The Cumulative effects of ICT adoption and Integration Practices on Supply Chain Performance in Nigeria

By

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Declaration

I declare that while registered as a candidate for the research degree, I have not been a registered candidate or enrolled student for another award of the University or other academic or professional institution.

I declare that no material contained in the thesis has been used in any other submission for academic award and is solely my own work.

Signature of Candidate …… *Abdullahi Mohammed…*

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Abstract

In today's dynamic supply chain environment, the successful operation of companies in most industries is becoming increasingly dependent on their ability to adopt and utilise ICT systems. However, the major challenges facing the adoption of ICT in developing countries are related to lack of knowledge and skills, lack of investment in IT infrastructure, and inadequate training in new technologies. This study aims to explore the effects of ICT adoption and supply chain integration on supply chain performance in Nigeria. This is envisaged due to inadequate empirical studies conducted on the roles of various dimensions of ICT and integration on supply chain performance on one hand and fundamentally also due to Nigerian government central ambition to develop a digital economy.

Moving from the separate and individual roles of ICT adoption and integration practices to their digital effects on Nigeria's economy. A literature review on ICT adoption, integration practice and supply chain performance measurement were carried out on developed and developing economies to identify and understand specific performance measures that can impact on Nigerians aspiration of developing an innovative and digital economy.

Pilot study was conducted with scholars from the University of Central Lancashire five Professionals in supply chain industry and ICT deployment experts from Nigeria. The questionnaire underwent a screening process prior to the commencement of data collection. The process ensures the questionnaire consisted of the relevant structure, readability, completeness, and devoid of ambiguity as stated by Alsuhaibani et al. (2021). The final survey questions had minimal modifications based on the input received. The Pilot testing was carried out utilising both mailed postal and web survey methodologies, as recommended by Dillman et al. (2017). The pilot test resulted in an initial list of performance measures based on the review. Industrial interviews were then conducted to confirm the measures and understand the distinct contextual definitions and diffrerences between ICT adoption and integration practices of developed economies from the emerging economies. Based on these a conceptual model was developed to describe the network and relationships between ICT adoption and integration practices and their influence on enhancing supply chain performance.

The network theory was used to explain relationships among linked entities that strong ties offer greater reliability, while loose ties enhance flexibility and a combination of strong and weak ties that matches supply chain needs is created to maximise supply chain performance in contrast to the traditional supply chains formed which has no concern for the overall network alignment. In addition, the study is grounded in the resource-based view (RBV) of the firm as the theoretical lens and integrative capability perspective for the interrelations among the adoption of ICT, integration practices and performance outcome of supply chains. The main argument is that the firms' resources are the source of competitive advantage which reflects tangible technologies and patterns of actions in the use of resources, this research considers ICT as such potential assets, which are complemented by supply chain integration capabilities.

The study adopts both qualitative and survey approaches conducted with 51 firms in the Nigerian Information and Communication Technology Development Agency (NITDA) sector. The interviews were transcribed, and data was assessed using correlation, regression, and factor SME analysis. Based on these the effects of intra- and inter-organisational ICT and the mediation of integration on supply chain performance was examined. The outcomes of the survey clarify the dominance of performance measures in the industry according to the level of importance. Furthermore, the structural equation model analysis indicated that there is a link between the choice of performance measures and organisations' strategies. Also, the results indicate a link between ICT adoptions organisational integration practice and actual performance of the organisations, thus suggesting that ICT adoption are essential organisational resources to support competitiveness. This study identifies the most influential strategy and performance measures in enhancing organisations' performance within the ICT companies and supply chain industry.

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Dedication

I dedicate this work to my late parents for the training, support, and encouragement from the foundation of my education up to this PhD journey, and to my wife for her support. Finally, I would like to thank my children for all their understanding and forbearance in allowing me to undertake this study.

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My warmest and most heartfelt appreciation goes to my late parents for their prayers, guidance, and for laying the solid foundation of my educational journey that ultimately led to my pursuit of a Ph.D. Their influence is immeasurable and continues to inspire me.

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In closing, my heartfelt gratitude extends to all who have contributed to my academic journey. Your support, encouragement, and belief in my capabilities have been instrumental, and I am deeply appreciative of the role each of you has played in my pursuit of knowledge.

List of Abbreviations

Abbreviations	Meaning
SCM	Supply Chain Management
ICT	Information and Communication Technology
SCI	Supply chain integration
SCP	Supply chain performance
SCC	Supply chain collaboration
SCV	Supply chain visibility
SCCO	Supply chain coordination
NCC	Nagerian communication commission
CAGR	Compounded Annual Growth
GON	Government of Nigeria
CC-HUB	Co-creation Hub
NBC	Naigeria broadcasting commission
NITDA	Nigeria information technology development authority
RoW	Right of way
MTN	Mobile Telephone Network
GSM	Global System for Mobile Communication
HTS	High trough satellite
EDI	Electronic data interchange
SPSS	Statistical Analysis In social science
ERP	Enterprise resource planning
MRP	Material resource planning
MRPII	Material resource planning II
RFID	Redio frequency identification
IoT	Internet of things
KPIs	Key performance indicators
SCM	Supply chain management
4Ms	Men machines materials and methods
CRM	Customer relationship management
BPR	Business process reenginnering
JIT	Just in time
EDIFACT	Electronic data Interchange for administration commerce & transport
EPC	Electronic product code
AI	Artificial intelligence
IBM	International business machine
EI	Electronic Integration
IS	Information System
IT	Information technology
CR	Continuous replenishment
EPOS	Electronic point of sale
B2B	Business to business
ANOVA	Analysis of variance
EFA	Exploratory factor analysis
CFA	Confirmatory factor analysis
CAD	Computer aided design
CAM	Computer aided manaufacturing
CEO	Chief executive officer
CIO	Chief information officer
APS	Applied planning and scheduling

MDs	Managing Directors
PCA	Principal component analysis
KMO	Kaiser Mayer Olkin
IIP	Internal integration practice
SIP	Supplier integration practice
CIP	Customer integration practice
ED	Electronic Data
AVE	Average variance
CMIN	Chi square mean index
DF	Degree of freedom
TLI	Tucker Lewis index
IFI	Incremental fit index
NFI	Normal Fit Index
RMSEA	Root Means Square Error of Approximation
SEM	Structiral Equation Model
R&D	Research and development
RBV	Resource Based View

