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THE IMPACT OF DIGITALLY ENABLED SUPPLY CHAINS ON FIRM AGGREGATE PERFORMANCE GAINS

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Abstract

The impact of digitally-enabled supply chains on firm performance

Many companies are transitioning to digitising their supply chain to yield firm performance. However, their supply chains are still fragmented, and they have not yet realised the full potential of digital supply chain capabilities. The full potential of digital supply chain capabilities cannot be realised without the integration of supply chain and competitive strategies. The understanding of the impact of digital platforms on firm performance is still limited, a considerable number of firms fail in their attempts to adopt such platforms. These realities provided the impetus for this study. The study addresses this by reviewing the relationship between digital supply chain integration and aggregate firm performance gains. This research aims to examine the linkage of supply chain integration, firm operational excellence, customer service and firm performance. The study was conducted within the interpretivism research paradigm aimed at focusing primarily on context-specific understandings. The researcher decided to apply this paradigm due to the philosophical orientation of the study, which seeks to capture the diverse perspectives on the impact of digitally enabled supply chains on firm performance. As part of the contribution, the study has identified five key properties that influence digital supply chain integration. These properties are *Automation of supply chain processes; Agile responsiveness; Digital transformation and smart technologies; Information availability* and *Integrated planning and execution* Given the research objective, *"to identify the impact of digital supply chain integration on a firm's aggregate performance",* the study has established three fundamental factors of supply chain integration that are capable of provoking firm performance. The three factors are process integration, internal integration and external integration. These factors are underpinned and characterised by four main actors, namely, *automation, intelligence technology, integrated ICT, smart technology and cloud technologies*. The dynamics and interplay of these three factors tend to influence the performance of the organisation through the firm's operational excellence, financial performance and customer satisfaction. The contribution would help companies to tap into the full potential and benefits of a digitally enabled supply chain to create a firm aggregate performance.

Keywords: *Supply chain integration, operational excellence, financial performance, customer relationship, firm aggregate performance, internal integration, external integration, process integration.*

Declaration and approval

I declare that this thesis entitled '**The impact of digitally-enabled supply chains on firm performance'** is my own and that it has not been submitted before for the award of any degree or examination in any other university and that all the sources I have used or quoted have been indicated and acknowledged as complete references.

This thesis has been submitted for examination after approval by my academic supervisors.

Signed by:

Name Bheki Hendry Thobela

Signature 

Dedication

I thank God Almighty for this opportunity and direction and for answering my prayers. I dedicate this thesis to my parents, Philemon and Elizabeth Thobela, for shaping me into the person I am today. Thank you for your unwavering love, advice, prayers and support throughout my life. You enabled me to succeed by instilling in me the belief that I am capable of accomplishing anything I set my mind to. To my wife, Nondumiso Thobela and my kids, Arete and Sphesihle Thobela, thank you all for your love, unshakeable support and encouragement and for being my anchor. I could not have done it without your never-ending patience and inspiration. Thank you very much.

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CHS - Cyber-Human Systems
CPS - Cyber-Physical Systems
DSC - Digital Supply Chain
ERP- Enterprise Resource Planning
IFC - International Financial Corporation
OECD - Organisation for Economic Co-operation and Development
PwC - Price Waterhouse and Coopers
SCI - Supply Chain Integration
SCM - Supply chain Management
SMAC - IT - social, mobile, analytics and cloud – Information Technology
WMS - Warehouse Management Software

CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 Introduction

In a supply chain, systems are designed to ensure stakeholder expectations and needs are realised (Gold and Schleper, 2017; Walker, Bourn and Rowlinson, 2008). Thus, businesses implement systems in response to these needs and expectations, basing their decisions on return on investment, systems security, scalability and interoperability, with a direct link to business benefits and how that ultimately impacts company performance and growth (Golicic and Smith, 2013; Kersten, Blecker and Ringle, 2017). Supply chain management is one of the core inter-organisational processes that fulfil customer requests and is critical to firm performance (de Sousa Bastos, 2018). To gain a competitive advantage, companies focus their supply chain strategies on improving and innovating their end-to-end processes between themselves, their customers and their suppliers (Rai, Patnayakuni and Seth, 2006).

A supply chain consists of all parties and functions directly or indirectly involved in fulfilling a customer request. Thus, the evolution of digitally empowered supply chain capabilities has transformed organisations across different sectors thus yielding huge growth opportunities for both organisations and suppliers (Hänninen, Smedlund and Mitronen, 2018; Ferreira, Moreira, Pereira and Durão, 2020). Seamless integration of systems across channel partners improves efficiency by enabling organisations to integrate all suppliers and parts manufacturers into the supply chain network (Singh and Jayraman, 2013). Integrating supply chain operations with suppliers and consumer allows businesses to streamline and enhance data and knowledge sharing, potentially improving material and product flows across the supply chain (Chienwattanasook and Jermsittiparsert, 2018).

SCM seeks to seamlessly integrate the internal functions of an organisation and effectively link them with the external operations of suppliers, customers and other channel members. This mechanism has the potential to enhance organisational competitiveness through improved interaction and collaboration in the firm supply chain. According to Lin (2009), several supplier integration activities, including supplier

involvement, design integration, supplier base reduction, supplier commitment and information-sharing practices are imperative strategies aimed at improving firm performance and enhancing a firm's competitive advantage in the marketplace. Lee, Kwon and Severance (2007) argue that integration with suppliers is the best strategy to achieve supply chain reliable performance. Lee et al. (2007) add that availability of fast and easy electronic ordering systems for customers is a significant technique to save money and increase performance reliability.

Digital supply chain capabilities enable the warehouse, distribution centre, storefront and e-commerce portals to connect to ascertain that all points can exchange information and re-route orders. This ensures that customers have what they want at any location and at any time (LaBombard, McArthur, Sankur and Shah., 2019). This innovation permeates product and process development, thus aiding organisations to reduce costs, improve profitability and enable competitive advantage (Roblek et al., 2021). Swarnakar, Singh, Antony, et al. (2022) argue that efficiency improvements occur through practices to cut down on production and manufacturing costs and seamless integration of systems across channel partners.

The transition to digitise supply chains can yield performance benefits. Findings from the study of Saryatmo and Sukhotu (2021) found that digital supply chains influence positively all three aspects of operational performance, vis-à-vis, quality, productivity and cost reduction. The digital supply chain is based on a new level of transparency and exchange of data where best practices are shared with internal and external stakeholders to improve efficiencies and interoperability (Chang, Chen and Lu, 2019). With more accurate demand forecasts, organisations can lower the overhead expenses associated with maintaining slow-moving inventory by stocking less low-moving goods to create a place for higher-moving and revenue-producing merchandise.

However, supply chains remain fragmented, and companies cannot capitalise on the full potential of digital supply chain capabilities for value creation. According to Büyüközkan (2018:1), “digital supply chains are still in their infancy and most of their potential for value creation remains unclaimed”. This study investigates the

relationship between supply chain integration and aggregate firm performance gains, the integration elements and the digital capabilities that enable these elements.

1.2 Statement of the research problem

The benefits of digitalisation in supply chains are still untapped because critical organisational transformations and the management thereof are ignored or delayed (Wong, Tan, Ooi, Lin & Dwivedi, 2022). Yunis, Tarhini and Kassar (2018) argue that understanding the impact of digitally enabled supply chains on firm aggregate performance gains is relatively scarce. Similarly, Cenamor, Parida and Wincent (2019) argue that because the understanding of the impact of digital platforms on firm performance is still limited, a considerable number of firms fail in their attempts to adopt such platforms. These realities provided the impetus for this study.

1.3 Research question and objectives

Provided these realities, this study investigates the linkage of supply chain integration, firm operational excellence, customer service and firm performance in different organisations in the Western Cape and Gauteng and will, therefore, seek to answer the following primary research question.

> What is the impact of digital supply chain integration on firm performance?

To support answering the main research question, the following research objectives were identified

- To conduct a literature review to identify key properties that influence digital supply chain integration.
- To identify a suitable framework to investigate the relationships between supply chain integration and firm performance.
- To apply a qualitative research design to identify the relationship between digital supply chain integration and firm performance.

- To make recommendations on the impact of digital supply chain integration on firm performance.

1.4 Research rationale

This research study investigates the relationship between supply chain digital integration, firm operational excellence, customer service, and firm performance. The literature review suggests that there are limited empirical studies exploring this relationship across various industries in South Africa. This research aims to address this gap by developing a framework that links a firm's supply chain integration strategy to its competitive strategy, and identifies how these linkages can be leveraged to enhance organisational performance. Ultimately, the proposed framework can help companies fully leverage the potential and advantages of a digitally enabled supply chain to achieve aggregate performance.

1.5 Scope of the study

To narrow the investigations, the scope of the study was confined within the boundaries of the outlined objectives of the study. Thus, the study summarised prior research on how digital supply chain capabilities can enable and enhance key factors that drive performance gains for firms. The study critically consolidated and examined the contributions of past research in line with the outlined objectives. Given the voluntary nature of the participation of participants in the survey, the researcher was only able to receive responses from willing organisations. Therefore, the sample size may not be entirely representative of organisations in South Africa.

1.6 Overview of research design

The research design refers to different types of enquiry within research methods (qualitative, quantitative and mixed methods) approaches that provide specific direction for procedures in a research design (Denzin and Lincoln, 2018). Creswell (2008) gives an overview of three research methods frequently applied: quantitative, qualitative and mixed-method. Quantitative research applies surveys and experimental research; qualitative designs apply narrative research, phenomenology, grounded theory, ethnographies and case study and mixed-

method involves convergent, explanatory sequential exploratory sequential transformative and embedded or multiphase designs.

The study utilised a qualitative method to understand underlying reasons, opinions and motivations. This enables the extraction of insights into the stated research problem and helps to develop ideas for the study. DeFranzo (2011) outlines qualitative research as a useful method to uncover trends in thoughts and opinions and dive deeper into the problem using unstructured or semi-structured data collection techniques. The study, therefore, used individual interviews with individuals in the supply chain at 10 organisations in the Western Cape and Gauteng.

1.7 Ethical considerations

The research was conducted within the acceptable prevailing norms and values in scientific research. Permission to conduct the research was sought and granted by the Faculty Research Committee of the University of Western Cape (See Appendix A). Correspondence requesting permission to conduct research was sent to the target group to obtain organisational approval.

The researcher initially provided the targeted group with information about the study while addressing any ethical issues. Before conducting the interviews and focus group discussions, those willing to participate were requested to provide written consent (informed consent and voluntary participation).

The responses obtained from the participants were kept confidential, and none of the participants would be identified by name. The study data would be password protected and accessible by the researcher. Access was restricted to the public. The transcripts were securely protected and locked in a drawer only accessible to the researcher. All the data from the audiotape and transcripts would be conducted three years after the study's completion.

During the interviews, participants were assured of confidentiality and anonymity of their responses. There were no risks to either party, the researcher or the participants,

and the exercise had a potential advantage for the participants. Concerning bias, this was drastically minimised by asking and following consistently the same semi-structured questions as a guide for each participant.

1.8 Structure of the thesis

Chapter 1 of this study presents the background of the study and states the problem statement. Furthermore, the chapter outlines the research objectives, research questions, location and scope of the study. It also highlights the significance and contribution of the study and provides the chapter outline.

Chapter 2 provides a concise review of various literature sources that were consulted in an attempt to provide a rational review of previous research in the area of digital supply chain integration.

Chapter 3 outlines the research methodology that was used in this study in terms of the research design, research method, data source, sampling method, units of analysis, data collection instruments, data analysis techniques and research ethics.

Chapter 4 presents the data results, interpretation and discussion of the results.

Chapter 5 provides insightful and thoughtful conclusions, recommendations and suggestions for future research.

1.9 Conclusion

This chapter gave an overview of the background of the study, the problem statement, the objectives and research questions as well as the assumptions and limitations of the study. It also provided information relating to the nexus between digital supply chain integration and organisational performance through the leverage of digital technologies. The next chapter presents the literature review.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This section reviews recent research on the impact of digitally enabled supply chains on firm performance gains. Several recent studies have been investigated and incorporated into the study. This provided contemporary narratives on the nexus between digitally powered supply chain and firm aggregate performance to identify the key properties that influence digital supply chain integration. The debate in this context is divided into the following sections: Supply chains, conceptualising digital supply chain integration, identifying key properties of digital supply chain integration, internal integration, external integration, and process integration, network integration, explaining how digital supply chains enable internal, external, process and network integration and contextualising supply chains in the South African logistics industry. Consequently, recent literature on factors influencing the efficacy of digital supply chain integrations, such as technological, organisational and environmental factors are explored. The role of supply chain integration in enhancing firm aggregate performance gains and questions about operational excellence in terms of how digital supply chain integration enables operational excellence, financial performance and customer satisfaction, are further investigated.

2.2 Supply chains

A supply chain is a connected series of activities concerned with planning, coordinating and controlling material, parts and finished goods from suppliers to the customer (Delgado and Castelo, 2013). It is concerned with the flow of material, information and capital in an organisation as well as cooperation among organisations along the supply chain (Gong, Gao, Koh, Sutcliffe and Cullen, 2019).

The scope of the supply chain begins with the source of supply and ends at the point of consumption. It extends much further than simply a concern with the physical movement of material and is just as much concerned with supplier management, purchasing, materials management, manufacturing management, facilities planning, customer service and information flow as with transport and physical distribution (Hanaysha and Alzoubi, 2022; Stevens, 1989).

The supply chain encompasses much more than physical distribution and is equally concerned with supplier management, purchasing, materials management, factory management, facility design, customer service and information flow with transportation and physical distribution (Stock, 2009; Hanaysha and Alzoubi, 2022).
Zighan (2021) contends that the purpose of the supply chain is to align customer demand with the flow of material from suppliers to achieve a balance between what is frequently perceived as competing goals of good customer service, low inventory investment and low unit cost. Sundarakani, Kamran, Maheshwari and Jain (2021) argue that every business's success is contingent upon the design and operation of an efficient supply chain.

The Internet and accompanying net-centric and web-based technologies and supply chain applications facilitate digitalisation as it seeks to provide solutions aimed at optimising supply chain management (Kumar, Tiwari and Zymbler, 2019; Verhoef, Broekhuizen, Bart, Bhattacharya, Qi Dong, Fabian and Haenlein, 2021). Digitalization can assist firms in overcoming the disadvantages of a disjointed and inconsistent IT infrastructure that may exist throughout the supply chain (Dhingra *et al.,* 2020). By using the relational capital intrinsic in supply chain relationships, firms can coordinate physical and financial movements throughout the supply chain. By facilitating supply chain activities via the web, information sharing is possible. Online procurement, production, distribution, and sales channels impact supply chain integration and performance (Patnayakuni, Patnayakuni and Rai, 2006). In a study conducted by Liu, Long and Wei (2022) on the correlation mechanism between smart technology and smart supply chain innovation technology, Liu, Long and Wei (2022) found that smart technologies enabled organisations to develop a quick response system, which makes their operations more efficient. Interestingly, with the mobile phones of employees on standby for 24 hours, the quick response requires all departments to reply to customers within a short space of time to achieve high-quality smart logistics service.

2.3 Conceptualising digital supply chain integration

Supply chain processes can be improved by using digital technologies to ensure customer acceptance (Iddris, 2018; Xue, Zhang, Ling and Zhao, 2013). Some scholars define digital supply chains (DSC) as inter-organisational systems businesses

implement to digitise transaction and collaboration processes with their supply chain partners (Iddris*,* 2018; Xue *et al*., 2013). Generally, digitalization and internet commerce are reshaping supply chain systems in various industries (Vendrell-Herrero, Myrthianos, Parry and Bustinza, 2017).

The distinction between a digital supply chain and a conventional supply chain is that a digital supply chain enables a rapid transition from manual transactions to digitalised information flows. In intra- and inter-firm operations, businesses can reduce internal company costs and increase efficiency through digitalisation (Korpela, Hallikas and Dahlberg, 2017).

Due to the rapid rise of digital technology, digitalisation will continue to pervade all facets of corporate operations, most notably supply chain management. Often, consumer and competitive pressures place significant pressure on targeted organisations to establish strategies for effective coordination, collaboration, integration, digitalization and technology used to respond to client demand (Björkdahl, 2020; Dredge, Phi, Mahadevan, Meehan and Popescu, 2019). Additionally, supply chain digitalization affects the success of real-time inventory monitoring, resource allocation, customer interaction and overall efficiency (Pascucci, Savelli and Gistri, 2023). Therefore, businesses must understand better DSC and how it can ultimately result in improved performance and profitability.

2.3.1 Key properties of digital supply chains integration

Digital supply chain integration is defined as integrating business processes, culture and organisational aspects to meet market requirements owing to digital technologies. In other words, it is the rethinking, reimagining and redesigning of business in the digital age (Matt, Hess and Benlian, 2015). Digital supply chain integration is a fundamental and essential change to business systems and involves digitising everything that can be digitalised (Hagberg, Sundstrom and Egels-Zandén, 2016) and massive data collection from various sources (Frank, Autor, Bessen, *et al.,* 2019). It also includes better networking between business operations via digital technologies (Berman, 2012), effective and efficient interface creation (Berman, 2012) and sharing of information based on digitalism (Berman, 2012; Frank, *et al*., 2019). Due to the critical role of digital technologies in digital integration, businesses must increase their

technical agility and properly use digital technologies (Frank *et al.,* 2019; Pramanik, Kirtania and Pani, 2019).

The benefit of digital supply chain integration can be realised by an effective linkage between various supply chain operations, subject to the effective construction and use of various supply chain practices to achieve an integrated supply chain (Zailani, Iranmanesh, Foroughi, *et al*., 2020). This means that a business that wants to improve its SCM practices should focus on SCI (Singh and Sohani, 2011). SCI streamline and improve data exchange and knowledge by integrating supply chain activities with manufacturers and customers, ultimately enhancing material and commodity flows across (Sriyakul, Umam and Jermsittiparsert, 2019). The major essentials of digital supply chain integration will be discussed below.

