scale:**					
SCALE: 1= "strongly disagree" to 5= "strongly agree"					
Supply chain finance is a risk avoidance strategy	1	2	3	4	5

Supply chain finance increases the capital flow of coordination in the supply chain	1	2	3	4	5
Supply chain finance brings a high level of overall supply chain efficiency	1	2	3	4	5
Supply chain finance improves the performance of my firm	1	2	3	4	5
Supply chain finance brings high level of coordination in supply chain business streams	1	2	3	4	5
Supply chain finance requires a high degree of technology for its application	1	2	3	4	5
Supply chain finance is considered as a high-risk prevention capability of my firm	1	2	3	4	5

BIO DATA OF RESPONDENTS

Section E – DEMOGRAPHIC CHARACTERISTICS

Please indicate {√} at appropriate sections

- Please indicate your gender

  { } Male { } Female

- Please indicate age range

  { } 20-24 { } 25-29 { } 30-34 { } 35-39 { } Above 40

- Please indicate the number of years in the organization

  { } Less than 1 { } 1-5 { } 6-10 { } Above 10

- Please indicate the age of the firm

  { } Less than 5 { } 5-10 { } 10-15 { } Above 15

- Please indicate your job role

  { } Junior Manager { } Middle Manager/Head of Department { } Senior Manager/Director

  { } Other

- Please indicate your job scope

  { } Supply Chain { } Logistics { } Procurement { } Production { } Planning { } Operations

- Please indicate the category of your firm's products

  { } Electrics and Electronics { } Chemicals { } Textiles { } Oil and Energy { } Packaging

  { } Food and Agriculture { } Rubber and Plastics { } Machinery and Hardware { } Other

- Please indicate the number of employees in your firm

  { } Less than 50 { } 50-100 { } Above 100