Definitions of terms

Terms	Meaning
Management	Management is the process of planning, organizing, directing, and controlling resources and activities within an organization to achieve specific goals and objectives efficiently and effectively.
Supply chain	A supply chain is a network of organizations, people, activities, information, and resources involved in the creation and delivery of products or services from suppliers to consumers.
Supply chain management	Supply chain management is the planning and controlling of the entire lifecycle of products or services, from raw material acquisition to delivery to the end customer.
Supply chain alignment	Supply chain alignment refers to the harmonization of goals, strategies, and operations among supply chain partners to improve coordination and efficiency.
Vendor	A vendor is a business or individual that supplies goods or services to another entity, often in a commercial transaction.
Supply chain visibility	Supply chain visibility is the ability to track and monitor the movement of products, materials, and information throughout the supply chain.
Procurement	Procurement is the process of acquiring goods, services, or resources through purchasing, contracts, or other methods to meet organizational needs
Inventory	Inventory refers to the stock of goods, raw materials, or products a business holds for production, sale, or future use.
Logistics	Logistics involves the planning, implementation, and control of the efficient flow of goods, services, and information within a supply chain.
Information and communication technology	Information and Communication Technology (ICT) encompasses technologies used for accessing, transmitting, and managing information, including computers, networks, and software.
Inter-ICT	Inter-ICT, refers to the integration of various ICT systems and technologies between one organition and another.
Intra-ICT	Intra-ICT, refers to the integration of various ICT systems and technologies between units within an organition.
Integration	Integration refers to the process of combining different parts or elements into a unified whole to enhance functionality, efficiency, or compatibility.
Internal integration	Internal integration refers to the coordination of various departments or functions within an organization to work cohesively toward common goals and objectives.
External integration	External integration is the collaboration of an organization with external partners, such as suppliers, customers, or other stakeholders, to achieve common objectives.
Supplier integration	Supplier integration is the strategic partnership and collaboration with suppliers to optimize processes and reduce costs.
Customer integration	Customer integration refers to involving customers in business processes, product development, and decision-making to better meet their needs and enhance satisfaction.
Performance	Performance refers to the measurable results or outcomes achieved in a particular activity, task, or process, often indicating effectiveness, efficiency, or success.
Strategic performance	Strategic performance relates to the assessment and evaluation of an organization's effectiveness in achieving its long-term goals and objectives.
Operational performance	Operational performance focuses on evaluating the efficiency and effectiveness of day-to-day activities and processes within an organization to meet immediate objectives.
Competitive advantage	Competitive advantage is an attribute that allows a company to outperform rivals and achieve superior market positioning.
Supply chain barriers	Supply chain barriers are obstacles, such as logistics challenges or regulatory constraints, that hinder the smooth flow of goods and information within a supply chain.
Supply chain obstacles	Supply chain obstacles are challenges that disrupt the efficient movement of goods, services and information within a supply chain.
Supply chain automation	Supply chain automation is the use of technology and software to optimize various supply chain processes thus, reducing manual intervention.

Conference contribution

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Chapter One: Introduction

1.1 Introduction

This chapter provide an overview of the coverage and/or structure of the project. It presents the research problems, or controversy in the field of study, and eastablish the background and/or importance of the topic. More so, the chapter also state the aim and purpose of the research and define key terms used in the project, as well the structure of the thesis is presented.

1.2 Background to the study

The use of Information and Communication Technology (ICT) has been extensively examined and analysed in academic literature. Nevertheless, the combined impact of ICT adoption and integration practises has been a topic of significant discussion among scholars and professionals in the field of operations and supply chain management. There exists a pressing necessity to effectively tackle the combined influence of ICT adoption and integration practices on the performance of supply chains in Nigeria.

The use of Information and Communication Technology (ICT) and the incorporation of integration practises in Nigeria are occurring in response to the country's dynamic technological environment and its desire for economic advancement. According to Oyinlola et al. (2022), there is substantial evidence indicating that the utilisation of Information and Communication Technology (ICT) has a significant role in fostering the growth and advancement of business and supply chain sectors in Nigeria.

The proliferation of mobile devices expanding internet access and governmental efforts, to foster digital inclusivity has paved the way for the integration of information and communication technologies (ICT). The primary barriers to the adoption of ICT in Nigeria have been identified as insufficient infrastructure development, inadequate acquisition of specialised skills and knowledge, a lack of clarity regarding the economic benefits, limited experience in conducting cost analyses for ICT projects, and the need to ensure data quality (Lawrence & Tar, 2010).

In their study, Oyinlola et al. (2022) observed the strategies employed by stakeholders to address these difficulties and leverage information and communication technology (ICT) to enhance operational efficiency, foster innovation, and stimulate economic growth. The investigation into the incorporation of information and communication technology (ICT) in Nigeria across various disciplines has been under studies (Akinwale et al., 2012). Yet there is urgent and timely needs to explore an understanding of local potential and challenges which can inform strategies to bridge the digital divide and promote inclusive development. One of the ojectives of this study is to investigate the relationship between the use of Information and Communication Technology (ICT) and the performance of supply chains. Additionally, it aims to provide insights into how the adoption of ICT might facilitate the integration of supply chains, as well as identify the advantages and obstacles associated with implementing ICT in Nigeria.

To effectively tackle these concerns, the present study is firmly rooted in the theoretical framework of the resource-based view (RBV) of the organisation, as proposed by Barney (1996).

The Resource-Based View (RBV) theory is a strategic management framework that posits sustained competitive advantage which stems from a firm's unique, valuable, and inimitable resources. Resources include tangible and intangible assets, capabilities, and organizational knowledge. RBV emphasizes leveraging these distinctive resources to create a competitive edge, as they are not easily replicable by competitors. This theory underscores the importance of internal strengths, rather than external factors, in achieving and maintaining long-term success in business strategy. The RBV perspectives in this study provide guidelines for examining the relationship between the use of information and communication technology (ICT), integration practises, and the performance of supply chains. This framework offers a structured approach to assess the strategic significance of information systems (Seddon, 2014). The Resource-Based View (RBV) framework proposed by Wade and Hulland (2004) explores the interconnectedness of supply chain resources, core capabilities, and the use of information and communication technology (ICT) in conjunction with supply chain integration practises. This framework aims to enhance competitive advantage within the supply chain context. Firm resources encompass a

range of assets, both tangible and intangible, as well as organisational processes, firm attributes, information, and knowledge. These resources are under the control of the firm and play a crucial role in enabling the firm to develop and execute strategies that enhance its efficiency and effectiveness (Barney, 2000). According to Branston et al. (2006), it is crucial for resources to possess certain characteristics to be considered valuable and non-substitutable. These characteristics include being implicit, which implies a level of causally ambiguity, as well as being socially complicated and scarce, specifically in relation to the enterprise. In contrast, firm capabilities are derived from the integration of resource bundles that are utilised to perform value-added activities. According to Branston et al. (2006), the elements encompass technology, design, procurement, production, distribution, services, and various other elements of supply chain management. This concept is utilised to define the objectives on the diverse methods by which intra- and inter-organizational information and communication technology (ICT) contribute to the improvement of supply chain performance.

1.3 Statement of the Research Problems

Research on difficulties and obstacles to the adoption of ICT and integration practices in operation and supply chain management is limited and linked to technical issues (Dang et al., 2018; Ejiaku, 2014; Datta, 2011). There is a need for clean data to train and test the models, as well as the need to use complex methods to deal with uncertainties of present data (Khashei and chahkoutahi, 2021). There are little contributions related to issues that hinder the ICT adoption within the supply chain, which should encompass not just technical issues but also organisational and financial challenges. It is important to extend this study to consolidated body of literature on the adoption of new technology. The challenges identified as critical by existing works could be vital for ICT adotiopn (Kamble et al., 2020; Bai et al., 2020). The main obstacles are limited infrastructure, affordability, digital literacy, and regulatory challenges, all of which impede the effective application of ICT in Nigeria (Agostini and Filippini, 2019; Pasi et al., 2020; Raj et al., 2020; Kumar et al., 2021). One of the aims of this research, therefore, is to identify benefits and obstacles to the ICT adoption across supply chain in Nigeria.

To date, there has been little agreement on the mediation effect of supply chain integration practice in the relationship between the degree of ICT adoption and the performance of supply chain among scholars. Also, the interaction between various dimensions of ICT and supply chain performance is unclear in the literature. Several researchers investigated the link between the application of ICT and supply chain performance. Such research includes Vickery et al. (2003); Frohlich and Westbrook (2002); Prajogo and Olhager (2012); Da Silveira and Cagliano (2006); Paulraj et al. (2008) who have shown a positive effect of ICT on supply chain performance. But there are conflicting results Jeffers et al. (2008); Li et al. (2009) of intra- and inter-organisational ICT having a damaging effect on the performance of supply chain, suggesting a need to find ways of boosting the performance effect of investments in ICT within supply chains. Hence, the purpose of this research is to explore investments in ICT and the resultant roles of ICT adoprtion and integration practices in the enhancement of innovative, digital economy and supply chain performance in Nigeria. Bridging this gap is vital for advancing the field operation and supply chain management. Overcoming the issue is crucial to unlock the full potential of supply chain integration practice within the Nigeria's digital economy**.**

1.4 The sector of the study

According to Moshood et al. (2020), the ICT sector in Nigeria remained considerably dynamic during the year 2020, as most of the country's industries adopted virtual work environments. According to the Nigerian Communications Commission (NCC), 2020, the telecommunications sector made a significant contribution of 12.45% to the Gross Domestic Product (GDP) during the final quarter of 2020. This figure represents an increase from the 10.60% contribution observed in the corresponding quarter of the previous year (Alugbuo & Eze, 2021). The observed expansion can be attributed to a rise in demand, the implementation of several policies over a span of multiple years, and a concerted effort to encourage investment in the sector (Alugbuo and Eze 2021).