2.3.2 Internal integration

According to Zhao, Huo, Selen and Yeung (2011) and Zhang, Lettice, Chan and Nguyen, 2018), internal integration occurs when a firm structures its functional departments' practices, procedures and behaviour into integrated and synchronised processes to fulfil customer requirements. However, some scholars have argued that internal integration facilitates the translation of production demands into purchasing specifications and improves material movements and ordering processes (Palomero and Chalmeta, 2014; Zhang, Lettice, Chan and Nguyen, 2018). Paulraj and Chen (2007) suggest that through scheduled interdepartmental meetings or casual contacts, purchasing and production employees can exchange information and performance feedback.

2.3.3 External integration

Arguably, information integration with suppliers enables a firm to obtain knowledge from suppliers, such as production scheduling and planning and inventory levels, which help the firm optimise inter-organisational processes (Zhang and Huo, 2013; Zhang, Lettice, Chan and Nguyen, 2018). Zhao (2013) also argues that financial and market criteria provide a useful tool to assess a firm's links with suppliers, internal functions and all external and internal processes over time. Direct communications and frequent information exchange improve supply chain transparency and visibility, reducing uncertainty and complexity during integration and facilitating measurement

and management processes in long-term supply networks (Omar, Jayaraman, Debe, Hasan, Salah and Omar, 2021; Roh, Tokar, Swink and Williams, 2022).

2.3.4 Process integration

Frohlich and Westbrook (2001) affirm that process integration with suppliers can create synchronised processes across a supply chain, seeking to bring suppliers into a firm's internal operations. This integration provides opportunities to improve transactional efficiencies, solve problems and identify new product ideas by involving suppliers in product development, production planning and project teams to reduce production lead times and speed up new product introduction and delivery (Alsharari, 2021; Vaska, Massaro, Bagarotto and Dal Mas, 2021).

2.3.5 Network integration

Supply chain networks enable us to see the big picture, providing a complete picture of the flow of information and resources. Frequently, organisations are solely concerned with their operations, with what they manufacture or supply, rather than with what the end client receives (Hahn, 2020). By examining a supply chain network, businesses can better understand the whole flow of materials/information from beginning to end, enabling them to recognise the benefit of partnering up and collaborating to achieve the highest possible value offered to the final consumer.

Supply chains and supply networks are both terms that refer to the inflow and movement of materials and information between organisations to serve the final user/customer (Ajaegbu, Uren and Schroeder, 2020). The term 'network' refers to a more sophisticated structure in which organisations are connected and exchange information in both directions; the term 'chain' refers to a simpler, serial set of links (Slack *et al.,* 2001).

2.4 Supply chains in the Gauteng and the Western Cape logistics industry

South Africa's supply chains operate in a challenging business setting. This environment impacts the effectiveness and competitiveness of enterprises and supply networks in South Africa. According to Simpson and Havenga (2012) and Mthembu and Chasomeris (2022), there is an urgent need to enhance South Africa's freight

transportation system, owing to the country's susceptibility in terms of logistics performance and competitiveness, notably in terms of transportation costs.

According to Park (2020), effective and efficient logistics operators are critical to the economy's viability. Numerous internal factors can affect the efficiency and efficacy of logistics operators and their supply chains, including the technology employed, management skills, corporate culture, inter-firm interactions and cooperation. Nonetheless, the success and performance of logistics operators and supply chains can also be impacted by aspects of the business environment, such as infrastructure provision, infrastructure management, human resource availability and a business-friendly regulatory framework (Nagitta and Mkansi, 2019).

Business risks and restrictions may have a detrimental effect on logistics organisations and the supply chains in which they operate (Badenhorst-Weiss and Waugh 2014; Azadegan, Syed, Blome and Tajeddini, 2020). These uncertainties and limitations present enormous challenges for organisations, and stakeholders must thus analyse all possible factors affecting supply chain performance (Bredell and Walters, 2007). As with any risk, they must be appropriately identified and their ramifications and significance acknowledged by all parties (Bredell and Walters, 2007).

2.5 Factors influencing the efficiency of digital supply chains in the South Africa logistics industry

Several industries have experienced a marked shift in recent years, prompted by a more remarkable ability to respond to client demand, compelling firms to embark on digital integration initiatives or risk falling behind competitors (Henriette, Feki and Boughzala, 2015; Van Veldhoven and Vanthienen, 2022). Digital integration is a strategy that alters an enterprise's business plan to supply customers with versions of a specific product through new or current digital technology (Gassmann, Frankenberger and Csik, 2014; Lin, Zhang, Yan and Jiang, 2020).

Due to business digitalization, the market environment is shifting in many industries. Enterprises confront interruption from new market entrants, while tech-savvy customers expect more from the company (Sia, Soh and Weill, 2016). Every firm and sector is impacted by digital integration, as the market-changing potential of digital technologies frequently exceeds the capabilities of sales channels, supply chains, products and business processes (Cannas, 2021; Hudson and Ozanne,1988;

Rangaswamy, Nawaz and Changzhuang, 2022). Integrating and leveraging new digital technology is one of the most significant difficulties businesses face today.

Enterprises must leverage digital technologies to increase their proximity to customers, improve their business processes and empower their personnel (Westerman, Bonnet and McAfee, 2014). Cloud computing, mobile, analytics, social media, robots and Internet of Things (IoT) technologies are all examples of emerging new digital technologies (Dery, Sebastian and van der Meulen, 2017). If integrated with the company's data connectivity, these digital technologies can provide the game-changing potential for enterprises to enhance their goods, services and customer connections (Sebastian *et al.,* 2017).

The intention of businesses in South Africa to implement digital integration is influenced by particular TOE (Technology, Organisational and Environmental) framework aspects. It is critical to investigate the elements that influence the anticipated adoption of digital integration so that businesses may identify and handle potential problems. Addressing these issues will benefit the organisation by developing a clear and cohesive digital strategy, keeping and attracting top personnel and fostering an inventive and creative work environment. Finally, a digitally integrated business will be able to easily respond to new opportunities and maintain a competitive edge over its competitors (Clauss, Kraus, Kallinger, Bican, Brem and Kailer, 2022; Tiwari, 2022).

Internet of Things (IoT) transforming supply chains

According to de Vaas (2018), IoT supports supply chain process integration by capturing and transferring key information in real-time. The features of IoT technologies with capabilities, such as connectedness, automated data capture and real-time communication among all supply chain members, tend to improve an organisation's capacity to make intelligent decisions, run efficient processes and respond quickly (Wu *et al.,* 2016). Therefore, IoT provides several ways to help SCM and could have a broad and profound impact on the supply chain in improved asset utilisation and higher uptime, improved end-to-end supply chain performance, supply chain visibility and reliability (Pettey, 2019). IoT devices can immediately track where a product is located along the supply chain, showing handling history from provenance to delivery. Although IoT shows promising applications for supply chains, the

technology faces numerous implementation challenges such as security, privacy and scalability (Uddin, Stranieri, Gondal, & Balasubramanian, 2021).

Cloud computing technology and supply chains

According to Attaran (2020), Cloud Computing Technology (CCT) is a cost-effective way to run applications, store data and accomplish other IT tasks. Among the many incentives for using the cloud, supply chain management stands out. Attaran (2020) maintained that CCT is used in supply chain processes mainly for cooperation and information sharing to improve Customer Relationship Management, Supplier Relationship Management and Customer Service Management. CCT has enabled companies to connect their supply chain with the supply chains of their suppliers and customers together in a single network that optimises cost for all stakeholders involved.

Scholars have argued that Cloud-based WMS and ERP (enterprise resource planning) solutions offer datasets that show patterns across time, allowing demand shifts to be predicted (Budde, Hänggi, Friedli and Rüedy, 2022; Calatayud, Mangan and Christopher, 2019; Pagano and Liotine, 2019). Demand management not only keeps the company's goods flowing, but it also helps to build positive client relations. Demand issues should never stand in the way of a company's relationship with a client, thanks to quick demand forecasts and easy access to data.

2.5.1 Technological factors

As a result of the 4th industrial revolution technological principles such as SMAC (Social, Mobile, Big Data Analytics, and Cloud computing), a company's internal processes and essential supply chain procedures are rapidly becoming digital (Geisberger and Broy, 2012; Attaran, 2020). However, a lack of trust and cooperation among customers and other stakeholders might negatively impact the adoption of digital supply chains. For example, adopting technological cloud-based systems and analytic solutions that manage inventory and client demand would be inefficient. However, Mell and Grance (2011) argue that this flexible computer resource requires minimal management effort or service provider contact, focusing on perceived complexity, making digital supply chain adoption unlikely. Another barrier to adopting digital supply chains within organisations is the financial muscle of such organisations.

Contestably, companies may decide against deploying SMAC-IT solutions due to the high costs associated with the technology (Liu, Xiao, Xia, Zhao, Peng, Srinophakun, and Bai, 2019; Shaqsi, Sopian and Al-Hinai, 2020). Despite the ability of digitally enabled firms to reduce implementation and management costs around inventory, adopting a digital integration commit them to a high investment as they transition from their existing systems, which are often predominately paper-based (traditional supply chain). This capital venture varies from installation, acquiring new resources and start-up costs, to mention a few (Ghobakhloo *et al.,* 2012).

This implies that the expense of technology might act as a barrier to company and industry adoption of financial technology (Ghobakhloo *et al.,* 2012; Ghobakhloo, Iranmanesh, Vilkas, Grybauskas and Amran, 2022). Adopting a digital supply chain also entails deploying the Internet of Things into businesses, which exposes them to security threats, as do many cloud-based businesses. Cyber intrusion is becoming an increasing threat for many businesses in poor countries that lack the infrastructure necessary to implement proactive security policies and technologies. A potential security flaw of this magnitude reduces the possibility of digital supply chain adoption (Egloff, 2020; Yathiraju, Jakka, Parisa and Oni, 2022).

Thus, working with cybersecurity firms can help businesses boost their defence against threats (Balakrishnan and Cheng, 2005; Egloff, 2020). According to Rogers (2003), relative advantage refers to the extent to which a technological breakthrough outperforms the tangible and intangible expectations associated with the originating concept. Additionally, Shapiro, Tang, Wang and Zhang (2015) assert that organisations are more likely to accept an innovation if they recognise the relative benefits connected with that innovation.

Rogers (2003) defines compatibility as the degree to which technology innovation is consistent with the established organisation's principles. Thus, an organisation is more likely to accept an innovation if it is consistent with the incumbent organisation's beliefs, practices, scope and information technology infrastructure (Shapiro, Tang, Wang and Zhang, 2015).

2.5.2 Organisational factors

Organisational factors influence digital integration adoption since elements such as an organisation's size and structure affect technology acceptance (Ngah, Zainuddin, Thurasamy, 2017). Without the direct backing of senior management, an organisation cannot successfully advocate for digital integration in the supply chain. Executive leadership must explain the vision for digital integration and its alignment with strategic objectives across divisions (Maduka, Mpinganjira and Duh, 2016).

Management must support the implementation of initiatives that address the concern and complexities associated with the Internet of Things and others. This chapter, in summary, provided background knowledge about the dynamics of supply chain integration, with a special focus on the key properties that influence digital supply chain integration.

Wade and Marchant (2014) assert that in the absence of human resource systems that create additional value for stakeholders involved in digital processes, the adoption of digital supply chains within the organisation may be harmed, resulting in increased employee opposition. Hoberg, Krcmar, Oswald and Welz (2015) refute this notion by highlighting the management's growing support for digital projects and SMAC-IT technology. Additionally, management capability is a critical factor in implementing digital supply chains. Management executives have achieved notoriety for successfully establishing a collaborative planning and forecasting culture within Amazon's manufacturing industry (Swaminathan and Tayur, 2003). However, if management does not properly analyse online channels that offer inventory and distribution management prospects, digital adoption may be fatal to businesses (Ahmed, Karmaker, Nasir and Moktadir, 2022; Priyono, Moin and Putri, 2020).

Technical capabilities have been identified as another element impacting the organisations' adoption of digital supply chains. Implementing digitally aligned initiatives in supply chains demands data science expertise and domain expertise. Internal IT expertise is lacking in most businesses, particularly in developing countries striving to grow and retain these capabilities, which may prevent companies from realising the full potential of analytics. It could exacerbate internal resistance to the use of digital supply chains (Álvarez, Zartha and Orozco, 2019; Vermunt, Negro, Verweij, Kuppens and Hekkert, 2019).

Additionally, the size of the business might affect the adoption of technological innovations (Orji, Kusi-Sarpong, Huang and Vazquez-Brust, 2020). According to Wang et al. (2016), large organisations are more likely to adopt new technologies since they have the financial means to support the adoption and manage any related risks.

2.5.3 Environmental factors

Environmental considerations would include how an organisation's environment, legislation and access to IT vendors, customers and competitors can affect technology adoption (Ngah *et al.,* 2017). The digital landscape (including the capabilities of retail vendors) and perceptions of IT vendors have an impact on the decision-making processes surrounding digital supply chain adoption and integration (Alshamaila, Alshamaila, Papagiannidis and Li, 2013; Shamout, Ben-Abdallah, Alshurideh, Alzoubi, Kurdi and Hamadneh, 2022). If the existing organisation believes it will receive IT assistance for integrating/adopting/maintaining digital supply chain solutions within the organisation, this will decrease risk perceptions connected with the innovation (Ageron, Bentahar and Gunasekaran, 2020; Alshamaila *et al.,* 2013). Additionally, the potential competitive advantage associated with technological integration, as well as pressure from industry competitors, may affect an organisation's decision to adopt the technology (Alshamaila *et al.,* 2013).

Additionally, organisations are more likely to accept an innovation if the incumbent believes that failure to integrate will result in a competitive disadvantage, such as losing potential customers (Shapiro, Tang, Wang and Zhang, 2015). Similarly, Rui (2007) argues that a firm's dependency and trust in its consumers significantly impact its adoption of innovative technologies. IT policies and regulations significantly impact how industries interact with data, which directly impacts the decision to integrate a digital supply chain.

The fourth industrial revolution's digital integration can promote innovation in businesses by making data readily available, which may be highly beneficial in growing sales, inventory management and logistics, to name a few (Van Ark, 2016). According to the OECD (2017), data flows also support digitally enabled goods and services, commerce and trade facilitation and enterprises' ability to organise production globally via global value chains (with a resulting trade in intermediate goods). As a result, laws

governing data management can significantly impact market transparency in the digital era.

Therefore, any organisation's trade policy should ensure that suitable safeguards are available to pursue legitimate public policy objectives while keeping the enormous benefits of an open digital environment. Finally, organisations exist largely to satisfy the requirements of their customers, which unwittingly forces the organisation to integrate new technology, notwithstanding their benefits (Alshamaila *et al.,* 2013; Kiswili, Shale and Osoro; Nosalska and Mazurek, 2021).

2.6 Role of supply chain integration in enhancing firm aggregate performance gains

Some indications indicate that supply chain integration affects the three performance parameters examined here. For example, it has been suggested that supply chain integration can improve a firm's time-based competitiveness (Cahyono, Purwoko, Koho, Setiani, Supendi, Setyoko and Wijoyo, 2023; Moosivand, Ghatari and Rasekh, 2019). The assertion, as mentioned earlier, that supply chain process integration affects a firm's aggregate performance as measured by operational excellence, financial performance and customer satisfaction will be examined in the following paragraphs.

2.6.1 Operational excellence

Operations are the systems, structures and procedures that plan and execute the movement of goods and services from suppliers to customers (Cannella, Dominguez, Framinan and Ponte, 2018). It includes monitoring, maintaining and enhancing internal and collaborative processes (Ivanov, Tsipoulanidis and Schönberger, 2019). The three aspects of operational excellence are exceptional performance and visibility across the value chain, value-added to customers and successful integration with external partners (Pellissier, 2009). Thus, digitalization provides automation, integrations, visibility and Big Data analytics to improve supply chain processes.

Operations excellence can also be described as a focal firm's responsiveness to consumers and productivity gains compared to competitors. Firms must strike a balance between operational costs and service level performance in terms of lead times to meet consumer expectations (Jha, Sharma, Kumar and Verma, 2022; Simchi-

Levi and Zhao, 2005). Secondly, businesses must accomplish market-driven success (Dehghani, Abubakar and Pashna, 2022; Robinson and Malhotra, 2005), which includes client connections (Groves and Valsamakis, 1998) and revenue growth (Rust, Moorman and Dickson, 2002). Integrated supply chains improve operational visibility, plan synchronisation and the flow of commodities thus reducing the time between a customer's request for a product or service and its delivery (Jamali, and Rasti-Barzoki, 2019). Many organisations today with a wide array of products have recognised that operational excellence is a continuing activity in which companies try to improve their outcomes. It is inherently interactive and often entails involvement from all levels of the business.

According to Aiassi, Sajadi, Hadji-Molana and Zamani-Babgohari (2020), Operation Planning (OP) must be a component of any broader plan for operational excellence. However, traditionally, this process has been one in which the anticipated demand for products is balanced and synchronised with the ability to provide the products.

This fact has not gone undetected. Numerous leading firms have implemented processes and applications to support Integrated Business Planning (IBP), a holistic approach that enables effective decision-making and control across the entire organisation. It more closely aligns sales and operations goals with financial and shareholder aspirations. Enterprises that implement integrated OP programmes consistently outperform those that take a more strategic and disjointed approach to operation planning (McManus, Winroth and Angelis, 2019).

2.6.2 Financial performance

The main goal of a business is to meet customer needs and make money for everyone in the supply chain channels. The goal of the supply chain is to provide value to the end consumer in terms of quality products or services and for each channel participant to make money as a result. Digitalization, on the other hand, gives businesses across all industries the chance to improve their processes and come up with new and profitable business models (Hole, Hole and McFalone-Shaw, 2021; Rachinger, Rauter, Müller, Vorraber and Schirgi, 2018).

Solis (2019) asserts that digital technologies shape client expectations. The same tools that enable them to research and shop differently also enable markets to transform marketing into a business growth engine. According to (Catlin, Harrison,

Plotkin and Stanley, 2016) organisations that utilise digital technologies outperform their competitors financially. Companies should respond with ambitious plans that incorporate digital technologies to modify a business model and give new revenue and value-producing opportunities. Several scholars (Arora, 2018; Gezgin *et al.,* 2017; Kersten *et al.,* 2017; Lee, Wang, Desouza and Evans, 2021) suggest that digital solutions can help reinvent procedures, increase quality and promote consistency. Using digital methods to increase revenue has a major impact on ROI (Astill, Dara, Campbell, Farber, Fraser, Sharif and Yada, 2019).

Research has established that more significant degrees of supply chain integration (SCI) generally correlate with higher levels of financial performance (Droge, Jayaram and Vickery, 2004; Frohlich and Westbrook, 2001; Munir, Jajja, Chatha and Farooq, 2020). SCI at any level benefits a firm's financial health. Businesses with complete supply chain integration demonstrated the best financial success. For example, a firm's SCI is directly associated with positive financial success (Green, Whitten and Inman, 2008). Logistics integration enhances the argument that a manufacturing entity's operations extend beyond its physical site limits to include relationships with its suppliers (Chen and Paulraj, 2004; Zhu, Kouhizadeh and Sarkis, 2022). Supplier inclusion results in increased collaboration and coordination between the manufacturer and supplier partners and increased sharing of information and blurring of organisational barriers.

Financial operations were among the first to be reconfigured to alleviate bottlenecks, increase productivity and eliminate unnecessary work (Hammer, 1990). Through event-based activation of payables and receivables, financial integration can enable improved working capital and cash flow management. For example, an electronic payment system can be prompted upon delivery of products (Akgün and Memiş Karataş, 2021; Song, Yang and Yu, 2020).

Financial integration using incidents can help minimise billing, payment processing and dispute resolution expenses, shorten the invoicing and receivables cycle time, speed up payments and increase financial information available for decision-making (Lacity and Van Hoek, 2021). Reduced payment delays, faster payment processing and the collection of consumer preferences through billing and invoicing operations can all result in improved customer relationships. Finally, financial integration can boost revenue growth by increasing cash flow availability for production ramp-up

during increased demand or product line exploration (Chang, Chen and Wu, 2019; Li and Kassem, 2021).

2.7 Obstacles to achieving digital supply chain integration

Digital transformation of supply chains is an ambitious undertaking as not all organisations experience success in implementing digital supply chain transformation projects (Boutetière, Montagner and Reich, 2018). Often, organisations overly concentrate on technology rather than on the people using the methods. Technology, in and of itself, will never be the solution to all problems (Cruickshank, 2016). Ben-Daya, Hassini and Bahroun (2017) have identified a lack of solid frameworks that guide IoT adoption in a supply-chain context with clear guidelines and a roadmap and a lack of models that address supply-chain problems in a new technological environment.

Solis, Li and Szymanski (2014) argue the need for organisations to recognise that a successful technology transformation is mainly a cultural and organisational transformation. According to Attaran 2020), companies need discipline, planning and committed top-down leadership to make it work and succeed in the long run. Moreover, Attaran (2020) and Coltman, Tallon, Sharma and Queiroz (2015) stipulate the imperativeness of ensuring that selected technology reflects the overall business strategy and can significantly add value to the business. Successful implementation of digital supply chain integration requires businesses to develop and realign priorities and operate with a sense of purpose and urgency. Thus, organisations should simplify the organisational and cultural changes that hinder the adoption of digital technology.

2.8 Key properties influencing digital supply chain integration

The benefit of SCI can be realised by an effective linkage between various supply chain operations, and this linkage should be subject to the effective construction and use of various supply chain practices to achieve an integrated supply chain. This means that a business that hopes to improve its SCM practices should focus on SCI (Hackius and Petersen, 2020; Singh and Sohani, 2011). SCI will streamline and improve data exchange and knowledge by integrating supply chain activities with manufacturers and customers, ultimately enhancing material and commodity flows

across the Supply Chain (Chienwattanasook and Jermsittiparsert, 2018). Integrating supply chain operations with suppliers and customers allows companies to streamline and improve data exchange and information, resulting in the betterment of material and product flows within the Supply Chain (Attaran, 2020; Chienwattanasook and Jermsittiparsert, 2018; Sriyakul *et al*., 2019).

Extant literature has extensively explored the implementation benefits of information and communication technology (ICT) for firm performance (Brynjolfsson and McAfee, 2014; Wamba-Taguimdje, Fosso Wamba, Kala Kamdjoug and Tchatchouang Wanko, 2020). Specifically, using ICT to optimise task management and market orientation through advanced market knowledge can improve operational performance (Melville, Kraemer and Gurbaxani, 2004). However, Yunis *et al*., (2018) maintain that ICT implementation may require a major investment that does not lead to performance improvements. Thus, understanding the impact of digitally enabled supply chains on firm aggregate performance gains is relatively scarce. Similarly, Cenamor *et al*., (2019) claim that because the understanding of the impact of digital platforms on firm performance is still limited, a considerable number of firms fail in their attempts to adopt such platforms. Scholars have found that organisations, specifically small and emerging businesses face increased difficulty in adopting new technologies due to lacking requisite resources, skills, commitment and proper understanding of digital opportunities (Giotopoulos, Kontolaimou, Korra and Tsakanikas, 2017). Hence the accrued benefits of digitally powered supply fundamentally remain untapped by most organisations.

2.9 Theoretical framework

In response to market competition and the changing business environment, firms have Adopted and invested in various state-of-the-art IT to improve their business operations (Amini& Jahanbakhsh Javid, 2023). Thus, companies have used various theories and models for the process of adopting new technologies. Among others, the Diffusion of Innovation Theory (DOI) which is predominantly based on characteristics of the technology and the users' perceptions of the innovation (Chigona & Licker, 2008), and the Technology-Organization-Environment (TOE) Framework which considers three features of an enterprise that influences the adoption of innovation - technology, organization and environment context (Tornatzky, Fleischer &

Chakrabarti, 1990). The TOE framework is discussed in details in 2.5. Singh and Sohani (2011) propose a supply chain integration model suggesting that supply chain integration enables operational excellence, financial performance and customer satisfaction that yield firm performance gains, as depicted in Figure 1 below.

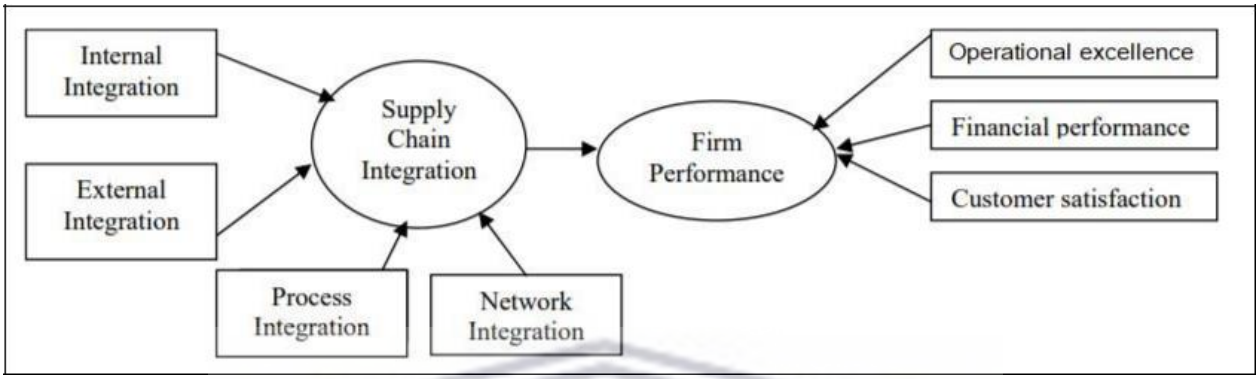

Figure 1: Model of Supply chain integration with firm performance (Sigh and Sohani, 2011:194)

External integration

Information integration with suppliers enables a firm to obtain knowledge from suppliers, such as production scheduling and planning and inventory levels, which help the firm optimise inter-organisational processes (Ganbold, Matsui and Rotaru, 2021). Zhao (2013) claims that financial and market criteria provide a useful tool to assess a firm's links with suppliers, internal functions and all external and internal processes over time. Direct communications and frequent information exchange improve supply chain transparency and visibility, reducing uncertainty and complexity during integration and facilitating measurement and management processes in long-term supply networks (Gualandris, Longoni, Luzzini and Pagell, 2021; Roh *et al*., 2022).

Process integration

Process integration with suppliers can create synchronised processes across a supply chain, seeking to bring suppliers into a firm's internal operations (Gajšek and Sternad, 2020; Frohlich and Westbrook, 2001). This integration provides opportunities to improve transactional efficiencies, solve problems and identify new product ideas by involving suppliers in product development, production planning and project teams to reduce production lead times and speed up new product introduction and delivery (Vaska, Massaro, Bagarotto and Dal Mas, 2021).

Customer Relationships

Customer relationship management refers to all of the activities, strategies and technologies companies use to manage their interactions with current and potential customers (Kulpa, 2017). Thus, the transformation of customer relationships is key to driving an organisation's performance. According to Chiguvi (2020), creating successful customer relations generates greater customer loyalty and customer retention, resulting in increased profits for a business. Digital innovations in customer relations are not just a mechanism for a company to be ahead of its competitors, but give customers holistic individual support and develop a journey of experiences with the wishes and needs of the customer at the centre (Matarazzo, Penco, Profumo and Quaglia, 2021). Many companies have started transforming their customer relations and incorporating these innovative approaches into their organisational strategies. In doing so, they continue engaging with numerous issues that are not yet even in the picture but are expected by their customers.

Seemingly, much work has been done on the importance of customer relations and its impact on a company's performance and digital capabilities to enhance customer relations. However, limited research highlights the dynamics of digital innovation and customer relations aimed at potentially increasing aggregate company performance. According to Chaffey and Smith (2013), in the context of customer relations, digital innovation means achieving customer relations objectives by applying digital technologies, including desktop, mobile tablet and other digital platforms. However, some scholars take digital innovation in the context of customer relations as a kind of innovation that influence a firm's capability of selling, promoting and marketing products or services online to yield more profit and minimise costs (Suoniemi, Meyer-Waarden, Munzel, Zablah and Straub, 2020).

2.10 Chapter Summary

The chapter has presented a review of recent research on the impact of digitally enabled supply chains on firm aggregate performance gains. Several recent empirical studies were explored. The chapter commences by conceptualising the phrases "digital supply chain integration" and "supply chain." Key properties of digital supply chain integration were discussed. Also prominently featured in the discourse is how the digital supply chain enables internal, external and network integration to enhance

performance. The next chapter presents a discourse on how the data used in the study were collected and analysed.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This section discusses the philosophical assumptions and design strategies and research method(s) deemed appropriate for developing knowledge in this study. The chapter demonstrates the researcher's values and beliefs regarding how best the phenomenon in question, as far as this study is concerned, can be understood and addressed. The chapter is structured to present discussions on the research paradigm, specifically on the ontological, epistemological and axiological orientations of the study. This is followed by the research designs, then the population and sampling methods used in the study. The process of data collection and data analysis followed next and lastly, the chapter summary.

The study investigates the linkage of supply chain integration, firm operational excellence, customer service and firm performance in organisations in the Western Cape and Gauteng and will, therefore, seek to answer the following primary research question.

> What is the impact of digital supply chain integration on firm performance?

3.2 Research philosophy

A research philosophy is a comprehensive philosophical and theoretical framework that guides a researcher's approach to researching a subject. Research philosophies or paradigms guide research approaches, research design, sample size, data collection instruments, and data analysis. Different research paradigms exist including positivism, interpretivism, realism and pragmatism.

This study was conducted within the interpretivism research paradigm aimed at focusing primarily on context-specific understandings (McChesney and Aldridge, 2019; Willis, 2007). The researcher decided to apply this paradigm due to the philosophical orientation of the study, which seeks to capture "the diverse perspectives

on the impact of digitally enabled supply chains on firm performance." This emphasis was congruent with the interpretivist viewpoint, which emphasises "the situatedness" of knowledge rather than the quest for generalisations or universal rules (Willis 2007:99).

Interpretivism is a philosophical and methodological approach in social science research that emphasises the importance of understanding and interpreting the meanings and interpretations that individuals or groups attach to their experiences, actions, and social phenomena (Kura, 2012). “Interpretivism is more concerned with in depth variables and factors related a context, where it considers humans as different from physical phenomena as they create further depth in meanings with the assumption that human beings cannot be explored in a similar way to physical phenomena (Alharahsheh & Pius, 2020, p.41)”. More discourse on research paradigm is presented below through the lenses of ontology, epistemology and axiology

3.2.1 Ontology

According to Crotty (1998), ontology is a community-based worldview regarding the nature of our world. Ontology is the study of being, which informs the theoretical perspective (Creswell and Plano Clark, 2011). In contrast, ontology is also concerned with the nature of being, existence or reality (Creswell, 2015). In carrying out research, the ontological question is about the form and nature of reality and, thus, what knowledge could be created about the phenomena. In this context, the ontological concern in this study is about the realities that could be known regarding the influence of a digitally enabled supply chain on organisational performance in organisations in Gauteng and the Western Cape in South Africa.

3.2.2 Epistemology

Epistemology is concerned with beliefs that relate to the scope and nature of knowledge or what constitutes acceptable knowledge in a particular field of study, that is, the types of evidence used to make claims (Creswell, 2015). In epistemology, researchers consider how knowledge is acquired and how we know what we know (Crotty, 1998). According to Maynard (1994), epistemology is concerned with establishing a philosophical underpinning for what kinds of knowledge are feasible and

how we may ensure that they are both adequate and acceptable. Therefore, epistemology is concerned with the appropriate level of knowledge in a certain field of study (Saunders *et al.,* 2009).

3.2.3 Axiology

Axiology is the theory of values, and values are features of human behaviour that arose during evolution and gave us aims, goals and views that influence our actions through our knowledge (Allen and Varga, 2007). However, our values generate our intentions which in turn drive changes in our epistemologies because they dictate what we intend to achieve and thus what we seek to know to do so. The axiological perspective of a research paradigm is aimed at depicting the level of consistency, reliability or otherwise reconstructing or extending the previously held theories or construction (Neuman, 1997).

It plays an important role in putting the standards and requirements of acceptable research approaches and research techniques for this research. Making the axiology explicit helps to set and clarify the guiding tone and rigour for action in research (Ruona and Lynham, 2004).

3.3 Qualitative research approach

Different approaches can be applied to explore to the relationship between digital supply chain integration and firm performance. Such as qualitative, quantitative and mixed method approaches. This research adopted a qualitative approach. Kaplan and Maxwell (2001) argue that qualitative research typically entails a logical and detailed study of individuals in natural settings (as against settings contrived), using open-ended interviews to elicit in-depth accounts of experiences and perspectives of participants on specific matters and situations. Kaplan and Maxwell (2005) maintained that qualitative methods are more useful than solely quantitative approach when a researcher pursues to examine the dynamics of a process rather than its static characteristics. The qualitative method is suitable for investigating complex social phenomena using interviews but is time-consuming and difficult to use to cover a large group of participants (Morse & Niehaus, 2009; Peng, Nunes & Annansingh, 2011).

Quantitative research collects information about the phenomenon using sampling methods and sending out online surveys and questionnaires. In quantitative methods, the researcher upholds a detached and objective interpretation to appreciate the facts (Duffy, 2005). The primary benefit of quantitative research design is that it is an outstanding way of finalising consequences and proving or disproving speculation (Shuttleworth, 2019).

Mixed methods research involves the use of both quantitative and qualitative methods in a research study. The quantitative method (questionnaire surveys) is economical and efficient in collecting large samples of data but has weaknesses in investigating social contexts associated with organisations. The qualitative method has been characterised by the limitation of being only suitable for investigating complex social phenomena using interviews and is time-consuming and difficult to use to cover a large group of participants. (Morse & Niehaus, 2009; Peng, Nunes & Annansingh, 2011).

Given these realities, a mixed method of mixing or integrating qualitative and quantitative methods, data collection and analysis in a single study in order to better understand the research problem becomes imperative. Mixed methods research is a means to resolve widely perceived inherent limitations of a single method design to complex research problems (Peng et al., 2011; Creswell, 2014).

Justification of the method

Qualitative research methods help the researcher study the underlying reasons for a phenomenon (Denzin & Lincoln, 2016). Therefore, it assisted the scholar with a deep understanding of the dynamics between digital supply chain integration and firm performance within the South African context. Qualitative research was deemed desirable for the study as the phenomenon is too complex to be encapsulated by a simple yes-or-no hypothesis (Cresswell, 2014). Given the limited budget, qualitative research becomes desirable. The qualitative approach yields rich and insightful information about the underlying motives and styles of the phenomena (Shuttleworth, 2019). For this reason, a qualitative research approach was used in the study. The benefits of the qualitative approach outweigh the inherent drawbacks and limitations; hence, its choice for this study.

The research was conducted with the use of interviews with participants that were purposively selected organisations with relevant experience in supply chain in South Africa. The collected data from individuals from these organisations and artefacts (books and articles) in the supply chain field were utilised as units of analysis to be analysed to arrive at a particular conclusion (Creswell, 2005). Captured data give very rich details concerning the participant's attitudes, feelings and experiences regarding the impact of digital supply chains on firm performance in organisations in South Africa.

Given the study's philosophical orientation, an interpretivism worldview was used to learn the truth about the impact of digitally enabled supply chains on firm performance and to develop or construct knowledge that was not only observable but also included values, beliefs, norms and reasoning. The study was based on the philosophy rooted in the stance that, to understand reality and develop knowledge, lived experiences (qualitative) are imperative for a better understanding of phenomena (Nickerson, 2022). The latter are constructed through social means, which tend to generate multiple realities through individuals' lived experiences. Qualitative researchers carry out more inductive reasoning to find meaning in their data (Dudovskiy, 2016).