According to Ladimeji (2020), Nigeria is widely recognised as the largest information and communication technology (ICT) market in Africa, accounting for greater percentage of the continent's telecoms customers and 29% of internet usage. According to projections, the region of Sub-Saharan Africa is anticipated to experience the most rapid expansion, with a compound annual growth rate (CAGR) of 4.6% and an estimated increase of over 167 million subscribers within the next five years (Osiebe, 2022; Ojo, 2016). It is anticipated that Nigeria will contribute more than 55% of this total. According to Akpobasa and Ishioro (2022), the Nigerian Communications Commission (NCC) has provided an estimate of approximately 76 million broadband subscriptions in the country, indicating a penetration rate of 40%. Additionally, as of May 2021, there were approximately 187 million voice lines, which represents a tele density of 97.9% (Yusufu et al., 2022; Ladimeji, 2020; Odufuwa, 2012).

The Nigerian government (GON) acknowledges the significance of information and communication technology (ICT) as a catalyst for the advancement of various essential sectors such as education, healthcare, agriculture, and manufacturing (Diga et al., 2013). The Government of Nigeria (GON) is actively promoting collaborations between domestic ICT companies and international investors as part of its efforts to reduce dependence on the oil and gas sector (Kunle et al., 2014). To foster these collaborations and cultivate an entrepreneurial ecosystem within the technology industry, the Government of Nigeria (GON) has provided support for the establishment of ICT incubator hubs, youth innovation initiatives, and scientific technology parks, which can be led by either governmental or private entities (Okewale & Atobatele, 2022).

One notable aspect of the relationships with the private sector includes agreements with local ICT accelerators such as iDEA and the Co-Creation Hub (CC-Hub), which are strategically located in key cities in Nigeria (Manya, 2020). These initiatives have garnered the attention of foreign investors such as Combinator, headquartered in Silicon Valley, and Andela, based in New York. These investors have established an incubation centre with the aim of recruiting and training skilled Nigerian individuals

in coding, with the intention of subsequently outsourcing them to foreign companies (Madichie & Hinson, 2022; Fatile & Hassan, 2020).

According to Adeyemo (2011), the ICT industry is under the purview of the Federal Ministry of Communications and Digital Economy, which holds the ultimate responsibility for its management and oversight. The ministry exercises jurisdiction over three distinct agencies, namely the NCC, which serves as the regulator for the telecommunications industry; the National Broadcasting Commission (NBC), which oversees the broadcast industry; and the National Information Technology Development Agency (NITDA), which is tasked with the implementation of ICT policies (Adeyemo, 2011).

In November 2019, the Government of Nigeria (GON) introduced the National Digital Economy Policy and Strategy (2020-2030) with the objective of restructuring the Nigerian economy to use the potential of digital technology and reduce reliance on the oil and gas industry (Ujah-Ogbuagu, 2021). In pursuit of this goal, the National Communications Commission (NCC) implemented the National Broadband Plan for the period of 2020-2025, as documented by Bakare (2021).

Nigeria has set its sights on attaining a position among the leading global economies and acknowledges that the development of information and communication technology (ICT) and widespread access to broadband are important prerequisites for realising this objective (Ihugba & Njoku, 2014). However, the achievement of this aim is still a long way off due to many obstacles that have hindered the spread of broadband and investment opportunities in the sector (Ihugba & Njoku, 2014; Obayelu & Ogunlade, 2006). The sector has encountered significant challenges, including prolonged permit processing times, the imposition of multiple taxes at the federal, state, and local government levels (Ihugba & Njoku, 2014), the presence of numerous regulatory bodies, the degradation of existing fibre infrastructure due to cable theft, road works, and other activities (Ihugba & Njoku, 2014), as well as the implementation of right of way (RoW) charges by various state governments (Ihugba & Njoku, 2014; Kim & Lee, 2009). This sometimes results in a significant financial burden associated with the lease of transmission infrastructure. In response to critiques and public outcry from various stakeholders, the Government of Nigeria

(GON) has been actively advocating for the revision of Right of Way (RoW) costs. This initiative is aimed at enhancing the convenience of conducting business and fostering increased investment within the country (Ayanwale, 2007).

The country's telecommunications business has several prospects since the government of the nation (referred to as GON) has expressed its dedication to achieving a 5G mobile broadband penetration in 2021. (Ekpe & Agbeb, 2021). The country's international connectivity has significantly improved due to the rapid growth and progress in its ICT landscape. In 2001, there was only one international submarine cable system installed with a total capacity of 340 GB. However, this has since increased to five cable systems, collectively providing an overall capacity exceeding 40 terabytes (Ogbe & Dike, 2017). Nevertheless, a significant portion of these resources remains underutilised due to insufficient distribution infrastructure and channels that fail to reach inland areas where they are most needed (Ogbe & Dike, 2017). The expansion of data capacity in Nigeria has significant implications for the country, as it can greatly benefit government agencies and enterprises operating within the technology sector by facilitating the implementation of digitization strategies (Jameaba, 2020).

According to Dieli (2020), the country is now dominated by four prominent mobile network carriers, namely Airtel, MTN, Globacom, and 9Mobile. These operators are actively working to enhance their market presence and solidify their positions in the industry. As of May 2021, MTN holds a significant majority in the GSM market, with a subscriber base of over 74 million, which accounts for over 39% of the market share. Globacom and Airtel closely trail behind with approximately 50 million users, accounting for 27% of the total. According to Dieli (2020), 9Mobile currently boasts approximately 12 million users, accounting for 7% of the market share.

According to the research conducted by James et al. (2014), Nigeria has successfully established a presence in space, primarily through the launch of its communications satellite, NigComSat-1R, in 2011. According to James et al. (2014), it is anticipated that the spacecraft will be decommissioned by around 2025. NigComSat issued a request for expressions of interest (EoI) in March 2021, targeting proficient manufacturers, contractors, vendors, and partners within the satellite industry

(ADUKU, 2018). According to ADUKU (2018), companies will undergo a pre-qualification process to be eligible for participation in the various stages of the high-throughput satellite (HTS) project, including design, manufacturing, launch, in-orbit testing, and commissioning.

1.4.1 Opportunities

Cunha et al. (2021) conducted an observation on the investment opportunities within Nigeria's information technology sector, which is characterised by its promising and diverse nature. It was noted that Nigeria's cloud service market is still in its early stages of development, with only a limited number of participants currently engaged in enterprise-grade deployments (ADUKU, 2018; James et al., 2014). According to industry observers, there is a growing anticipation for the emergence of partnerships, as well as an increase in equipment sales and technical services. According to ADUKU (2018), the digital financial services and financial tech sector are undergoing constant evolution, characterised by the emergence of new participants and the introduction of novel products. The impetus for this phenomenon is twofold: firstly, the government's implementation of policies aimed at fostering a cashless economy, and secondly, the significant presence of digital natives within the ecosystem (ADUKU, 2018; James et al., 2014).