3.4 Case study research design

Research design is conceptualised by De Vos (2002) as an overall plan for conducting scientific research. According to Babbie and Mouton (2001), the research design is a framework and guide as to how a particular researcher intends to conduct the research process. A case study research design was determined to be appropriate for the study because it incorporates many perspectives in understanding the complexities of the impact of digitally-enabled supply chains on firm performance.

Case study research strategy is a qualitative research method, which is most widely used method to carry out an in-depth investigation of a particular phenomenon, event, individual, or group within a real-life context (Baskarada, 2014). According to Crowe, Cresswell, Roberston, Huby, Avery & Sheikh (2011), the case study approach usually involves the collection of multiple sources of evidence, using a range of both quantitative techniques (e.g. questionnaires, audits and analysis of routinely collected data) and qualitative techniques (e.g. interviews, focus groups and observations) to

generate an in-depth, multi-faceted understanding of a complex issue in its real-life context.

The case study research technique is widely used in information systems research because of its capacity to provide knowledge of the link between organisations and technology (Oates, 2006; Jokonya, 2014). Because of its in-depth approach, case study research has been identified as a feasible research strategy in information systems (Jokonya, 2014). A case study research technique is a well-established, tried and tested empirical investigation (Yin, 2009) that has been determined to be suitable for examining information systems in organisations (Oates, 2006).

3.5 Population and sampling

3.5.1 Population

The population of the study comprises supply chains in organisations in the Western Cape and Gauteng in South Africa.

3.5.2 Sampling design

A purposeful sampling strategy of a non-random selection of participants was utilised in this study. According to Mcdermott and Sarvela (1998), purposeful sampling is a method in which researchers select participants that they judged to be typical of individuals possessing a trait. Thus, the target group in this study was those major stakeholders who are involved in designing and implementing digitised supply chain integration systems in South Africa. According to Peter DePaulo (2000), to reduce the chances of discovery failure, as opposed to reducing (quantitative) estimation error, a qualitative sample must be big enough to ensure that one is likely to hear most of the important perceptions.

Sampling frame

The research on the dynamic relationship between digital supply chain integration and firm performance in Gauteng and the Western Cape remains in its early stages. Given the objectives of this study aimed at investigating the dynamic relationship between digital supply chain integration and firm performance in Gauteng and the Western Cape, insight of digital supply chain integration and its influence on firm performance

was sought from the participants. From the collected data, the researcher was able to examine different opinions surrounding the topic. As such, it was important to administer interviews to those placed at the leading edge of the decision-making process of supply chain integration and the logistics industry in Gauteng and the Western Cape. The interviews were thus administered to selected experts in logistics who are active users of the digital supply chain technology in Gauteng and the Western Cape. Below is a list of the participants.

Table 1: *List of participants in the interviews*

Date of interview	Province	Organisation	Department	Job title of participants
3/23/2022	Western Cape	Mitrovic Development and Research Institute		Director
5/3/2022	Western Cape	City of Cape Town	IT	Corporate Portfolio, Programme and Project Management Consultant
5/4/2022	Western Cape	SPPRAC Consulting	IT	Analyst
5/10/2022	Western Cape	SPPRAC Consulting	Consulting	Project Manager
5/13/2022	Western Cape	Woolworths	IT	Systems Analyst
5/16/2022	Western Cape	Bantubyte	IT	Software Engineer
5/17/2022	Gauteng	Fresh Scope	Management	SAP PPM Functional Consultant
5/17/2022	Gauteng	Ntshembo on Point	Finance	Financial Officer
5/20/2022	Gauteng	Transnet	Information Systems	Principal ERP Analyst - Project Portfolio Management
5/20/2022	Gauteng	Johannesburg Water	CAPEX	Senior Manager - Programme Management Unit
5/20/2022	Western Cape	Ideation and Contract Freelancing - Technologies		Specialised Project Practice (SPPRAC)

Sampling Technique

Sampling techniques are frequently employed to identify unique and illuminating segments of the population of interest to the research enquiry. Although there are no precise sample size criteria, sampling in qualitative research often relies on small

sample sizes to undertake an in-depth study (Miles and Huberman, 1994; Patton, 1990). There are numerous types of sampling in qualitative research: deliberate, accidental and systematic sampling, quota sampling and snowball sampling. For this study, a purposive sampling strategy was adopted.

Sampling Size

Given the nature of qualitative research, there is no agreed-upon sample size for qualitative research. The sample size for qualitative research is intuitively determined by the researcher based on his or her ability to obtain adequate data about the phenomenon (Saunders, Sim, Kingstone, Baker, Waterfield, Bartlam and Jinks, 2018). The sample consisted of 11 individuals where data saturation was obtained and therefore deemed this to be appropriate for the study. According to Fuch and Ness (2015), data saturation in qualitative research refers to the point at which no new or relevant information is emerging from the data being collected. It means that the researcher has gathered enough data to answer their research questions and to fully understand the phenomena being studied.

3.6 Data collection

The data collection methods chosen for this investigation include semi-structured interviews and desktop study (assessment of documentary data).

Semi-structured interviews

According to Cohen and Crabtree (2006), semi-structured interviews contain a guide that provides a clear set of instructions for interviewers and can provide reliable and comparable qualitative data. The interview guide that was used for this study is attached and can be found in Appendix A. This interview schedule allows for a certain degree of consistency across different interview sessions. Thus, a balance can be achieved between flexibility and consistency (Zhang and Wildemuth, 2009). The interviewer follows the interviewees' narration and generates questions spontaneously based on their reflections on that narration. Interviews will be conducted remotely with participants via online or internet-based applications. Notably, the continued restrictions of Covid-19 presented specific ethical concerns regarding privacy,

transparency, confidentiality and security. Specific measures were devised and implemented to mitigate the associated risks.

Desktop study

The study embarked on using document analysis in conjunction with other qualitative research methods as a means of triangulation. Bowen (2009:29) pointed out that qualitative research requires robust data collection techniques and the documentation of the research procedure. As a result, as argued by Merriam (1988:118), documents of all types can help the researcher uncover meaning, develop understanding and discover insights relevant to the research problem. Thus, analysing documents through content analysis yields data excerpts, quotations or entire passages that are then organised into major themes, categories and case examples (Labuschagne, 2003). To this end, consideration was accorded to varieties of documents about the subject matter which can provide data in the context within which the research participants operate, as well as provide a historical insight that could help researchers understand the historical roots of specific issues and be able to indicate the conditions that impinge upon the phenomena currently under investigation.

3.6.1 Interview guide design

The study reviewed the current literature in this field to design an interview guide that can thoroughly critique and evaluate the findings of the study. The study employed the qualitative data collection method to gain in-depth insight. Ritchie (2003) describes the qualitative data collection method as descriptive and exploratory, mainly concerned with gaining insights and understanding underlying reasons and motivations. Firstly, an extensive search was launched to find all the existing studies or theories related to digital innovations in the supply chain context to drive performance gains. Secondly, qualitative data were collected through in-depth interviews and discussions to acquire a high degree of meaning and identify common themes in people's perceptions of their experiences. Marshall and Rossman (2014) and Patton (2005) confirm that interviews allow the researcher to understand the meanings that everyday activities hold for people, and the use of open-ended questionnaires enables the participants to provide detailed answers in their words. This instrument was first piloted and tested before it was administered in the main study.

3.6.2 Data collection processes

As data were collected via online interviews, the researcher was not in direct contact with the participants. Thus, the anonymity of the participants was guaranteed, and the subjectivity of the participants and researcher was not compromised (Muijs, 2004; Bryman and Cramer, 2012). The qualitative interviews were conducted through Microsoft Teams. The researcher took the first few minutes of the interview process to explain to the participants their rights in the context of voluntary participation, anonymity, confidentiality, and the right to withdraw from participation without facing any negative consequences. Before the start of the interview and throughout the interview process, permission to use a digital audio recorder was routinely sought from each participant. The use of audio recording helped the researcher capture data that was later transcribed accurately. Importantly, the data were collected in English. Hence, there was no need for translation during the process of transcription. As part of the requirements for a credible research study, the researcher remained neutral on all the questions asked. The researcher also conducted secondary research to ensure a complete understanding of the topic. Regarding the analysis of the collected data, the researcher also requested assistance from multiple people to code and verify the data with more data sources, which gave the researcher confidence that the results were legitimate.

3.7 Data analysis

The qualitative data that were collected for the study were analysed with the aid of SPSS to produce descriptive statistical results about the backgrounds of the participants. The responses to the open-ended textual data were analysed through the process of thematic analysis (Byrne, 2022) to deductively and inductively identify the themes and the sub-themes (Proudfoot, 2022), respectively. The process followed was partly guided by advances offered by Creswell (2005: 185) and Miles and Huberman (1994).

The Atlas.ti software package was used to extract, compare, explore and aggregate the study data and further delineate the relationships among derived themes and emerging sub-themes. According to Hyldegård (2006: 215), Atlas.ti is an effective

systematic approach to sorting chunk or unstructured data that cannot be meaningfully analysed by formal, statistical approaches. The process of the analysis in Atlas.ti started with uploading the transcribed interviews into the software. This was followed by the coding of the documents which required a significant amount of iterative reading of the transcribed data to enable further understanding, synthesising, theorising and constant comparison of the emerging codes. In other words, the uploaded transcripts were intuitively coded. These codes were synthesised and grouped into categories to inductively identify the subthemes. The main themes were deductively generated from the study's research objectives.

3.8 Ethics

The research was conducted within the acceptable prevailing norms and values in scientific research. Permission to conduct the research was sought and granted by the Faculty Research Committee of the University of Western Cape (Appendix B). Correspondence requesting permission to conduct research was sent to the target group to obtain organisational approval.

The researcher initially provided the targeted group with information about the study (Appendix C) while addressing any ethical issues. Before the interviews and focus group discussions, those willing to participate were requested to provide written consent (Appendix D) (Informed consent and voluntary participation).

The responses obtained from the participants are confidential, and none of the participants will be identified by name. The study data are password-protected and only accessible to the researcher. Access was restricted to the public. The transcripts were securely protected and locked in a drawer only accessible to the researcher. The disposal of all the data from the audiotape and transcripts will take place three years after the study's completion.

During the interviews, participants were assured of the confidentiality and anonymity of their responses. There were no risks to either party, the researcher or the participants, and the exercise had a potential advantage for the participants.

Concerning bias, this was drastically minimised by asking and following consistently the same semi-structured questions as a guide for each participant.

3.9 Chapter Summary

This chapter provided the research design and methodology that were used in the study for the collection and analysis of data in this study. The study was based on an interpretivist and constructive approach. Hence, a qualitative method of study was employed in the study. The chapter provided insight into the research paradigm, research design used in the study, population and sampling method used in selecting participants in the study, as well as the method used in data collection and analysis. The following chapter presents the data results and a discussion of the key findings.

CHAPTER 4: RESULTS AND FINDINGS

4.1 Introduction

The research methodology was discussed in the previous chapter. This chapter presents the results that were derived from the data analysis. This study aims to determine the relationship between digital supply chain integration and firm performance in Gauteng and the Western Cape. Whilst the demographic results data are presented using descriptive statistics with the frequencies incorporated into charts and graphs, the textual data results are categorised into themes and sub-themes. Thus, this chapter examines the research's primary findings, the efficacy of the technique used and the supporting literature that surrounds the study's questions and objectives. As a result, the discussion of the findings focuses on the research questions in connection with the data collection methods.

The study's findings are reported in this section. In the study, an interview guide was used. The interview guide comprised sixteen questions presented to the participants. Four questions were asked about the participants' backgrounds, and twelve questions were on the dynamics between the digital supply chain and organisational performance. The results of the data are presented below. The results are divided into three categories: demographic characteristics of the participants, thematic results obtained from textual data and other results.

4.2 Demographic Analysis

This section presents the biographical characteristics of the participants concerning age, gender, position, educational level, job title, department, organisation and industry.

4.2.1 Age

The age distribution of the participants that participated in the study is shown below in Figure 4.1. As shown in Figure 4.1, the findings of the study reveal that a higher percentage (58.3%) of participants were between 30 and 39 years of age, while 25.0% of the participants were between the ages of 40 and 49 years, and 8.33% of the participants were within the respective age groups of 50–59 and 60–69.

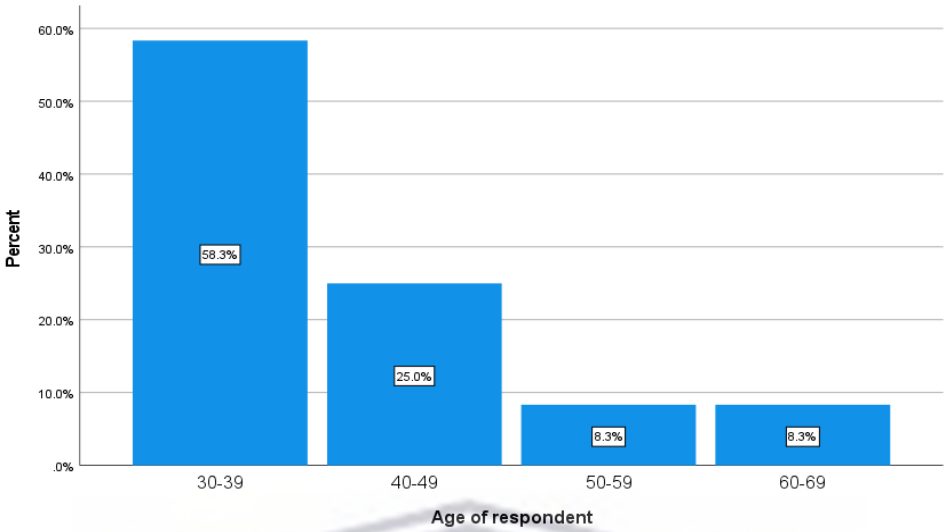

Figure 2: Age distribution of participants

4.2.2 Gender

The pie chart in Figure 4.2 below represents the distribution of gender among participants in the study. Thus, it shows 66.7% and 33.3% of males and females, respectively.

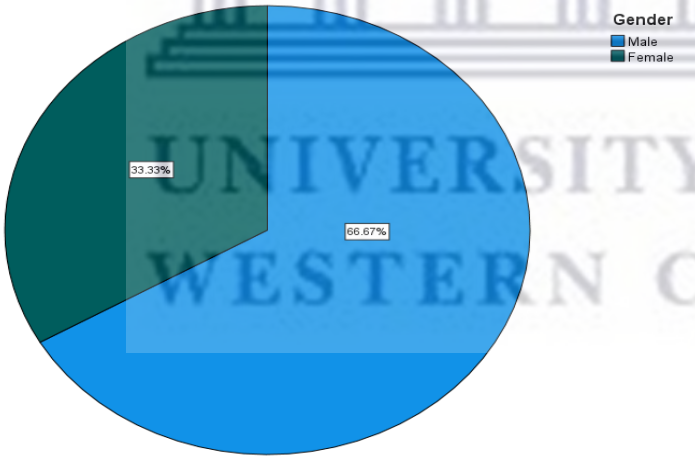

Figure 3: Gender distribution of participants

4.2.3 Educational level

Figure 4.3 displays the educational attainment levels of the participants, where 41.7% of the participants had a postgraduate degree, 33.3% had a bachelor's degree, 8.33% had a diploma and another 16.7% had a grade 12 certificate qualification. The

scholastic attainment of the participants also provides credence to the quality of the obtained data, as the majority of the participants have postgraduate qualifications.

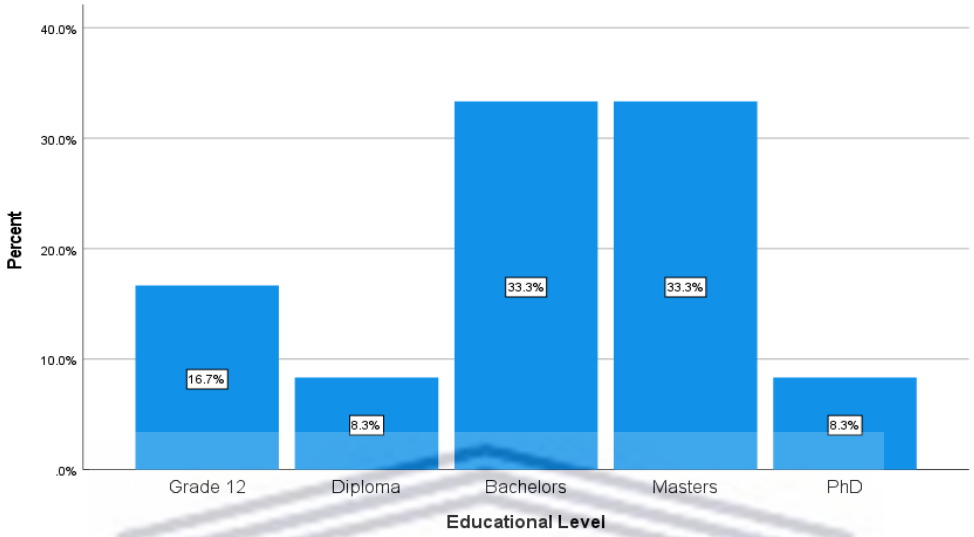

Figure 4: Educational level distribution of participants

4.2.4 Job experience distribution of participants

Figure 4.4 depicts the participants' respective job experiences. Given the figure below, 41.7% of the participants have work experience between 5 and 10 years. While 25% of the participants have work experience between 10 and 15 years, the remaining 33.3% have work experience of over 15 years. From this, it can be deduced that the majority of the participants have adequate experience in supply chain management, which can also be an added advantage in terms of the quality of the data collected for the study.