Furthermore, it is worth noting that Nigeria's fibre optic and broadband sector holds significant promise, primarily due to the ongoing growth of the country's international submarine cable infrastructure, as highlighted by Agboje et al. (2017). The existing environment exhibits a collective aggregate capacity over 40 terabytes, with additional projects slated for imminent launch. According to Agboje et al. (2017), the current efforts are contributing to the promotion of interest in the creation of smart cities. Clients have the option to engage in direct investment or form partnerships with local enterprises in Nigeria for any of the options.

1.4.2 Challenges

Despite Nigeria's continued prominence as a significant information and communication technology (ICT) hub in Africa, recent reports indicate that the sector

has experienced a deceleration due to the escalation of currency rates (Terrall, 2022). The downstream consequences encompass foreign exchange scarcity, significant differential between the dollar and the local currency (naira), affected investment, and escalated expenses associated with the buying of IT equipment (Marshal & Solomon, 2017).

There has been ongoing discourse surrounding the proposed regulatory measures by the Government of Nation (GON) pertaining to the utilisation of social media platforms. Nigeria's current position in the 2021 World Press Freedom Index is 120th, representing a slight decrease from its ranking of 115 in the previous year. Terrall (2022) observes that there is a recurring pattern of substantial and regular changes in the policy stances of the Government of Nations (GON) regarding information and communication technology (ICT). These shifts continue to be evident in specific governmental choices and responses.

1.5 Aim of the Research

This study aims to explore the effects of ICT and supply chain integration practices on supply chain performance in Nigeria. This is envisaged because there is a lack of empirical study on the roles of various dimensions of ICT and integration on supply chain performance in Nigeria and yet ICT remains central to the government's ambition to develop a digital economy. The government has a National Information and Communication Technology Development Agency (NITDA) as a vehicle to foster diffusion of ICT adoption with the agency under the purview of the Ministry of Information Technology and Digital Economy. In addition, the proposed research will investigate the cumulative effect of inter/intra-organizational ICT and supply chain integration on the overall supply chain performance. The research challenges outlined here will be examined and clarified with data drawn from organisations in Nigeria.

1.6 Research Objectives

In specific terms, the main research objectives are to:

i. Review extant literature on inter/intra-organisational ICT and supply chain performance.

ii. Develop a conceptual framework of ICT adoption and integration practice and their effects on supply chain performance.

iii. Investigate the role of ICT in enhancing supply chain performance through a survey by questionnaire.

iv. Explore the intervening effect of supply chain integration in the relationship between ICT and supply chain performance.

v. Examine the effects of ICT and supply chain integration on the performance of supply chain.

1.7 The geographical setting of the study

The geographical setting for studying ICT adoption and integration practices in Nigeria is diverse and dynamic, encompassing a vast expanse of West Africa. Nigeria, located between latitudes 4°N and 14°N and longitudes 3°E and 15°E, shares borders with several countries, including Benin, Niger, Chad, and Cameroon. Its geography consists of a mix of urban centres, rural areas, and various ecological zones, ranging from savannah to rainforest (Ayanlade et al, 2021).

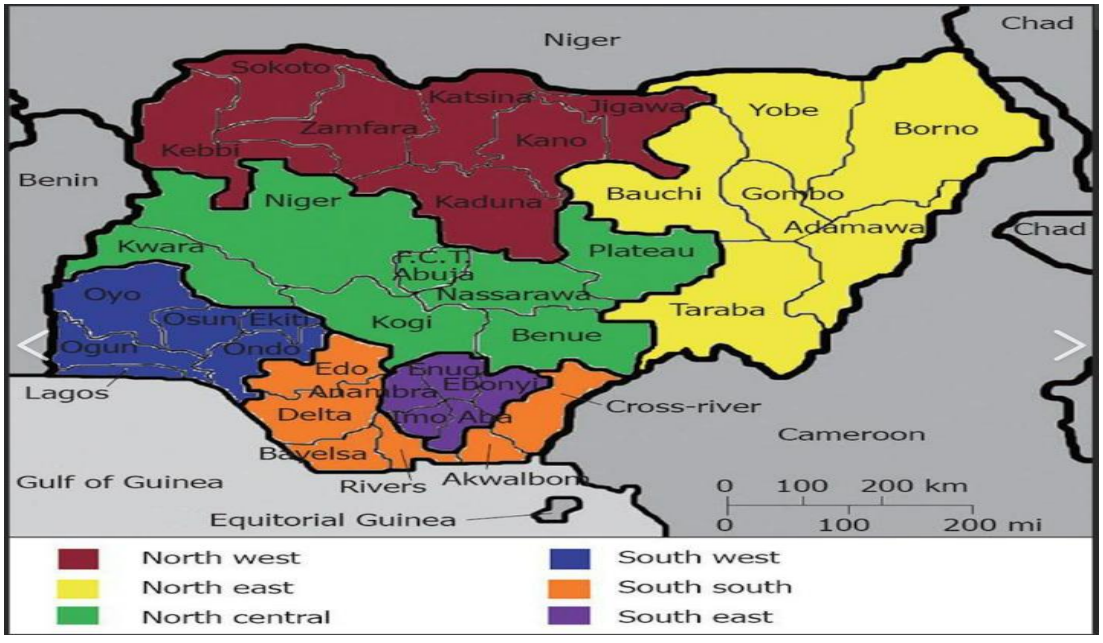

Figure 1.0 Presnting the geographical settings of the study

Major cities like Kaduna, Abuja, kano and Port Harcourt serve as key technology hubs, witnessing high levels of ICT adoption and innovation (Abubakar & Aina, 2019). These urban areas feature modern infrastructure, higher digital literacy rates, and advanced connectivity, often driven by a concentration of businesses, educational institutions, and government offices (Abubakar & Aina, 2019).

Rural regions present a contrasting scenario, with limited access to basic amenities and lower technology penetration. Akpan, (2003); Iwuoha, (2018) argues that disparity in infrastructure and connectivity creates an interesting dynamic for studying ICT integration, as researchers explore the challenges and opportunities within both urban and rural contexts.

The geographical diversity within Nigeria also influences the availability of resources, regulatory frameworks, and socio-cultural variations that impact the adoption and integration of ICT (Akinnusi et al., 2017). Therefore, understanding the geographical context is essential to comprehensively analyse the variations in ICT practices across Nigeria's landscape and to develop context-specific strategies that can foster technology adoption and integration across the nation (Mendy et al., 2021).

1.8 Significance of the study

Abdulquadri et al. (2021) have made noteworthy contributions to research on the practises of ICT adoption in Nigeria yet had underscored the significance of governmental initiatives, such as the National Digital Economic Policy and Strategy, in fostering the advancement of information and communication technology (ICT) and ensuring equitable participation in societal progress. Nigeria, as one of the most populous countries in Africa, faces unique challenges and opportunities in harnessing the potential of ICT. Research in this area can inform policies and strategies tailored to address local needs, bridge the digital divide, and promote inclusive development. Additionally, understanding the Nigerian context provides valuable insights for other developing nations, contributing to a broader understanding of how ICT can be leveraged for progress in similar settings. Moreover, this study has examined the obstacles and potential advantages of information and communication technology (ICT) implementation, providing insights into the elements that impact the

incorporation of ICT into various practices. Furthermore, the research has undertaken an investigation into the correlation between the selection of performance metrics and the strategies employed by firms, as well as the significance of supply chain integration in achieving a competitive edge.

Why is this study important?

Studying and understanding how ICT is adopted and integrated enables policymakers and businesses to formulate effective strategies for leveraging these technologies to drive growth and innovation. Empirically also, it helps identify barriers and challenges unique to emerging economies, such as infrastructure limitations, digital literacy gaps, and affordability issues. By addressing these challenges, Nigerian government, Agencies, and private organisations can promote inclusive development and bridge the digital divide. Equally, studying ICT adoption facilitates knowledge transfer and best practices sharing, enabling Africa and other emerging economies to substitute manual traditional to digital advanced approaches and accelerate their socio-economic progress to a more interconnected globalised world.