Figure 5: Job experience distribution of participants

4.2.5 Job Title/position

Figure 4.5 below shows the percentage distribution of positions held by participants in their various organisations. The participants occupy various positions in their organisation, ranging from the director (8.33%), C3PM (8.33%), project manager (8.33%), systems analyst (8.33%), software engineer (8.33%), functional consultant (8.33%), financial officer (8.33%), principal ERP analyst PPM (8.33%), senior manager PMU (8.33%), a specialist in project management (8.33%) and lecturer (8.33%).

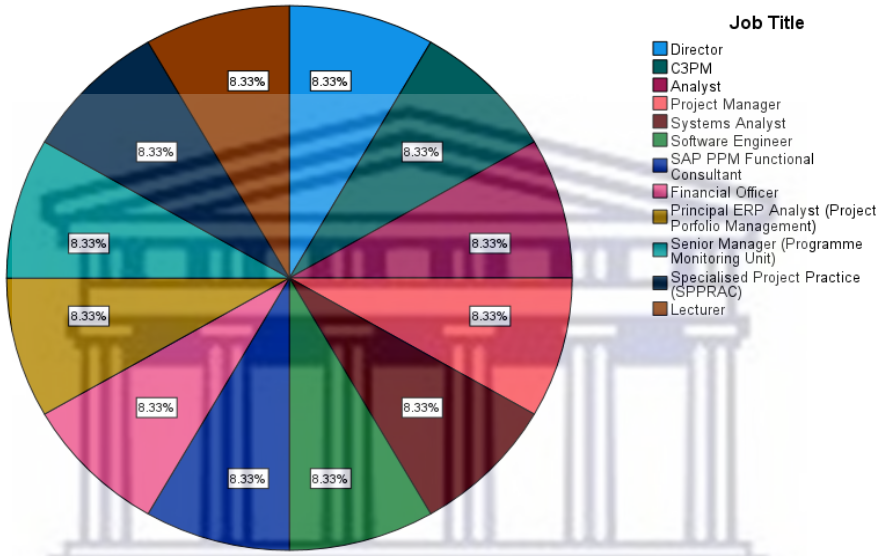

***Figure 6: Job title distribution** of participants*

4.2.6 Department

Figure 4.5 below shows the percentage distribution of departments in the organisations from which the participants were drawn. The participants came from various departments in their organisation, and the majority (41.67%) of the participants were drawn from the IT department. Other departments are consulting (8.33%), clothing and home (8.33%), management (8.33%), finance (8.33%), CAPEX (8.33%) and information systems (8.33%).

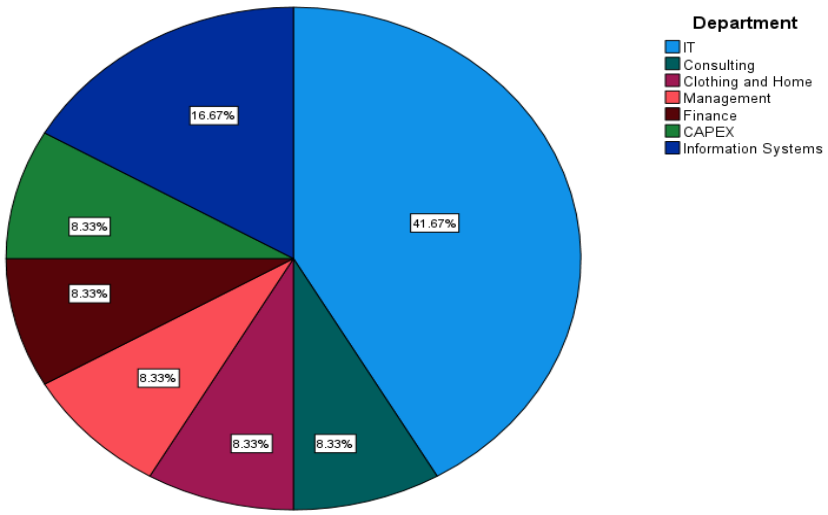

Figure 7: Department of participants distribution

4.2.7 Organisation

Figure 4.7 below shows the percentage distribution of organisations among the participants. The participants represent various organisations. A majority (16.3%) of the participants were from Woolworth. Other organisations are Mitrovic Development and Research Institute (8.33%), the City of Cape Town (8.33%), SPPRAC Consulting (8.33%), Bantubyte (8.33%), Fresh Scope (8.33%), Ntshebo on Point (8.33%), Transnet (8.33%), Johannesburg Water (8.33%), Ideation and Contract Freelancing (8.33%) and the University of Johannesburg (8.33%).

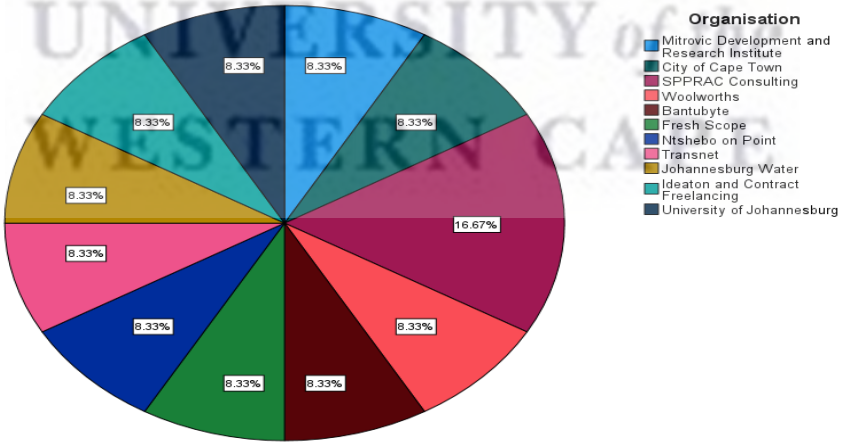

Figure 8: Organisation distribution of participants

4.2.8 Industry

Figure 4.7 below shows the percentage distribution of industries among the participants. The participants were drawn from various industries. A majority (50.0%)

of the participants were from the ICT. Other industries are civil engineering and management (8.33%), management consulting (8.33%), retail (8.33%), finance (8.33%), water and sanitation (8.33%) and education (8.33%).

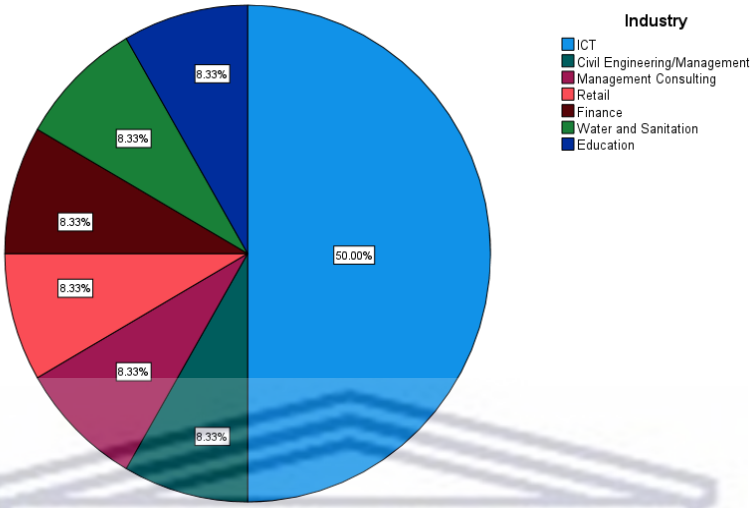

Figure 9: Industry distribution of participants

4.2.9 Location

Figure 4.9 shows the percentage distribution of the participant's respective organisations' locations. Whilst 58.33% of the participants' organisations are in the Western Cape province, 41.67% of the organisations are in the Gauteng province.

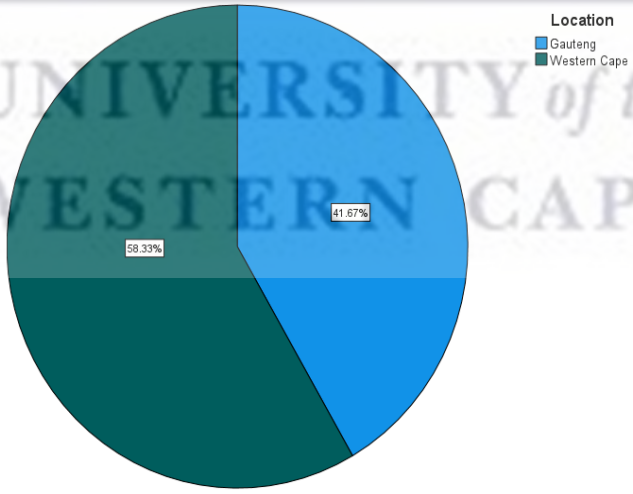

Figure 10: Location of respondent distribution

4.3 Thematic results

As shown in Table 4.2 below, the results emanating from the data were categorised and grouped to inductively emerge the themes (sub-themes) as already discussed in the methodology chapter. The research questions were adapted to generate the main

themes. Therefore, 10 themes and 35 sub-themes were developed. The themes are key properties of digital supply chain integration, digitalization enabling internal and external integration, digitalization enabling process integration, digitalization enabling network integration, the linkage between digital supply chain integration and aggregate firm performance, digital supply chain integration enabling operational excellence and digital supply chain integration enabling financial performance.

Table 2: Emerging themes and sub-themes

Themes	**Sub-themes**	**Research objectives**
Digital supply chain integration key properties	● Automation of the supply chain ● Agile responsiveness ● Digital transformation and smart technologies ● Information availability ● Integrated planning and execution	Objective 1
Digitalization enabling internal integration	• incorporating activities across different functions • Integrated ICT • Information integration to provide real-time information Cloud capabilities • Enhanced collaborations • Flexibility • Enhanced coordination	Objective 2
Digitalization enabling external integration	● Facilitate coordination and improved service to customers	Objective 2
Digitalization enabling process integration	● Improved business processes ● Improved efficiency gain	Objective 2
Digitalization enabling network integration	● Improved relationships between the organisation, customers and employees ● Innovative business ecosystem	Objective 2
The linkage between digital supply chain integration and aggregate firm performance	● Improved customer satisfaction ● Better value creation ● Decreased production cost ● Increased market share	Objective 2

Digital supply chain integration enables Operational Excellence	● Optimise business operations ● Reduced wastes	Objective 2
Digital supply chain integration enabling Financial Performance	● Agile financial approach ● Efficiency gain ● ROI uptrend and downward COP	Objective 3
Digital supply chain integration enables Customer Satisfaction	● Change management ● Improved quality of services	Objective 2
Obstacles in achieving digital supply chain integration	● Inability to adapt ● Lack of change management process ● Lack of required skills ● Lack of trust ● Resistance to change ● Operational risks ● Capital intensive	Objective 2

4.3.1 Theme 1: Digital supply chain integration key properties

The result emanating from the study that relates to the key factors that influence the digital supply chain is categorised into five sub-themes: automation of supply chain processes, agility and responsiveness, digital transformation and smart technologies, information availability and integrated planning and execution. Each of these sub-themes is further discussed below.

Automation of supply chain processes

Participants cited the automation of supply chain activities as one of the supply chain's essential qualities when asked to describe aspects that enable more significant supply chain optimisation. This entails utilising technological solutions to perform or optimise supply processes with minimal human intervention (Helo and Hao, 2022). Automation in the supply chain ensures a constant flow of goods and, hence, increases the efficiency of the process (Magableh, 2021). According to Kumar, Narkhede and Jain (2021), the initial phase of automation began in the 1990s and is now widespread. Academics have highlighted the numerous accrued benefits of supply chain automation. Less expensive purchases, improved manager expertise, faster and more

accurate acquisitions and less paperwork and administrative overhead were highlighted as some of the benefits (Giunipero and Sawchuk, 2000; Deeter-Schmelz et al., 2001; Sternberg, Hofmann and Roeck, 2021).

Due to the simplicity of handling new interactions and the absence of additional human capital inputs, there was also the opportunity to increase the number of clients (Xu et al., 2021). Participants agreed that traditional supply chain practices are not only obsolete but also unproductive and perhaps harmful to any organisation. This assertion can be substantiated by the following quotes from the participants:

"Digital transformation breaks barriers presented by obsolete traditional supply chain processes from marketing, product development, manufacturing and distribution that affect organisational efficiency." [P1]

"In comparison to manual supply chain practices, digital technologies bring more transparency throughout the supply chain network by converting supply chain processes into digital formats and enabling unified process integration, information flow and collaboration among supply chain players." [P5]

Companies may now harness the power of automation in their supply chains thanks to new technology. Participants in the study believe that if supply chain automation is properly implemented, it may save businesses money and time, boost their productivity and position them for future growth. This can be observed in the following statement:

"Digitally enabled supply chain technology enables real-time inventory control, analytics-driven demand forecasting, dynamic inventory fulfilment and point-of-sale powered auto-replenishment, all of which reduce operational costs." [P7]

Agile responsiveness

Agility and responsiveness are the most crucial determinants of future digital transformation success (AlNuaimi, Singh, Ren, Budhwar and Vorobyev, 2022; Rane, Narvel and Bhandarkar, 2020). This sentiment was equally shared by some of the participants in the study. This sentiment can be observed in the following comments:

"The digitalization of the supply chain helps enable network architecture and agility and efficiency are enhanced." [P8]"Organisations need to establish a vision for how digital applications can improve service, cost, agility and inventory levels." [P9]

The term "supply chain agility" refers to an organisation's response to market demands. Simply put, an organisation's level of adaptability rises with rapid transitions and flexibility in responding to customer requests (Naughton *et al.,* 2020). Based on the study's theoretical framework, researchers have claimed that organisations that can adapt fast and keep up with abrupt changes can retain their consistency while others struggle (Wong, Lirn, Yang and Shang 2020; Shou, Zhao, Dai and Xu, 2021). According to Kazancoglu (2022), organisations can provide resilience and sustainability in supply chains if they adopt a flexible, agile and responsive strategy. The study found that modern businesses require agile organisations because they seek to make change a regular part of organisational life to reduce or eliminate the organisation-wide shock that paralyses many businesses attempting to adapt to new markets, environments and technologies. Because change is constant, an agile business can adapt to and capitalise on emerging trends. The agile enterprise perceives itself as an essential part of a broader system whose activities cause a cascading impact of change inside the organisation and a more effective system.

Digital transformation and smart technologies

The study's findings indicate that digital transformation and intelligent technologies are two of the most critical elements of the digital supply chain. This assertion can be substantiated by the following comments emanating from the participants in the study:

“Building your supply chain on digital transformation and smart technologies improves the performance of internal and external relationships in supply chain management”. [P5]

"Supply chain digital transformation helps enable internal integration by incorporating activities across different functions, such as real-time inventory information, production schedules, etc." [P1]

"Digital transformation facilitates the integration of information into supply chain processes." [P8]

The introduction and spread of intelligent technology, such as autonomous automobiles, computers, smartphones and wearable electronic gadgets, have revolutionised every aspect of business, including supply chains. The research conducted by Nasiri, Ukko, Saunila and Rantala (2020) examines how the digital transformation of businesses might drive innovative technologies, resulting in enhanced relationship performance. The study's findings indicate that the digital transformation of organisations cannot increase relationship performance on its own and must be integrated with intelligent technology to achieve this objective. Thus, intelligent technologies fully mediate the connection between digital transformation and relationship performance. According to Strom et al. (2014), the digital transformation of businesses enables them to take advantage of new capabilities, including barcode scanning, location-based services and near-field communication. These behaviours are made possible by intelligent technologies, which consist of a collection of elements embedded into devices that enable intelligence.

Information availability

Data from the study show that one characteristic of digital supply chains is the pervasiveness of information. Digitalisation has significantly altered how individuals engage with their environment, network socially and communicate with one another. The following quotes manifest this assertion:

"Digital technologies enable a seamless flow of information between internal supply chain technologies, creating greater visibility and flexibility that allow organisations to make data-driven decisions across the internal supply chain network." [P1]

"A digitally enabled supply chain brings digital capabilities that close the collaboration gaps with other members of the supply chain, such as suppliers and customers." [P6]

"Closing this gap enhances coordination of resources as well as information sharing to gain supply chain excellence." [P6]

It might be argued that digitalization has altered how individuals engage with their environment and communicate with one another. According to Nasir et al. (2022), smart devices have a spectrum of information that helps revolutionise how we all acquire and share information. It has been argued that better interactions, communication and collaboration are made possible by the digital supply chain, which boosts trust, agility and productivity (Büyüközkan and Göçer, 2018). The studies of Nasiri et al. (2020) maintain that businesses that successfully implement a digital supply chain would have an average cost reduction of 20% and an increase in revenue of 10%.

Integrated planning and execution

According to the study's data, one of the characteristics of the digital supply chain is the integration of planning and execution. The quotes below from the participants can attest to the latter assertion:

"Adopting digital technologies facilitates the strategic alignment of business processes, information sharing and collaboration with suppliers and customers." [P8]

"Adopt technologies that enable integrated planning and execution, logistics visibility, Procurement 4.0, smart warehousing, efficient spare parts management, autonomous and B2C logistics, prescriptive supply chain analytics and smart supply chain enablers." [P5]

However, as with so many other digital transformations, it can be challenging for businesses to decide which technologies to adopt and how to implement them at scale to realise their potential fully. The study has also demonstrated that the complexity of the supply chain would only increase and the following excerpt attest to this:

"There is the obvious problem of knowing what type of technology to adopt to bring better results." [P1]

This result appears to be consistent with how the term "digital supply chain" has been defined by some researchers, including Büyüközkan and Göçer (2018). Scholars have described it as a collection of related activities that are part of supply chain processes between suppliers and customers that are handled by new technologies.

According to Büyüközkan and Göçer (2018), internal and external collaboration is a significant factor in how well businesses succeed in their relationships with one another in the digital supply chain. Digital transformation has provided opportunities and problems for business cooperation activities, such as greater automatisation, data collection, information exchange and networking (Riemer and Schellhammer, 2019; Singh *et al.,* 2018). According to Riemer and Schellhammer (2019), the ability to cooperate and exchange information has created networking arrangements and various virtual organisations thus necessitating a shift in how businesses do their business.

Following the study's findings, integrated planning and execution synchronises all supply and demand plans with supply chain execution processes hence enabling businesses to read consumer demand and sales data and respond accordingly.

4.3.2 Theme 2: Digitalization enabling internal integration

Scholars have argued that internal integration in the supply chain occurs when a company structures its functional departments' practices, methods and behaviours into integrated and synchronised processes to satisfy client expectations. In contrast, scholars have noted that internal integration enhances material flows and ordering procedures and makes translating production demands into purchasing specifications easier (Sternberg *et al.*, 2021). Given the results emanating from this study as they relate to the enabling internal capability of digitalization, seven sub-themes were intuitively generated from qualitative data. These sub-themes are: incorporating activities across different functions, integration of ICT, information integration to provide real-time information, cloud capabilities, enhanced collaboration, flexibility, and enhanced coordination. Each of these sub-themes is presented and discussed below.

Incorporating activities across different functions

The digital supply chain's business objective is the fastest possible delivery of the correct product to the consumer (Bovet and Martha, 2000; Attaran, 2020). However, this delivery must also be reliable and responsive, with automation boosting efficiency and saving costs. This objective cannot be met without a completely integrated supply

chain that runs through a central cloud-based command centre and seamlessly connects suppliers, manufacturing, transportation, warehousing and customers.

"Supply chain digital transformation helps enable internal integration by incorporating activities across different functions, such as real-time inventory information, production schedules, etc." [P1]

Integration of ICT

The supply chain, however, eventually dissipates into a dynamic, integrated supply network as each supply node gets more powerful and connected (Banerjee, 2019; Sathiya, Nagalakshmi, Jeevamalar, Babu, Karthi, Acevedo-Duque and Ramabalan, 2023). By utilising real-time data, DSNs get beyond the linear supply chain's delayed action-reaction cycle by making better-informed, transparent and collaborative decisions across the supply network.

As previously noted, emerging technologies (Industry 4.0, blockchain, AI, IoT, etc.) are necessary to manage Global Supply Chain (GSC) disruptions during the Covid-19 pandemic. All GSC stages are integrated with AI, IoT and other technologies thanks to Industry 4.0. By enhancing traceability, automation and visibility, these cutting-edge technologies offer GSCs that are more resilient and sustainable against interruptions (Rejeb, Suhaiza, Rejeb, Seuring and Treiblmaier, 2022). This increases flexibility and agility in sustainable GSCs during the Covid-19 pandemic as these emerging technologies were integrated into businesses' GSC operations. Drawing from this study's findings, the participants believed that a digitally-enabled supply chain enables the integration of ICT to promote integrated supply networks to make stakeholders in the supply chain more powerful and connected. This assertion is buttressed with the following comments from the participants:

"Using digital technological capabilities that harness the seamless exchange of information between the supply chain and communication systems of all stakeholders." [P4]

"Using digital technological capabilities that harness the seamless exchange of information between the supply chain and communication systems of all

stakeholders, and this exchange permeates all the key processes of planning, execution and completion of transport and logistics operations." [P9]

Information integration to provide real-time information

The study found that information digitalization and the use of cutting-edge new technology offer the chance to increase corporate value along the whole supply chain. This statement can be substantiated by the quote below from one of the interview participants in the study:

"*Real-time data updates and information available that underpins integrated planning across the supply chain bringing the ability to identify potential problems and predicting their consequences shared and up-to-date quality and control data in the sourcing, procurement, conversion, inventory management and logistics management activities." [P8]*

Arguably, improved collaboration has considerable promise in addressing problems that may prevent stakeholders in the digital supply chain from effectively sharing their strategic resources in actions and information. The study by Chan and Reich (2007) argues that effective organisations are frequently distinguished from less successful ones by the level or degree of alignment between IT capabilities and business strategy (Fragapane *et al.*, 2020; Ivanov *et al.,* 2020). Therefore, real-time data integration connects various programmes and databases so that when data in one system changes, it updates simultaneously in the other systems.

Cloud capabilities

As revealed in the study, it is now possible for businesses to communicate fully and swiftly with supply chain stakeholders thanks to a range of corporate networks and collaborative cloud-based platforms that operate similarly to social networks. These platforms are already far more sophisticated than early trading networks like SAP's Ariba, which concentrated on balancing supply and demand for certain commodities. All the participants in the network can communicate about demand, stocks, manufacturing capacity and logistics capacity and provide input in close to real-time on changes like potential supply chain bottlenecks after a demand rise. These claims can be attested by the following comment from one of the participants:

"The conversion of supply chain processes into digital technologies such as cloud computing, big data, blockchain, IoT, etc., improves visibility and decision-making and thus creates a new platform for optimisation that enhances responsiveness, agility and transparency throughout the network." [P7]

Cloud-based capabilities can offer a centralised platform that can be accessed from anywhere, at any time and by any (authorised) collaborator over the internet. Bonamigo and Frech, 2021 and Sandu and Gide (2019) argue that cloud solutions are frequently touted as having several benefits for various parties, including:

- The lowering of upfront costs SME organisations can save money using cloud-based capabilities since they do not have to own the servers and storage that create the computing power and require payment.

- With simple, universal access via the internet with the help of cloud-based computing capabilities, businesses now have more chances to advance virtual collaborative alliances, removing geographical constraints and fostering dynamic and ongoing collaboration that creates globally diversified commercial value.

Enhanced collaborations

The findings from the study reveal yet another important benefit of blockchain adoption, as it tends to enhance collaboration between organisations in the supply chain. As argued by Rangaswamy, Moch, Felten, Van Bruggen, Wieringa and Wirtz (2020), traditional strategies emphasise lowering transaction costs or boosting productivity. However, they do not account for the advantages of happy end users (Ibid).

Blockchain promotes the emergence of an integrated community, enabling a wide range of stakeholders, including suppliers, partners, customers, commodities and assets, to work together and share data and information. Scholars have argued that supply chain links are becoming more collaborative due to their ability to remove uncertainty (Golan, Jernegan and Linkov, 2020; Kalyar, Shafique and Ahmad, 2020). Collaboration appears to be one of the most critical aspects of an agile supply chain

network (Centobelli, Cerchione and Ertz, 2020). However, researchers have noted that attempts to collaborate between organisations are not always successful (Annosi, Brunetta, Bimbo and Kostoula, 2021).

Flexibility

The concept of flexibility refers to the ability of a supply chain to be adaptable, responsive and modified to satisfy shifting consumer demands (Delic and Eyers, 2020). The idea of flexibility emerges from the need to lessen the negative consequences of uncertainty and hazards in GSCs (Can Saglam, Yildiz Çankaya and Sezen, 2021). According to Kazancoglu (2022), the global supply chain's flexibility makes it simpler to come up with fresh approaches to maintain resilience and sustainability in the face of occurrences like Covid-19 (Sriyanto *et al.,* 2021). As part of the findings emanating from this study, such technological advancements as blockchain adoption could reduce the challenges businesses will face due to unexpected interruptions because they boost a GSC's flexibility (Anser *et al.,* 2020).

Enhanced coordination

The workflow can be precisely modelled to incorporate all collaborative activities and offer quick, accurate information regarding when finalised products will be delivered to clients.

The study reveals that the focus of supply chain strategies is on enhancing and innovating the procedures that connect businesses with their consumers and suppliers The following statement from one of the participants can attest to this assertion:

"Using digital capabilities to structure organisational practices, procedures and behaviours into collaborative, synchronised and manageable processes will enable the coordination, collaboration and integration of logistics with other functional areas." [P10]

These descriptions imply that improved supply chain coordination necessitates information sharing among partners and the creation of globally optimal plans (Ho *et al.,* 2002) thus taking advantage of resource visibility to optimise the staging and flow of materials (Lee, 2000).

4.3.3 Theme 3: Digitalization enabling external integration

Given the context of digitalization enabling external integration, the following sub-theme emerged from the study.

Facilitate coordinated and improved service to customers

In this context, the study's findings corroborate the study done by Zhang and Huo (2013) that asserts that information integration with suppliers allows a firm to gain knowledge from suppliers, such as production scheduling, planning and inventory levels, which aids the firm in streamlining inter-organisational procedures.

"Gaining efficiency by adopting digital technologies could convert processes into digital formats, which fuels optimisation that enhances efficiency, productivity, profitability and customer satisfaction." [P8]

4.3.4 Theme 4: Digitalization enabling process integration

This section of the study presents data results as it relates to how digitalization tends to enhance process integration. The emerged sub-themes are presented below.

Improved services to external customers

According to Zhao (2013), financial and market factors can evaluate a firm's relationships with suppliers, internal operations and all external and internal activities. Direct interactions and regular information sharing increase supply chain visibility and transparency, lowering unpredictability during integration and enabling measurement and control procedures in long-term supply networks (Ahmed, Kalsoom, Ramzan, Pervez, Azmat, Zeb and Ur Rehman, 2021; Omar, Jayaraman, Debe, Hasan, Salah and Omar, 2021; Roh *et al*., 2022 This study found that digital information also facilitates coordination, improves services to external customers and synchronises organisational capabilities. With digital external integration, supply chain members can form collaborations and external partnerships (collaborating more extensively with start-ups, partners and competitors). These assertions can be attested by the quote below:

"Gaining efficiency by adopting digital technologies could convert processes into digital formats, which fuels optimisation that enhances efficiency, productivity, profitability and customer satisfaction." [P8]

Indeed, the supply chain is the business of many businesses. It extends the vertical integration of all organisational processes to the horizontal dimension, tying together essential parties such as suppliers of raw materials and components, the production process itself, warehouses and distributors of finished goods and ultimately the client.

Improved business processes

One of the study's key findings concerning the process integration capabilities of digitally enabled supply chains corroborates with the findings of Frohlich and Westbrook (2001) and Gajšek and Sternad (2020), who demonstrated that process integration with suppliers can synchronise processes across a supply chain to incorporate suppliers into a company's internal operations. This integration offers opportunities to improve transactional efficiencies, solve problems and identify new product ideas by involving suppliers in product development, production planning and project teams to shorten production lead times and accelerate the introduction and delivery of new products (Alsharari, 2021; Vaska, Massaro, Bagarotto and Dal Mas, 2021). This claim resonates with the following quote from the study's interview:

"Gaining efficiency by adopting digital technologies could convert processes into digital formats, which fuels optimisation that enhances efficiency, productivity, profitability and customer satisfaction." [P8]

Improved efficiency gain

The study found that when business processes and procedures are integrated and run as a cohesive unit, every aspect of the supply chain is simplified, including the acquisition of raw materials and components, inventory and storage, shipping and logistics and value-added support, thus reducing unnecessary, repeated efforts and expenses. When inefficiencies are minimised, companies are better positioned to improve their service quality while focusing on capital-generating upgrades and assets.

"Gaining efficiency by adopting digital technologies could convert processes into digital formats, which fuels optimisation that enhances efficiency, productivity, profitability and customer satisfaction." [P8]

4.3.5 Theme 5: Digitalization enabling network integration

This section of the study presents results regarding the enablement of network integration through digitalization. The two emerged sub-themes are presented below

Improved relationship between organisations' stakeholders

The data from the study reveals that digital supply chain provides organisation the leverage of shared information and assets with both internal and external stakeholders in ways that were previously off-limits. In this context, the study tends to corroborate with the study done by Nasiri, Ukko, Saunila and Rantala (2020) which describes digital supply chain as a bundle of interconnected activities powered by emerging technologies, involved in supply chain processes between different stakeholders. Moreover, Singh and Hess (2017) argues that digital technologies enable interaction across borders with suppliers, customers and competitors. This can create a momentum for organisation to attain a competitive advantage by transforming organisation to leverage existing core competencies or possibly develop nouvel ones (Liu et al., 2011)

Innovative business ecosystem

The emergence of an innovative ecosystem through the digital supply chain was revealed in the study. Shcherbakov and Silkina (2021) describe the business ecosystem as a network structure without borders. It provides a platform for achieving synergy among multilevel stakeholders through interactions among interested parties in an open environment. Multilevel stakeholders in an ecosystem could include suppliers, manufacturers, competitors, market intermediaries, and other interested parties. As argued by Shcherbakov and Silkina (2021), today's business is increasingly shifting from being an individual effort to a collective effort. Put differently, the overarching principle of an ecosystem is interconnection. Through interconnection, the stakeholders in the ecosystem stand to increase their chances of survival through connections with the rest of the ecosystem, while at the same time increasing the

number of associated entities with the ecosystem. The ecosystem provides leeway for members to align their interests and play a mutually supportive role in achieving a shared vision.

4.3.6 Theme 6: Linkage between digital supply chain integration and aggregate firm performance

The findings from the study reveal the linkage between digital supply chain integration and aggregate firm performance. In this context, the following sub-themes emerged: Improved customer satisfaction for both customers and employees is an innovative form of cooperation between companies. These sub-themes are discussed below.

Improved customer satisfaction

The study found that organisations frequently prioritise their operations, and the products they produce or supply over the satisfaction of their customers. The study found that organisations tend to achieve efficiency gains aimed at optimising customer satisfaction through digital integration of their processes and procedures. Below is a quote from one of the participants:

"Gaining efficiency by adopting digital technologies could convert processes into digital formats, which fuels optimisation that enhances efficiency, productivity, profitability and customer satisfaction." [P8]

Businesses can see the benefits of teaming up and collaborating to obtain the maximum potential value delivered to the final consumer by looking at a supply chain network, which helps them better understand the entire flow of materials or information from beginning to end. Businesses are digitising their processes to enhance process effectiveness and cost optimisation (Shivajee *et al.,* 2019). According to Singh et al. (2019), the efficient use of information technology (IT) tools ensures the long-term success of enterprises. Supply chain networks give us a comprehensive picture of the flow of information and resources thus allowing the organisation to see the big picture.

Better value creation

The study reveals that digital supply chain integration can improve aggregate firm performance through better value creation. This assertion can be observed in the following quotes:

"These digital technologies enhance the performance of the end-to-end value chain through improved visibility into supply chain performance, process automation, improved innovation that reduces costs, advanced analytics and improved supply chain planning." [P3]

"Supply chain digital capabilities close the collaboration gaps with other members of the supply chain, such as suppliers and customers. Closing this gap enhances coordination of resources as well as information sharing to gain supply chain excellence." [P9]

"Successful companies build their internal value chain upon process integration through digital capabilities." [P10]

It was articulately discussed in the theoretical framework of the study that integrating supply chain operations with suppliers and consumers allows businesses to streamline and enhance data and knowledge sharing, potentially improving material and product flows across the supply chain (Chienwattanasook and Jermsittiparsert, 2018). Digital supply chain capabilities enable the warehouse, distribution centre, storefront and e-commerce portals to connect to ascertain that all points can exchange information and re-route orders. This ensures that customers have what they want at any location and at any time (LaBombard *et al.,* 2019).

Decreased production cost

Given the findings of this study, one of the benefits of supply chain integration for businesses is the possibility of decreased production costs, which could boost returns on investment. This finding seems to corroborate the study of Singh and Jayraman (2017). The latter argue that efficiency improvements occur through practices that cut down on production and manufacturing costs and seamless integration of systems across channel partners. This claim can be attested by the following quote from the study's interview:

“The digital integration of organisational processes and procedures improves product quality while lowering production costs, resulting in higher value and, thus, higher customer satisfaction.” [P9]

“Helping firms identify and eliminate the activities that do not add value to the whole supply chain.” [P10]

Increased market share

As revealed in the study, seamless digital supply chain integration could benefit organisations through increased market share. As previously discussed in the study, digital supply chain integration can streamline and enhance data and knowledge sharing, which could potentially improve material and product flow across the supply chain (Chienwattanasook and Jermsittiparsert, 2018). This ensures that customers have what they want at any location and at any time (LaBombard *et al.,* 2019). Organisations can leverage the latter to increase their market share. These above assertions are reflected in the following comment made by one of the participants:

"Increased market share and return on investments, lower total costs duplicated activities within the firm." [P6]

4.3.7 Theme 7: Digital supply chain integration enables operational excellence

In this context, the study reveals that organisations can optimise their operations, minimise waste, improve competitiveness and financial performance, gain efficiency and enhance customer satisfaction through supply chain integration.

Optimise business operations

The study reveals that organisations can optimise their business operations through supply chain integration to achieve operational excellence. Operational excellence (OE) is a phrase that has been used frequently over recent years, although its exact definition is still unclear. Businesses are digitising their processes to enhance process effectiveness and cost optimisation (Luz Tortorella *et al.,* 2019), and the efficient use of information technology (IT) tools ensures the long-term success of enterprises. The scope of operational excellence goes beyond the conventional event-based

improvement paradigm to include a sustained shift in company culture. Arguably, integrated performance across revenue, cost and risk is another indicator of operational excellence (Gólcher-Barguil, Nadeem and Garza-Reyes, 2019), which focuses on exceeding customer expectations by continually improving operational procedures and organisational culture (Burton and Pennotti, 2003).

"Through digitalization, we can reduce waste, control costs and optimise business processes." [P4]

Reduces waste

The study also revealed that integrating the supply chain will significantly minimise waste in various areas. For example, better route management will save warehouse space for the organisation. This will also help the organisation reach its environmental goals by reducing emissions. Trucks will be filled on every leg of the journey, optimising efficiency and guaranteeing that no empty trucks are driving around. This implies that one will be more efficient and save money. The following quotes from the participants' testimonies to this thinking:

"Adopting a digitally-enabled supply chain is a flexible approach because it helps manage cash flow and eliminate waste." [P7]

Through digitalization, we can reduce waste, control costs and optimise business processes." [P4]

4.3.8 Theme 8: Digital supply chain integration enabling financial performance

The key findings from the study were grouped into the following sub-themes:

Agile financial approach

The study reveals the benefit of an agile financial approach as an essential by-product of supply chain integration.