Why should anybody care about this?

This study offers significant insights into potential digital markets and investment opportunities in Nigeria and other neighbouring econimies. Therefore, understanding these practices aids in developing practical solutions that address specific ICT integration challenges, thereby fostering sustainable development and economic growth. The study also promotes inclusivity by ensuring that advancements in technology benefit all segments of society and reducing inequality. It facilitates international cooperation and knowledge elucidation thus, driving innovation and progress on a global scale. Overall, studying ICT adoption in emerging economies is integral to shaping a more connected, equitable, and prosperous world.

Who stands to benefit from it (Nigerian industries?

The research provides valuable insights into successful strategies and policies implemented elsewhere, informing the development of similar initiatives to enhance Nigeria's ICT ecosystem. Secondly, understanding global trends and best practices as

presented in this study enables Nigerian government to attract foreign investment and foster partnerships with international organisations, bolstering the country's digital infrastructure and innovation capacity. These study helps identify and address local challenges, such as digital literacy gaps and infrastructure limitations, ensuring that ICT advancements contribute effectively to Nigeria's socio-economic development initiative especially within the supply chain industry.

Other African countries? (Beneficiaries)

From study, other African economies can gain valuable insights into successful approaches and lessons learned from technologically developed economies like USA, UK and China, thus enabling emerging economies to learn how to accommodate or avoid pitfalls and accelerate their own ICT development. Furthermore, this study facilitate knowledge sharing and collaboration among African nations, fostering regional integration and collective progress. However, understanding global trends helps African countries attract investment and build partnerships with international stakeholders, driving innovation and competitiveness in the region. Ultimately, leveraging insights from such studies can empower African countries to harness the transformative potential of ICT for sustainable development and inclusive growth.

Global level industries?

This study clarifies the untapped innovative capacity in terms of the effects of various dimensions and opportunities of ICT adoption, allowing industries to modify their products and services to meet the specific needs of emerging economies. Secondly, understanding the direct and mediation effects of ICT and integration practices helps industries develop best ICT interaction effects and innovative solutions that best meet their business objectives locally and scaled globally, driving market expansion and revenue growth. Additionally, by collaborating with local stakeholders and governments, global industries can establish strong partnerships and enhance their corporate social responsibility initiatives, fostering sustainable development and positive socio-economic impact in emerging markets.

In general, this study enhances our comprehension of the multifaceted aspects of ICT integration in Nigeria. It considers socioeconomic, cultural, and policy factors,

thereby offering valuable insights into viable approaches for the long-term adoption and integration of technology.

1.9 Theoretical implication

According to David-West et al (2018), the Resource-Based View (RBV) theory provides valuable insights into the practises of ICT adoption and integration within supply chain organisations in Nigeria. The meaning of the Resource-Based View (RBV) theory is centred on its emphasis on the significance of firm-specific resources and competencies in determining competitive advantage. Dahiya et al. (2022) and Madhani (2010) are cited in the text. For example, in the Nigerian context, Harry, (2019) study on business process reengineering (BPR) and corporate competitive advantage of bottled water manufacturing companies in Rivers State Nigeria. Study shows that the relationship between efficiency improvement and competitive advantage with its dimensions such as service quality, innovation and market focus are very positively strong and significant it is emphasised by this theory that the efficient utilisation of information and communication technology (ICT) resources, including sophisticated supply chain management software and data analytics tools, has the potential to improve operational efficiency, facilitate information sharing, and enhance decision-making processes within supply chains (Awan, 2021; Chae, 2014). Furthermore, Mikalef et al. (2020) argue that the resource-based view (RBV) emphasises the importance of aligning technology investments with a firm's specific strategic objectives. This implies that supply chain companies in Nigeria should customise their information and communication technology (ICT) adoption strategies to capitalise on their unique resources, such as local market knowledge, knowledge of the population demography and supplier relationships. In Agwaniru's (2023) study, the implementation of the Resource-Based View (RBV) framework is discussed, specifically focusing on the strategic significance of Information and Communication Technology (ICT) adoption and integration in Nigerian supply chain organisations. The study establishes a connection between technology investments and the attainment of sustained competitive advantage through the utilisation of local resources, outsourced resources, and the alignment of strategic objectives.

The importance of Network Theory in the context of ICT adoption and integration within Nigerian supply chain organisations is rooted in its focus on linkages and interconnections (Tukamuhabwa et al., 2017). The study by Hearn et al. (2007) emphasises the role of information and communication technology (ICT) in enabling effective collaboration, communication, and information exchange among different stakeholders within the supply chain network. According to Tukamuhabwa et al. (2017), the integration of information and communication technology (ICT) in Nigeria is believed to have the potential to improve coordination, mitigate information asymmetry, and cultivate trust among suppliers, distributors, and partners. This observation is consistent with the intricate commercial environment of the nation, highlighting the significance of robust interpersonal connections in effectively overcoming obstacles. The Network Theory underscores the significant impact of information and communication technology (ICT) on the development of collaborative and efficient supply chain networks in Nigeria, as evidenced by the works of Agwaniru (2023) and Zhong et al. (2017).

1.10 Managerial implication

The use and integration of information and communication technology (ICT) in supply chain organisations in Nigeria have substantial management consequences. To begin with, the adoption of modern technologies can result in enhanced real-time visibility throughout the supply chain, facilitating more informed decision-making and risk mitigation. According to Oliveira et al. (2019), Additionally, the incorporation of information and communication technology (ICT) techniques has the potential to improve the precision of demand forecasting, hence facilitating the optimisation of inventory and mitigating the expenses associated with carrying inventory (Tummala et al., 2006). Furthermore, the implementation of information and communication technology (ICT) can effectively optimise operations by automating tasks, resulting in enhanced efficiency and decreased occurrence of errors (Bortolotti & Romano, 2012). In addition, the utilisation of data-driven insights derived from integrated systems has the potential to enhance the management of strategic supplier relationships, hence promoting collaboration and negotiation (Fröhlich & Steinbiß, 2020). Finally, this study aims to find and establish the correlation between the

successful adoption of information and communication technology (ICT) requirements and the investment made in employee training to optimise the utilisation of technology. This underscores the need of prioritising the enhancement of skills within the workforce. In general, Nigerian supply chain enterprises have the potential to utilise information and communication technology (ICT) integration to improve their competitiveness, agility, and resilience in operational activities. However, it is important for these organisations to recognise the importance of strategic planning, staff development, and change management to effectively utilise these benefits.

Firstly, embracing advanced technologies can lead to improved visibility across the supply chain, enabling better decision-making and risk management Oliveira et al., 2019). Secondly, integration of ICT tools can enhance demand forecasting accuracy, aiding in inventory optimisation, and reducing carrying costs (Tummala et al., 2006). Thirdly, automation through ICT can simplify processes, reducing operational inefficiencies and minimising errors (Bortolotti & Romano, 2012). Fourthly, data-driven insights from integrated systems can facilitate strategic supplier relationship management, fostering collaboration and negotiation (Fröhlich & Steinbiß, 2020). Lastly, this study also, identify and define the link between effective ICT adoption requirements and investment in employee training to maximise technology utilisation, necessitating a focus on upskilling the workforce. Overall, Nigerian supply chain companies can leverage ICT integration to enhance competitiveness, agility, and resilience in their operations while acknowledging the need for strategic planning, employee development, and change management.

1.11 Research methodology

The initial stage of this study involves conducting a comprehensive evaluation of existing literature pertaining to the integration of information and communication technology (ICT) into supply chain management. The review conducted an analysis of various information and communication technology (ICT) and integrative practices, along with their impact on supply chain performance. Consequently, a conceptual model has been established and is illustrated in Figure 1 below.