A digital supply chain (DSC) is a higher-order dynamic capacity that can provide value by making impromptu issue solutions more efficient (Bingham and Eisenhardt, 2011). Although implementing a digital supply chain calls for dedication and significant organisational adjustments (Jain, Benyoucef and Deshmukh, 2008), and doing so

helps businesses respond to demand-driven changes rapidly and efficiently, thereby improving competitiveness and financial performance (Gligor, Esmark and Holcomb, 2015). Al-Shboul (2017) asserts that a firm's market and financial performance are enhanced by its capacity to increase the rate of product customisation, enhance delivery performance and cut development and delivery timeframes. Evidence from the study substantiates this for example:

"We have seen a great deal of versatility in our operations regarding our responses to demand-driven changes through an agile financial approach." [P5]

Efficiency gain

Digitalization, on the other hand, gives businesses across all industries the chance to improve their processes and come up with new, profitable business models (Rachinger *et al.,* 2018). The findings of this study seem to collaborate with the work of the latter scholar as it concerns the concept of efficiency gain as a by-product of supply chain integration. Solis (2019) asserts that digital technologies shape client expectations. The same tools that enable them to research and shop differently also enable markets to transform marketing into a business growth engine. According to a McKinsey and Company report (Catlin, 2016), organisations that utilise digital technologies outperform their competitors. Some scholars (Arora, 2018; Gezgin *et al.,* 2017; Kersten *et al.,* 2017) suggest that digital solutions can help reinvent procedures, increase quality and promote consistency. Using digital methods to increase revenue has a major impact on ROI (Astill, Dara, Campbell, Farber, Fraser, Sharif and Yada, 2019). Responses substantiated this for example:

"By improving the supply chain, it is possible to maintain lower inventories, resulting in lower working capital and faster time to market for goods." [P5]

"Using digital technologies to increase manufacturing throughput and quality and minimise the number of breakdowns." [P6]

"The internal and process dimensions of integration had a positive effect on operational performance and financial performance." [P7]

ROI uptrend and downward COP

The findings of this study have shown that organisations that have embraced supply chain integration can witness an uptrend in returns on investment and a downward trend in production costs. Given the efficiency gained from a seamless integration of organisational processes and procedures internally and externally, there is bound to be a reduction in production costs and efficient use of capital aimed at boosting the organisation's returns on investment. As discussed in the theoretical framework of the study, research has established that more significant degrees of supply chain integration (SCI) generally correlate with higher levels of financial performance (Droge et al., 2004; Frohlich and Westbrook, 2001). SCI at any level benefits a firm's financial health. Businesses with complete supply chain integration demonstrated the best financial success. Below is a quote from one of the participants:

"By bringing in a versatility which not only allows one to maximise ROI but also lower the cost of production and minimise misspending." [P2]

4.3.9 Theme 9: Digital supply chain integration enables customer satisfaction

This section of the study presents the themes on digital supply regarding towards customers' satisfaction. Two sub-themes were generated as presented describing how the adoption of digital supply chain can enforce change management that enhances transactional relationship between the business and its customers, and improved quality services that satisfies customer expectations while lowering the administrative strain.

Change management

The study has shown that the adoption of a digital supply chain by organisations could result in an inevitable change in management in such organisations aimed at boosting the transactional relationship between the business and its customers. Frequent and effective communication should characterise the connection, resulting in efficient customer service, increased brand recognition and customer loyalty and a high customer retention rate.

As businesses expand, it becomes vital to engage with a rising number of clients, particularly those whose administrative and digital operations are optimised and made

more reliable by centralised structures. Thus, the digital supply chain is becoming increasingly vital to usher in customer satisfaction. This can be deduced from the quote below:

“Digitising and improving business processes and reacting to changes in an agile way – more and more companies are facing respective challenges.” [P9]

Improved quality of services

As seen in the study, the digital supply chain tends to satisfy customer expectations, particularly for large organisations organised in central offices, while lowering the administrative strain. As a result, businesses may now considerably enhance the quality of customer service through increased timeliness, precision and dependability. According to the OECD (2017), data flows also support digitally enabled goods and services commerce and trade facilitation and enterprises' ability to organise production globally via global value chains. The above assertion can be observed in the following comment:

"By improving communication between the firm’s employees and external partners, resulting in higher quality and more informed decision making." [P1]

4.3.10 Theme 10: Obstacles/constraints/challenges

The study's findings highlight a variety of limitations. The limitations were categorised and aggregated to produce the ten sub-themes listed below: inability to adapt, a lack of change management process, a lack of customer engagement, a lack of business integration, a lack of required skills, a lack of supplier and logistics partner engagement, a lack of supply chain visibility, a lack of trust, a lack of understanding, resistance to change and technical constraints. Below is a presentation and explanation of the numerous sub-themes.

Inability to adapt

The incapacity of organisations to adapt to the unique terrain of the digital supply chain, as evidenced by the study's data, was cited by the majority of interviewees as one of the most significant obstacles. The integration of blockchain technology in the

supply chain necessitates modifications to the organisation's current operations and procedures. According to the participants, adjusting to these changes is challenging for their organisation.

Lack of change management process

Some participants cited the absence of a change management process as a limitation. As stated previously, while most participants cited an inability to adapt to changing processes and procedures, some lamented the absence of a change management procedure. To be effective in an organisation, adopting innovative technologies necessitates managerial change. To digitalise effectively, well-defined change management trajectories are essential (van Oorschot, 2021), hence the following sentiment:

"This is where marketing comes in, "meaning understanding the customers and who they are. The human factor should never be taken for granted." However, change management may be the key to getting this right." [P5]

Lack of required skills

Competency requirements are described as "skill demands that the employee has to obtain to complete the job description" by Rintala and Suolanen 2005, p. 55) in their study on the consequences of digitalisation for job descriptions, competencies and quality of working life. The requirement for social and creative intelligence, innovative capacity, cooperation and problem-solving capacity, is highlighted in PwC's 2018 analysis of the essential competencies and capabilities for digitalisation. While specific information is still required, social and creative intelligence appears to be more critical. This sentiment of a lack of skills was shared by the participants in the study as reflected in the comment below:

"Lack of required skills in the organisation. By clearly defining your vision, then training and upskilling your employees within the company." [P8]

Lack of trust

Many participants raised the possibility of robotics having an impact, and they anticipate that robotics will significantly impact the labour market and, consequently,

temporary agencies. Low-skilled, physically demanding and repetitious jobs are among those that robots may eventually replace humans. It is also anticipated to involve robotic process automation, which enables robots to take over back-office tasks.

Participants raised concerns about privacy dangers concerning blockchain and artificial intelligence. Regulations, such as the general data protection rule (GDPR), are fraught with uncertainty in the context of artificial intelligence (AI). Blockchain is viewed as having a more favourable impact on privacy. The ability to control one's data and the technology's compatibility with the European GDPR is believed to grant data ownership to anyone. Several business executives from the industry mentioned the possibility of bias. Therefore, it was added to the final template. Because they deal with humans, temporary agencies are prone to bias. Participants draw a connection between this and AI, stressing the importance of ensuring AI systems are promoted because of their impartiality. The above assertion can be buttressed with the following quotes from the participants in the study's interview:

"Uncertainty among employees and supply chain partners about the system's impact on privacy." [P8]

"There is a lack of education and training to reskill employees, and this makes them apprehensive of smart technologies, AI, and robotics applications regarding their impact on the labour market." [P2]

Resistance to change

In their study, Duerr et al. (2018) highlighted the influence of organisational culture on a company's efforts to adopt digitalisation, even referring to organisational culture as a barrier. The same study also found a set of attitudes and characteristics that successful digitalising businesses hold, including a start-up mindset, an acceptance of failure, employees who embrace digital abilities and shared decision-making (at lower levels in the firm).

On the board in the future, the Chief Information Officer (CIO) is essential since they will be in charge of developing and implementing the digital company strategy. CEOs and other C-level executives, specifically CIOs, "are dedicating more of their attention and are more intimately involved in digital efforts now than ever before" (Gottlieb and

Willmott, 2014, p. 2). Additionally, Cortellazzo et al. (2019) defined several talents, such as high-speed decision-making, managing disruptive change and managing connectedness that characterise leaders in the digital era. More information about the evolving roles and demands of leaders is provided by Lees (2019).

According to Rintala and Suolanen (2005), employees who are learning to use new technology are also more likely to experience stress. In particular, needing to learn and satisfy new competency standards caused anxiety and panic.

"Implementing proper well-defined change management processes is essential in curbing resistance to change and enhancing the transition to gigital environment."[P5]

Operational risks

Scholars have highlighted operational disturbances, tactical disruptions and strategic uncertainty from a business management perspective (Pandey, Singh, Gunasekaran and Kaushik, 2020; Shishodia, Sharma, Rajesh and Munim, 2021). Operational risk, internal risk, network risk and external risk, notably cybersecurity risk, have been identified in this study as some of the difficulties of the digital supply chain. Significant dangers are associated with the technologies used to digitise the supply chain, notably cybersecurity. Due to its interconnectedness and diversity, a digital supply chain exposes any organisation to supply chain threats. For instance, sensors and devices are interconnected on the Internet of Things. A danger at one device could swiftly propagate throughout the entire network due to the increased connection. Similarly, data corruption can happen at any stage of the supply chain, resulting in poor performance, delays or errors. Because of various factors, including software bugs and JGOSS vulnerabilities discovered in any supply chain partner through information exchange, cyberattacks may impact the systems of other SC partners (Woods, 2018). Many of the participants in the study's interviews shared this sentiment, as can be noticed from the quotes below:

"We have experienced several times our system being corrupted and getting down and this makes us always be apprehensive of cyberattacks." [P6]

"Our worries with this type of system is that any cyber attacks on one device can be spread to the others, thereby easily corrupting the system." [P4]

Capital intensive

Lastly, the study found that another problem of digitising the supply chain is that it involves a lot of capital expenditure. The biggest benefits are obtained when the entire supply chain is digitally optimised. However, not every company in the ecosystem may be able to afford these capital inputs. This assertion can be inferred from the quote below made by one of the participants:

"A large amount of capital is required for organisations to operate digitally enabled supply." [P8]

4.4 Chapter Summary

The chapter has provided and discussed the findings of the data analysis employed in this study. The results were organised into four key areas, including the demographic characteristics of the participants and the thematic analysis results of the study. Given the objectives of the study, the ten themes and their corresponding sub-themes were presented and discussed. The following chapter contains the conclusions and recommendations.

CHAPTER 5: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This last chapter contains conclusions and suggestions for future research. The discussions in the previous chapter and the observations on the ground facilitated these conclusions and recommendations. This study examined the correlation between digital supply chain integration and company performance in Gauteng and the Western Cape. In this chapter, the researcher concludes and makes recommendations based on the findings, opinions and statements of employees regarding the relationship between digital supply chain integration and firm performance. In addition, the suggestions of this study are based on the research questions and objectives of the study, which seek to grasp the dynamics of digital supply chain integration to enhance business performance.

5.2 Research question and objectives

The study investigates the linkage of supply chain integration, firm operational excellence, customer service and firm performance in organisations in the Western Cape and Gauteng and will, therefore, seek to answer the following primary research question.

> What is the relationship between digital supply chain integration and firm performance?

To support answering the main research question, the main objective is to conduct a literature review to identify key properties that influence digital supply chain integration.

- To conduct a literature review to identify key properties that influence digital supply chain integration.
- To develop a conceptual framework depicting the relationships between supply chain integration and firm performance.
- To apply a qualitative research design to establish how digital supply chain integration can enable firm performance gains.

- To analyse findings to identify the impact of digital supply chain integration on a firm's performance.

5.3 Relating findings to research objective one

The first objective was to conduct a literature review to identify key properties that influence digital supply chain integration. Several relevant contemporary articles on digital supply chain integration were reviewed to provide a theoretical base for the study. This was done to assist the researcher to gain familiarity with the current knowledge in digital supply chain, as well as boundaries and limitations of that digital supply chain integration. The literature review rigorously and systematically carried out to provides a description, summary that enabled the researcher to identify the key properties that influence digital supply chain integration. These properties are discussed below.

5.3.1 Automation of supply chain processes

This entails utilising technological solutions to perform or optimise supply processes with minimal human intervention. Automation in the supply chain ensures a constant flow of goods and, hence, increases the efficiency of the process. The study revealed that manual supply chain practices are not only obsolete but also unproductive and perhaps harmful to any organisation. Companies may now harness the power of automation in their supply chains thanks to new technology. The study has demonstrated that if supply chain automation is properly implemented, it may save businesses money and time, boost their productivity and position them for future growth.

5.3.2 Agile responsiveness

Agility and responsiveness are the most crucial determinants of future digital transformation success. Organisations must be adaptable and responsive to remain in the sweet spot of what digital technology can provide for a business. The study found that modern businesses require agile organisations because they seek to make change a regular part of organisational life to reduce or eliminate the organisation-wide shock that paralyses many businesses attempting to adapt to new markets, environments and technologies. Because change is constant, an agile business can adapt to and capitalise on emerging trends. The agile enterprise seeks to perceive

itself as an essential part of a broader system whose activities cause a cascading impact on change inside the organisation and a more effective system.

5.3.3 Digital transformation and smart technologies

The study's findings indicate that digital transformation and intelligent technologies are two of the most critical elements of the digital supply chain. The introduction and spread of intelligent technology, such as autonomous automobiles, computers, smartphones and wearable electronic gadgets, have revolutionised every aspect of business, including supply chains.

Information availability

Data from the study show that one characteristic of digital supply chains is the pervasiveness of information. Digitalisation has significantly altered how individuals engage with their environment, network socially and communicate with one another. It might be argued that digitalization has altered how individuals engage with their environment and communicate with one another. Smart devices have a spectrum of information that helps revolutionise how we all acquire and share information.

Integrated planning and execution

According to the study's key findings, one of the characteristics of the digital supply chain is integrated planning and execution. However, as with so many other digital transformations, it can be challenging for businesses to decide which technologies to adopt and how to implement them at scale to realise their full potential. The study has also demonstrated that the complexity of the supply chain would only increase. Following the study's findings, integrated planning and execution synchronise all supply and demand plans with supply chain execution processes, enabling businesses to read consumer demand and sales data and respond accordingly.

5.4 Relating findings to research objective two

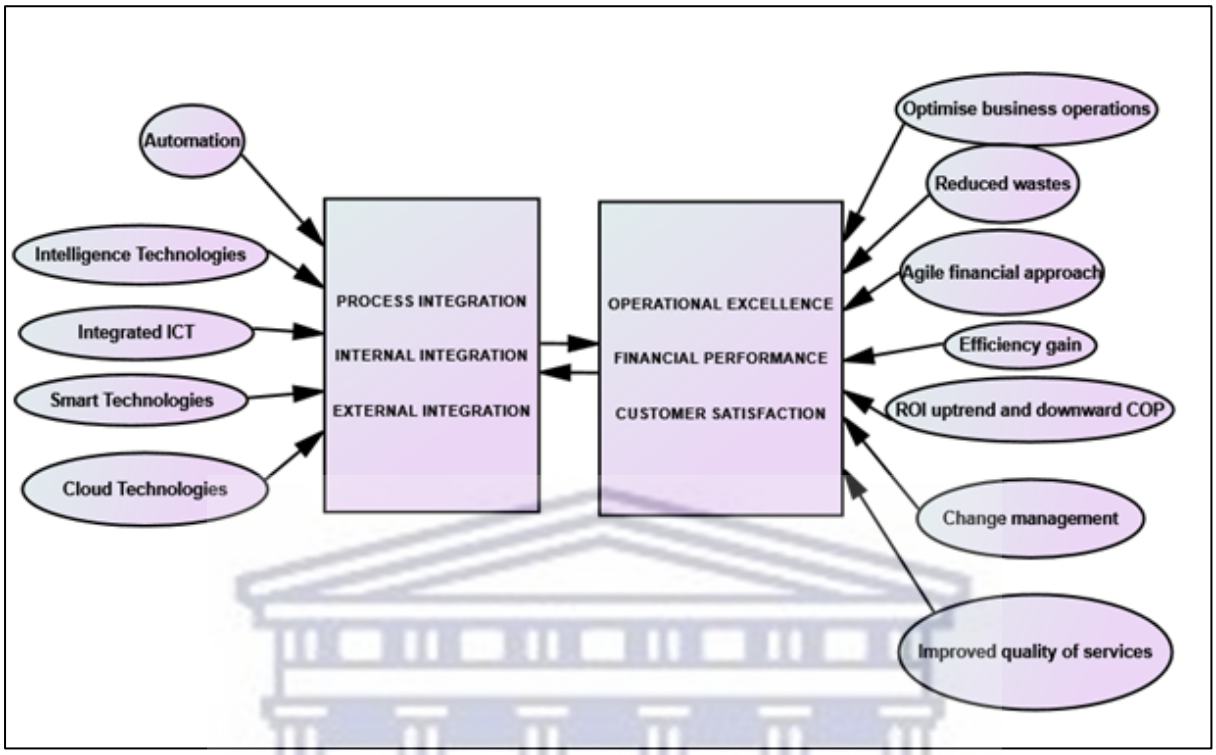

Figure 11: Updated Conceptual Framework

The data from the study has been synthesised to evolve a conceptual framework. The conceptual framework is based on the opinions and experiences of the study participants. Based on the framework, the study has established three fundamental factors of supply chain integration that are capable of provoking firm performance. The three factors are process integration, internal integration and external integration.

As revealed in the study, the three factors are underpinned and characterised by four main actors, namely, automation, intelligence technology, integrated ICT, smart technology and cloud technologies. As mentioned, the dynamics and interplay of these three factors influence the performance through a firm's operational excellence, financial performance and customer satisfaction. As also revealed in the study, the perceived enhanced firm performance will be manifested in seven folds, namely, optimised business operations, reduced wastes, agile financial approach, efficiency gain, ROI uptrends and downward COP, change management and improved level of services. Interestingly, a kind of iterative process in the sense that the performance

gains from the digital integration can be fed back to enhance the integration process. Each of these factors are briefly explained below.