Furthermore, a comprehensive literature review will be conducted to enhance the model as the project advances. Based on an extensive assessment of existing literature, a total of five interviews were performed with individuals who possess expertise and a keen interest in the adoption of information and communication technology (ICT) and the integration of supply chain processes. These interviewees consisted of both supply chain professionals and academicians. The interviews facilitated the identification of diverse types of information and communication technology (ICT) as well as integrative practices throughout the supply chain. The described ICT systems encompass both intra-organisational and inter-organisational ICT systems. Similarly, the recognised integrative practises encompass internal integration, supplier integration, customer integration, and integration practices involving additional stakeholders. The identified performance indicators for supply chain management encompass speed, prices, quality, delivery reliability, innovation, and adaptability.

The measuring items were generated in accordance with the recommended methodologies proposed by Gawankar et al. (2020) and Maestrini et al. (2017). Three items were used to measure the practices of supply chain integration. The following practices pertain to internal integration within supply chain management. The items utilised in this study were derived from previous research conducted by Flynn et al. (2010), Schoenherr and Swink (2012), Sanders (2007), and Sanders and Premus (2005). To evaluate the implementation of external integration practices in supply chains, the researcher used established measures from previous studies conducted by Das et al. (2006), hao et al. (2011), Cao and Zhang (2011), and Zhang et al. (2020). The researchers employed a five-point scale to assess the level of proficiency in supply chain integration practises within each organisation surveyed.

The measurement of Information and Communication Technology (ICT) in this study was conducted by employing measures that were derived from existing literature on ICT. Previous research has mostly examined the use of Electronic Data Interchange (EDI) as a means of assessing inter-organisational information and communication technology (ICT) (Hill and Scudder, 2002; Chang, 2011). Additionally, there have been studies that explore inter-organisational information systems (Sodero et al., 2013;

Markus and Loebbeecke, 2013). Additional sources for inter-organisational information and communication technology (ICT) were referenced from Kabelele and Musabila (2020) as well as Zhang et al. (2011). These studies specifically examine ICT solutions that encompass both internal and external ICT components. The measurement instruments employed for assessing intra-organisational information and communication technology (ICT) were derived from the work of Zhang and Yang (2016). However, slight modifications were made to the original five-point scale utilised by Zhang et al. (2016), with a particular focus on the aspects of adoption and investment. The measures pertaining to the constructs of supply chain performance were found to be in alignment with those employed by Yusuf et al. (2007) and Anand & Grover (2015). The components were measured using a five-point scale, as indicated in the accompanying questionnaire.

The development of the questionnaire was undertaken using the following approach. Initially, an exploratory interview was administered employing an unstructured approach, with open-ended inquiries, to scholars and industry executives affiliated with the Nigeria Information and Communication Technology Development Agency (NITDA). This level provided a foundational comprehension of supply chain integration practises and ongoing industry information and communication technology (ICT) initiatives. The study proceeded to enhance a preliminary questionnaire by synthesising the insights gathered from the interviews and the analysis of existing literature. The preliminary version of the questionnaire underwent a pre-testing process involving three individuals from the academic community and six individuals from managerial positions. The purpose of this pre-testing was to assess the questionnaire's clarity, utility, and relevancy. Based on the feedback received, certain measuring items were revised, and extraneous items were eliminated. The survey was conducted using an online form, adhering to the guidelines proposed by Schaefer and Dillman (1998). Reminder emails were sent to individuals who did not respond within a two-week period after the initial email communication. Additionally, in accordance with the recommendations put forward by Lewin and Somekh (2011), follow-up telephone calls were conducted.

The methodology employed in this study comprised the utilisation of simple random sampling to choose organisations operating within various sectors of the Nigeria Information and Communication Technology Development Agency (NITDA). The NITDA database was utilised as a sampling frame for the selection of firms. The individuals who held senior managerial positions within the organisations were deemed most appropriate to respond to the survey inquiries. This is due to their extensive knowledge of their respective companies' operations and their ability to obtain pertinent data pertaining to the management of information and communication technology (ICT) concerns, as well as performance indicators within their supply chains.

The questionnaire underwent a screening process conducted by some academic staff at the University of Central Lancashire, prior to the commencement of data collection. The process ensures the questionnaire consisted of the relevant structure, readability, completeness, and devoid of ambiguity as stated by Alsuhaibani et al. (2021). The final survey questions had minimal modifications based on the input received. The piloted testing was carried out utilising both mailed postal and web survey methodologies, as recommended by Dillman et al. (2017).

In accordance with the adapted methodology of Dillman et al. (2014), physical copies of the questionnaire were dispatched by postal mail to recipients whose addresses were sourced from the NITDA database. The research package included a questionnaire, a cover letter, and a participant's information sheet. The information sheet provided an overview of the research objectives and instructions for completing the questionnaire. Additionally, a stamped and addressed envelope was included to enable the return of the completed questionnaire. Comiskey and Dempsey (2013) assert that the normal distribution is characterised by a bell-shaped curve exhibiting the highest frequency (Planing & Planing, 2014). Various methods exist for testing normalcy, including the assessment of skewness and kurtosis values, as well as the utilisation of the explore option within the descriptive statistic menu provided by SPSS.

1.12 Structure of the thesis

This research comprises eight primary chapters. In the first chapter, the research's contextual background is presented and the rationale for its necessity is elucidated. The research scope was aligned with the stated objectives. The choice of Nigeria's industry as the empirical context for the study was supported. Furthermore, the study elucidates the noteworthy contribution of the research and finishes by delineating the employed technique and the organisational framework of the thesis.

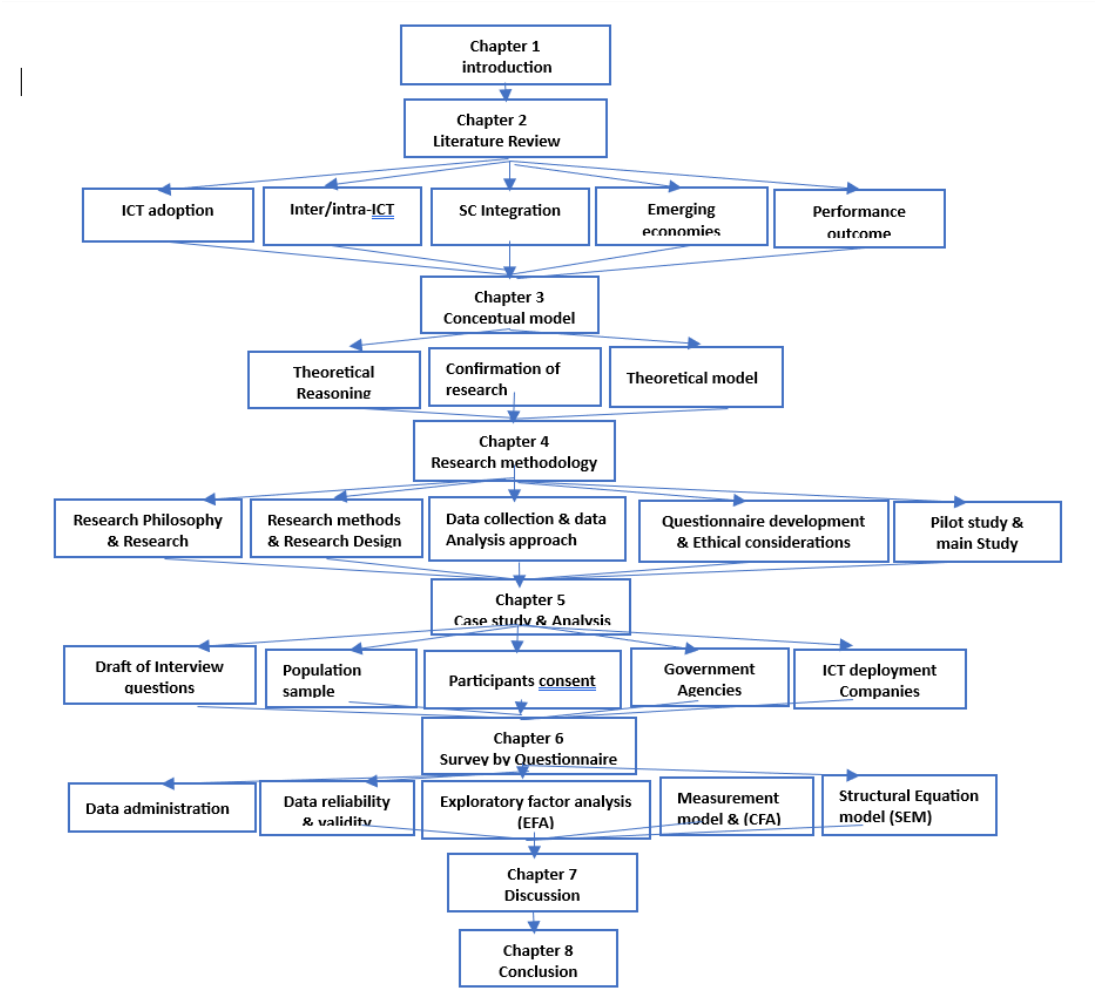

Figure 1.1 Presenting the structure of the thesis.

Chapter 2 – Literature review

Chapter two explore how different practices of ICT adoption and integration are implemented. Then, the chapter reviews the extant literature on ICT adoption,

supply chains integration practices, strategic and operational performance, and key performance measures.

Chapter 3–Conceptual model

Building from review of related literature, the chapter explores discussion of the resource-based view theory and Network based theory which aids in developing the conceptual model.

Chapter 4 – Research methodology

This chapter discusses the study's methodology, including an overview of research philosophy, logic, approaches, and methods. This chapter explains why a mix method was adopted. In addition, it defines measures of constructs, the sampling method, and ethical considerations. The chapter concludes with a discussion of the techniques for pilot testing and the full-scale survey.

Chapter 5 – Case study analysis

The chapter presents an analysis of the findings derived from the conducted study. The analysis incorporates specific characteristics of the individuals, like their qualifications, experiences, years of employment, and the sort of organisations they belong to. The study examined the company's dimensions, including its size, return on investment, annual turnover, and employee count, to ascertain the pertinence of the participants' responses to the research data and to validate the credibility of the source. The chapter also addresses response bias by providing a thorough explanation of the research's aims and objectives. Additionally, it critically examines and takes measures to prevent any ethical issues that could potentially affect the reliability and validity of the data sources, as outlined in the chapter.

Chapter 6 –Analysis and Results

This chapter discusses the survey data analysis, results, and testing of the research objectives. The data analysis was conducted using social science statistical software of SPSS and AMOS version 28. The chapter also includes a thorough discussion of descriptive statistics, non-response bias, reliability, validity, common method bias was statistically computed and analysed. The research model fit was evaluated to

validate the research constructs and report the research findings, structural equation modelling (SEM) was employed to achieve the research objective.

Chapter 7 – Discussions

The chapter presents an analysis of the findings derived from the conducted study. The analysis incorporates specific characteristics of the individuals, like their qualifications, experiences, years of employment, and the sort of organisations they belong to. The study examined the company's dimensions, including its size, return on investment, annual turnover, and employee count, to ascertain the pertinence of the participants' responses to the research data and to validate the credibility of the source. The chapter also addresses response bias by providing a thorough explanation of the research's aims and objectives. Additionally, it critically examines and takes measures to prevent any ethical issues that could potentially affect the reliability and validity of the data sources, as outlined in the chapter.

Chapter 8 Conclusions

This chapter provides a concise overview of the study's aims, objectives, and research methodology to illustrate the findings of the study. Furthermore, the restatement and emphasis of the research objective serves to reinforce their reliability and validation. The chapter also outlines the study's contribution to both theoretical understanding and practical application. The chapter finishes by providing an analysis of the constraints encountered throughout the study and offering suggestions for potential avenues of future research.

1.13 Summary

Studying the effects of ICT adoption and integration practices on supply chain performance in Nigeria stems from the country's dynamic economic landscape and growing recognition of technology's role in enhancing operational efficiency. Nigeria, as a prominent emerging economy, faces unique supply chain challenges stemming from its diverse geography, infrastructure disparities, and evolving business environment.

The rapid expansion of Information and Communication Technology (ICT) offers potential avenues to address these difficulties and enhance the efficiency of supply

chain operations. The ubiquitous utilisation of mobile phones and the escalating prevalence of internet access serve as the fundamental basis for advancements propelled by technology. Nevertheless, it is necessary to investigate the effects of ICT adoption on different facets of supply chain performance, including inventory management, communication, and coordination, to gain a comprehensive knowledge.

The supply chains in Nigeria encompass both urban areas and outlying locations, resulting in intricate networks where information and communication technology (ICT) can play a crucial role in bridging information gaps and facilitating improved decision-making processes. Additionally, the Nigerian government's efforts to promote digital transformation, in conjunction with private sector endeavours, underscore the need of understanding the relationship between technology integration and the consequences of supply chain performance.

Chapter Two: Literature Review

2.1 Introduction

The definition of “supply chain” appears to be more conventional across scholars than the definition related to “supply chain management” (Lambert, 2017). Earlier, supply chains were defined based on logistics, which means the objectives of directing material flow and information flow through the supply chain to meet end-customer needs (Harrisons et al., 2019). Similar importance is now given to downstream partnership with customers and cross collaboration with competitors as a means of integrating the absolute value creation process (Yusuf et al., 2004). Supply chain, thus, depicts the sequence of related activities amongst companies that participate in the process of designing, manufacturing and delivery of products and services (Yusuf et al., 2004). It entails the series of exchange activities that moves materials from suppliers, through the organisation or middlemen, to customers (Mohiuddin et al., 2019). Here, several individual firms are involved in producing a product and transporting it to the end user through the supply chain. Supply chain is constituted of several interconnected organisations such as producers, assemblers, middlemen and transportation companies performing related activities adding value chain and delivering goods or services to the end user (Ibrahim & Hamid, 2014). In the same token, Enz & Lambert (2023) defined a supply chain as the grouping of business processes to make available products or services to market. From these perspectives, supply chain can be seen to include among other things the final consumer as part of the supply chain.

The second theme examined and explained the intervening role of integration practices in the relationship between ICT adoption and supply chain performance. The chapter also examined the changes in ICT technologies and the impact on business and enterprise and potential problems to ICT adoption. This chapter also describe individual processes for supply chain integration related to ICT strategies, such as ERP, EDI, MRP, RFID, and other electronic technologies, and integration

practices. The final chapter moves to assess supply chain performance measurement systems. Here, the chapter describes the concept of performance measurement system, assess key performance indicators (KPIs) such as cost, quality, reliability, flexibility, speed of responsiveness, innovation, and financial measures. The last section of the chapter looked at the relationships between supply chain integration and ICT technologies and their effect upon the supply chain performance.

2.2 Supply Chain Management

The definition of "supply chain" appears to be more common across authors than the definition of "supply chain management" (Lambert, 2017). Earlier, supply chains were understood in terms of logistics, which means the task of coordinating material flow and information flow across the supply chain to meet end-customer needs (Harrisons et al., 2019). An equal amount of emphasis is now paid to downstream collaboration with customers and lateral collaboration with competitors as a means of integrating the total value creation process (Yusuf et al., 2004). A supply chain, thus, depicts the series of linked activities amongst companies that contribute to the process of design, manufacture and delivery of products and services (Yusuf et al., 2004). It entails the series of activities that moves materials from suppliers, through the organisation, to customers (Mohiuddin et al., 2019). Here, several independent organisations are involved in manufacturing a product and placing it in the hands of the end user in a supply chain – raw material and component producers, product assemblers, wholesalers, retailer merchants and transportation companies are all members of a supply chain (Ibrahim & Hamid, 2014). In the same token, Enz & Lambert (2023) defined a supply chain as the alignment of business processes that brings products or services to market. These concepts of supply chain include the final consumer as part of the supply chain.