5.4.1 Automation

Supply chain automation is using current technologies to automate historically manual operations to optimise supply processes with minimal human intervention aimed at boosting productivity. The study has demonstrated numerous accrued benefits of supply chain automation such as less expensive purchases, improved manager expertise, faster and more accurate acquisitions and less paperwork and administrative overhead was highlighted as some of the benefits.

5.4.2 Intelligence Technology

The introduction and spread of intelligent technology, such as autonomous automobiles, computers, smartphones and wearable electronic gadgets, have revolutionised every aspect of business, including supply chains. The study's findings have indicated that the digital transformation of organisations cannot increase relationship performance on its own and must be integrated with intelligent technology to achieve this objective. Thus, intelligent technologies fully mediate the connection between digital transformation and relationship performance. The manifestation of relationship performance through Intelligence Technology can be seen in organisational improved business operations and improved quality of services.

5.4.3 Integrated ICT

The study has demonstrated the nexus and imperativeness of integrated supply chain networks to organisational performance. Put simply, the study has shown in this context that one of the fundamental characteristics of digital supply chains is the pervasiveness of information. Digitalisation has significantly altered how organisational stakeholders engage with their environment, network socially, and communicate. Integrated ICT provides leverage for organisations to cooperate and exchange information and has created networking arrangements and various virtual organisations thus necessitating a shift in how to conduct business. Following the study's findings, integrated planning and execution synchronises all supply and

demand plans with supply chain execution processes hence enabling businesses to read consumer demand and sales data and respond accordingly.

5.4.4 Smart technologies

The study's findings indicate that the introduction and spread of intelligent technology, such as autonomous automobiles, computers, smartphones and wearable electronic gadgets, have revolutionised every aspect of business, including supply chains. Given the capabilities of smart technologies, smart devices have a spectrum of information that helps revolutionise how we all acquire and share information. It has been argued in the study how *smart technologies can help to improves the performance of internal and external relationships in supply chain management.*

5.4.5 Cloud capabilities

As mentioned in the study, cloud-based capabilities can offer a centralised platform that can be accessed from anywhere, at any time and by any (authorised) collaborator over the internet. As revealed in the study, it is now possible for businesses to communicate fully and swiftly with supply chain stakeholders thanks to a range of corporate networks and collaborative cloud-based platforms that operate similarly to social networks.

5.4.6 Internal integration

Internal integration occurs when an organisation structures its functional departments' practices, procedures and behaviours into integrated and synchronised processes to fulfil customer requirements. It facilitates the translation of production demands into purchasing specifications and improves material movements and ordering processes. Through scheduled interdepartmental meetings or casual contacts, purchasing and production employees can exchange information and performance feedback.

5.4.7 External integration

External integration enables information integration with suppliers to obtain knowledge from them, such as production scheduling and planning and inventory levels, which help the organisation optimise inter-organisational processes. Thus external

integration provides the pathway for organisations to link suppliers, internal functions, and all external and internal processes for efficiency gains.

5.4.8 Process integration

Process integration seems to bring suppliers into an organisation's internal operations. This integration provides opportunities to improve transactional efficiencies, solve problems and identify new product ideas by involving suppliers in product development, production planning and project teams to reduce production lead times and speed up new product introduction and delivery.

5.4.9 Operational Excellence

As established in the study, operational excellence can be achieved by an organisation by consistently doing things well across the value chain as a way of gaining competitive advantage by focusing on achieving efficiency gains through change management, waste reduction and optimised business operations. Digital integration can provoke in organisations superior performance and visibility across the value chain, value-added delivered to customers and effective integration with external partners. Thus, digitalization enables automation, integrations, visibility and big data analytics as components that influence operations excellence in the supply chain.

5.4.10 Financial Performance

It was presented in the study that digitalization provides opportunities and benefits across all industries to improve processes and drive new profitable business models. As demonstrated in the study, digital integration through financial agility could help to improve firm's performance by minimising cost of sales and optimising ROI. Organisations that have adopted digital technologies have stronger financial returns than their competitors. To gain a competitive advantage by doing things better, faster and cheaper than competitors, companies ought to respond with bold strategies in incorporating digital technologies to change their business models and provide new revenue and value-producing opportunities.

5.4.11 Customer Relationships

The transformation of customer relationships is a key aspect of driving an organisation's performance. Creating successful customer relations generates greater customer loyalty and customer retention, resulting in increased profits for a business. Digital innovations in customer relations are not just a mechanism for a company to be ahead of its competitors; they give their customers holistic individual support and develop into a journey of experiences with the wishes and needs of the customer at the centre. In other words, customer relations through digital innovation means achieving customer relations objectives by applying digital technologies, including desktop, mobile, tablet and other digital platforms.

5.5 Relating findings to research objective three

The study has established the following key findings as to how digital supply chain integration can enable aggregate firm performance gains: The key findings are presented under three fundamental elements namely, operational excellence, financial performance and customer satisfaction.

5.5.1 Operational excellence

Operational excellence comprised two key factors as discussed below:

Optimise business operations

The study has established that organisations can optimise their business operations through supply chain integration to achieve operational excellence. The scope of operational excellence goes beyond the conventional event-based improvement paradigm to include a sustained shift in company culture, which can provoke integrated performance across revenue, cost and risk.

Reduces waste

The study also established that integrating the supply chain will significantly minimise waste in various areas. For example, better route management will save warehouse space for the organisation. This will also help the organisation reach its environmental goals by reducing emissions. Trucks will be filled on every leg of the journey, thus

optimising efficiency and guaranteeing that no empty trucks are driving around. This implies that one will be more efficient and save money.

5.5.2 Financial performance

In this context of financial performance, the following factors emerged;

Agile financial approach

The study has demonstrated the benefit of an agile financial approach as an essential by-product of supply chain integration. The study asserts that a firm's market and financial performance are enhanced by its capacity to increase the rate of product customisation, enhance delivery performance and cut development and delivery timeframes.

Efficiency gain

The study has established that digitalization gives businesses across all industries the chance to improve their processes and come up with new and profitable business models. The findings of this study seem to collaborate with the work of the latter scholar as they concern the concept of efficiency gain as a by-product of supply chain integration. Solis (2019) asserts that digital technologies shape client expectations. The same tools that enable them to research and shop differently also enable markets to transform marketing into a business growth engine. According to a McKinsey and Company report (Catlin, 2016), organisations that utilise digital technologies outperform their competitors. Some scholars (Arora, 2018; Gezgin *et al.,* 2017; Kersten *et al.,* 2017) suggest that digital solutions can help reinvent procedures, increase quality and promote consistency. Using digital methods to increase revenue has a major impact on ROI (Astill, Dara, Campbell, Farber, Fraser, Sharif and Yada, 2019).

5.5.3 ROI uptrend and downward COP

The study has demonstrated that organisations that have embraced supply chain integration can witness an uptrend in returns on investment and a downward trend in production costs. Given the efficiency gained from a seamless integration of organisational processes and procedures internally and externally, there is bound to be a reduction in production costs and efficient use of capital aimed at boosting the

organisation's returns on investment. As discussed in the theoretical framework of the study, research has established that more significant degrees of supply chain integration (SCI) generally correlate with higher levels of financial performance (Droge *et al.,* 2004; Frohlich and Westbrook, 2001). SCI at any level benefits a firm's financial health. Businesses with complete supply chain integration demonstrated the best financial success.

5.5.4 Customer Satisfaction

Regarding customer satisfaction, the following factors emerged from the study:

Change management

The study has established that the adoption of a digital supply chain by organisations could result in an inevitable change in management in such organisations aimed at boosting transactional relationships between the business and its customers. The study argued that transactional relationships should be characterised by frequent and effective communication, resulting in efficient customer service, increased brand recognition and customer loyalty and a high customer retention rate.

Improved quality of services

As seen in the study, a digital supply chain tends to satisfy customer expectations, particularly for large organisations organised in central offices while lowering the administrative strain. As a result, businesses may now considerably enhance the quality of customer service through increased timeliness, precision and dependability.

5.6 Relating findings to research objective four

As already presented above, the study has established the impact of digital supply chain integration on a firm's aggregate performance in various ways. These range from achieving operational excellence in the organisation through strong financial performance to enhancing customer satisfaction in other ways. The study has established that organisations can leverage the provisions of digital supply chain integration to optimise their operations, do things better and reduce waste.

The study also demonstrated the impact of the digital supply chain on the financial performance of the organisation. This can be achieved, as revealed in the study,

through efficiency gains, increased returns on investment, and decreased production costs provoked by the organisation's adoption of digital supply chain integration. Moreover, the study has established that the adoption of a digital supply chain by organisations could result in an improved quality of service delivery to customers and an inevitable change in management in such organisations aimed at boosting transactional relationships between the business and its customers. The study argued transactional relationships should be characterised by frequent and effective communication, resulting in efficient customer service, increased brand recognition and customer loyalty and a high customer retention rate.

5.4 Recommendations

Given the obstacles to the adoption of digital supply chain integration as revealed in the study, to ensure best practices in supply chain integration, the following recommendations are advanced in the study:

5.4.1 Improve adaptive capacity

The incapacity of organisations to adapt to the unique terrain of the digital supply chain, as evidenced by the study's data, should be addressed through capacity building to prepare the employees to adjust to the modifications, organisation's current operations and procedures

5.4.2 Change management process

The absence of a change management process was revealed in the study as one of the constraints of supply chain integration. To be effective in an organisation, adopting innovative technologies necessitates managerial change. To digitalise effectively, well-defined change management trajectories are essential

5.4.3 Lack of trust

Many participants raised the possibility of robotics having an impact, and they anticipate that robotics will significantly impact the labour market. Low-skilled, physically demanding and repetitious jobs are among those that robots may eventually replace humans. To address the mentioned scepticism, employees need to upskill and

reskill themselves to well position themselves in benefiting from the benefits of supply chain integration.

5.4.4 Resistance to change

The study has established organisational culture as a barrier to digital supply chain integration. The embrace the latter, a holistic approach to embracing change should be employed. The involvement of all the business stakeholders becomes imperative.

5.4.5 Mitigate operational risks

Operational risk, internal risk, network risk and external risk, notably cybersecurity risk, have been identified in this study as some of the difficulties of the digital supply chain. A risk implementation plan that involves the identification, assessment and mitigation of potential risks should be in place.

5.5 Suggestion for future study and research gaps

Regarding future research, the researcher would like to see a longitudinal study on how digitally enabled supply chain integration enhances organisational performance over time.

5.6 Limitation of the study

Given the voluntary nature of the participation of participants in the study, the researcher only obtained responses from willing individuals in the relevant organisations. Which means individuals in the relevant organisations that are unwilling to participate will not. Therefore, the sample size may not entirely be representative of the logistics organisations in Gauteng and the Western Cape. Geographical and time limitations also have been huge factor in reaching a larger audience in the country.

5.7 Overall contribution of the study

The study has provided an insightful contextual knowledge on the dynamics of digital supply chain integration and firm performance gains. The study has identified factors that impact digital supply chain integration on firm performance. The study has evolved a nomadic model containing the key characteristics/variables of supply chain

integration and firm performance and the dynamics of these variables on firm performance. This can be used to design, monitor and evaluate the supply chain integration process on firm performance.

5.8 Concluding remarks

This study has identified the key properties that influence digital supply chain integration, established how digital supply chain integration can enable aggregate firm performance gains and examined the impact of the digital supply chain on a firm's performance. The study has developed a framework depicting the relationships between supply chain strategy, firm operational excellence, customer service and firm performance.

The study's findings indicate that digitally enabled integration capabilities for SCM necessitate data consistency and cross-functional application integration, with data consistency being substantially more crucial. Businesses must employ digital integration capabilities to achieve supply chain integration capabilities of a higher order that will generate performance advantages. This capability demands the sharing of strategic, tactical and operational information across supply chains and the holistic optimisation of physical flows.

The development of supply chain integration capacity positions businesses to realise performance enhancements, particularly in operational efficiency and revenue growth. Finally, the study has advanced some recommendations aimed at achieving best practices in digital supply chain integration.

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APPENDICES

APPENDICE A: INTERVIEW GUIDE

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Faculty of Economic and Management Sciences Department of Information Systems

Research Instrument: Interview

Project Title:	The impact of digitally enabled supply chains on firm aggregate performance gains

You are invited to participate in an interview to assess the **impact of digitally enabled supply chains on firm aggregate performance gains.** This interview is conducted by Bheki Hendri Thobela (student number: 2649282), in partial completion of a Master in Information Management degree at the University of the Western Cape.

Please note that the interview is completely anonymous, and the data will only be used for research purposes.

Demographics

1. Age

a. 18-29

b. 30–39

c. 40–49

d. 50–59

e. 60–69

2. Gender
    a. Male
    b. Female
3. Education
    a. Grade 12
    b. Diploma
    c. Bachelor
    d. Honours
    e. Master
    f. PhD
4. Experience
    a. 0 – 3 years
    b. 3 -5 years
    c. 5 – 10 years

d. 10 – 15

e. 15+

5. Role in Organisation:

Interview Questions

1. Supply Chain Integration

a. What are the key properties of digital supply chain integration?
b. How does digitalization enable internal integration?
c. How does digitalization enable external integration?
d. How does digitalization enable process integration?
e. How does digitalization enable network integration?

2. Firm Performance

a. What is the linkage between digital supply chain integration and aggregate firm performance?
b. How does digital supply chain integration enable Operational Excellence?
c. How does digital supply chain integration enable Financial Performance?
d. How does digital supply chain integration enable Customer Satisfaction?

3. What are the main obstacles to achieving digital supply chain integration?
4. What are the best practices to achieve digital supply chain transformation?

Thank you for your participation

APPENDICE B: ETHICS APPROVAL LETTER

UNIVERSITY of the WESTERN CAPE

50 YEARS of hope, action & knowledge

22 December 2021

Mr B Thobela
Information Systems
Faculty of Economic and Management Sciences

HSSREC Reference Number:	HS21/8/35
Project Title:	The impact of digitally enabled supply chains on firm aggregate performance gains.
Approval Period:	**22 December 2021 – 22 December 2024**

I hereby certify that the Humanities and Social Science Research Ethics Committee of the University of the Western Cape approved the methodology, and amendments to the ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report by 30 November each year for the duration of the project.

For permission to conduct research using student and/or staff data or to distribute research surveys/questionnaires please apply via:
https://sites.google.com/uwc.ac.za/permissionresearch/home

The permission letter must then be submitted to HSSREC for record keeping purposes.

The Committee must be informed of any serious adverse events and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

Director: Research Development
University of the Western Cape
Private Bag X 17
Bellville 7535
Republic of South Africa
Tel: +27 21 959 4111
Email: research-ethics@uwc.ac.za

NHREC Registration Number: HSSREC-130416-049

***APPENDICE C**: INFORMATION SHEET*

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Faculty of Economic and Management Sciences Department of Information Systems

Research Project Information Sheet: Interview

Project Title:	The impact of digitally enabled supply chains on firm aggregate performance gains

What is this study about?

My name is Bheki Hendry Thobela, a student at the University of the Western Cape (South Africa) pursuing a Master Degree in Information Management specialising in e-Logistics. The purpose of this research study is to identify key properties that influence digital supply chain integration and establish how this integration can enable aggregate firm performance gains.

What will I be asked to do if I agree to participate?

If you agree to participate in this research project, you will be required to participate in an interview for the purpose of this study. Completion of this interview will take approximately 45 – 60 minutes. If you do not want to answer any question, you do not have to.

Would my participation in this study be kept confidential?

You are not required to provide any personal details, such as your name, address or identity number. The participants' responses will remain strictly confidential and anonymous.

What are the risks of this research?

There are no known risks associated with participating in this research process. This research will not expose you to any harm as a consequence of your participation.

What are the benefits of this research?

The outcomes of this study will give retailers a deeper understanding of the key properties of digital supply chain integration and insight into how this integration can potentially increase their aggregate performance gains.

Do I have to be in this research and may I stop participating at any time?

Your participation in this survey is completely and entirely voluntary. You are free to withdraw from the study at any point in time.

What if I have questions?

If you have any questions feel free to contact the study leader:

Contact details of student Name: Bheki Hendry Thobela Telephone: 0791184609 Email: 2649282@myuwc.ac.za

Contact details of project leader (study supervisor)

Name: Dr Carolien van den Berg

The University of the Western Cape, Department of Info0rmation Systems Telephone:021 9593247

Email: cvandenberg@uwc.ac.za

UNIVERSITY of the
WESTERN CAPE

NOTE: This research project has received ethical approval from the Humanities & Social Sciences Research Ethics Committee of the University of the Western Cape, Tel. 021 959 2988, email: research-ethics@uwc.ac.za

***APPENDICE D**: CONSENT FORM*

University of the Western Cape

Faculty of Economic and Management Sciences Department of Information Systems

Research Participant Consent Form: Questionnaire

Project Title:	The impact of digitally enabled supply chains on firm aggregate performance gains

Please tick Yes or No to each of the following

	Yes	No
1. I confirm that I have read and understand the information sheet explaining the above research project and I have had the opportunity to ask questions about the project.		
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences.		
3. I understand that should I not wish to answer any particular question or questions, I am free to decline.		
4. I understand my responses and personal data will be kept strictly confidential. I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the reports or publications that result from the research.		
5. I agree for the data collected from me to be used in future research.		
6. I agree to take part in the above research project.		

Name of Participant	Date	Signature
Name of person taking consent	Date	Signature

Contact details of the study supervisor:

Name: Dr. Carolien van den Berg University of the Western Cape Department of Info0rmation Systems Telephone:021 9593247

Email: cvandenberg@uwc.ac.za

NOTE: This research project has received ethical approval from the Humanities & Social Sciences Research Ethics Committee of the University of the Western Cape, Tel. 021 959 2988, email: research-ethics@uwc.ac.za