Christopher (2022) maintained that a supply chain is the grouping of connected and related organisations systematically working together to coordinate, manage, and sustain the flow of goods/services and information from suppliers through the middlemen to the end users. It also includes the administration of individual and separate connections, in the different processes and activities that produce value in

the form of products or services delivered to the final consumer (Christopher, 2022). Viewed differently, a supply chain consists of many firms performing separate interconnected and related activities I.e., transportation, distribution, and the ultimate consumer.

Ellram & Cooper (2014); Mentzer (2001) described a supply chain as several firms directly or indirectly involved in facilitating the flows of goods, services, finances, and/or information from a manufacturer/producer to a customer. Involved in this definition, were three attributes of supply chain: a “direct supply chain,” an “indirect supply chain,” and an “general supply chain.” A direct supply chain involves of a manufacturer, a wholesaler, and a retailer involved in the flows of goods, services, finances, and information. A general supply chain includes immediate suppliers, extended middlemen and extended retailers of the immediate customer, all involved in the flows of goods/products, services, finances, and information. A general supply chain includes all the organisations involved as middlemen facilitating the effective and efficient flows of products, services, finances, and information from the potential producer to the ultimate customer.

This description pertains to the involvement of various entities in logistics operations. A third-party logistics (3PL) entity manages the logistics activities between two firms. Additionally, a third-party financial provider may offer financial assistance, assume a portion of the associated risks, and provide financial guidance. Furthermore, a market research firm is engaged in supplying information regarding the end consumer to a company situated further up the supply chain. This exemplifies a variety of functions that complex supply chains can do. It is imperative to acknowledge that supply chains persist regardless of whether they are actively maintained or not. Even if none of the organisations choose to apply any of the notions stated regarding the supply chain as a business phenomenon, it is essential to note that the supply chain remains in existence (Ellram & Cooper, 2014; Mentzer, 2001). Hence, a differentiation is made between the supply chain as a phenomenon that exists within the realm of business and the subsequent management of those supply chains. The latter necessitates explicit managerial endeavours by the firms involved in the supply chain, whilst the other refers to the existence of distribution channels. Based on the information mentioned above, it is crucial to acknowledge

that a single business has the potential to be involved in many supply chains. It is worth noting that, according to the definition of supply chain, the ultimate consumer is regarded as a constituent of the supply chain. The significance of this argument lies in its acknowledgement of retailers' involvement in both the upstream and downstream components of a supply chain. Figure 1 below illustrates a visual representation of the organisational framework of a supply chain.

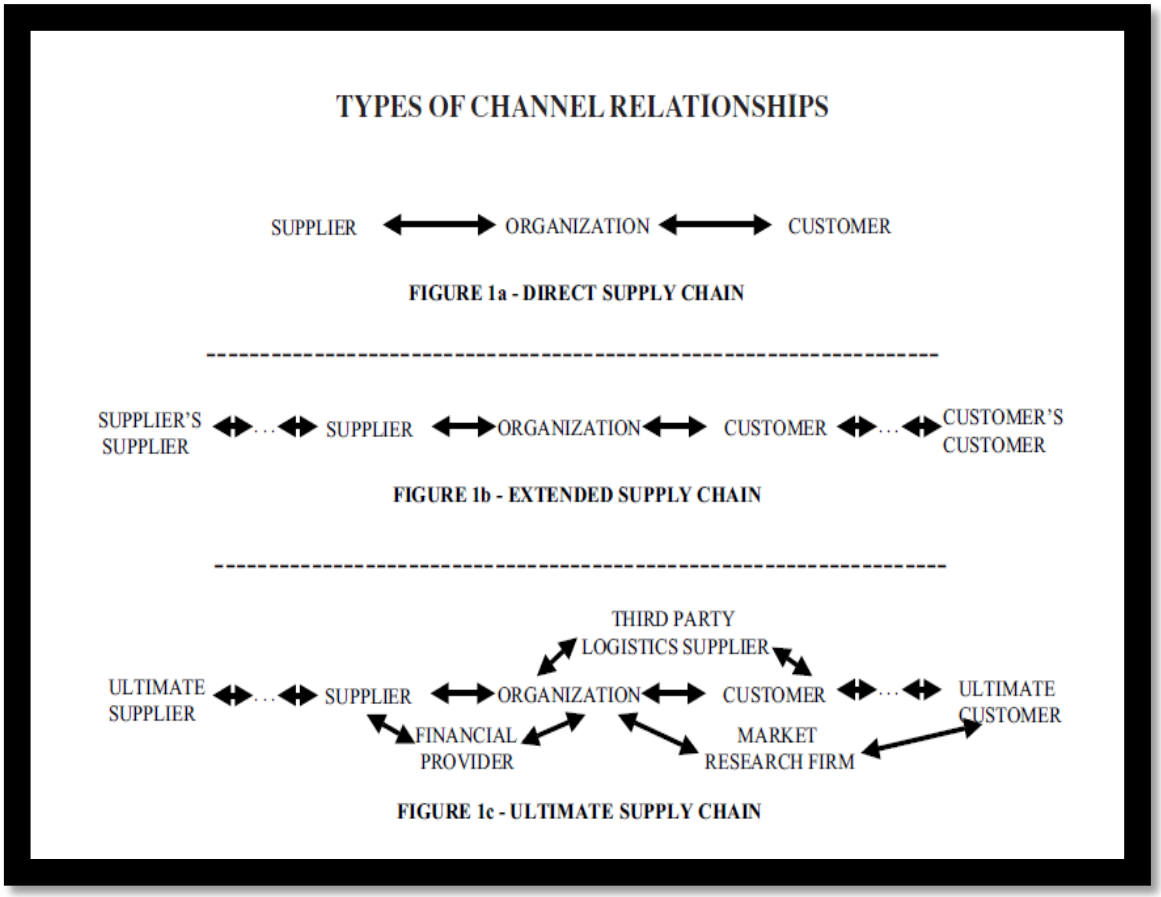

Figure 2.1: Types of channel relationships (Mentzer, 2001)

2.2.1 The development of supply chain management

The terms supply chain management is defined in several ways, as it involves integrating the business's processes with identified and defined middlemen (Lyson and Farrington, 2020). In line with Harrison et al. (2019), supply chain management involves major elements such as planning and directing of all processes involved in sourcing/procurement, processing, transportation, and distribution across a series of supply chain. It also includes the efficient coordination and partnership between supply chain firms, which can be suppliers, middlemen, third-party service providers

to the final customers. In essence, supply chain management coordinate supply and facilitate demand management within and between firms to serve the needs of the end customer (Harrison et al., 2019).

Mentzer et al. (2001) categorised supply chain management into three distinct classifications, namely: a management philosophy, the application of said theory, and a collection of management methods.

2.2.2 Supply chain management as a management philosophy

According to Sweeney (2011) and Mentzer et al. (2001), supply chain management (SCM) is a managerial philosophy that adopts a systems perspective in perceiving the supply chain as a cohesive entity, rather than a collection of disjointed components, each fulfilling its own specific role. The theory underlying supply chain management on a wider scale of collaboration encompass a collective attempt across multiple firms aimed at effectively facilitating the complete distribution of goods from the supplier to the end user (Ellram and Cooper, 2014). Supply chain management is built on the understanding that every business within a chain has a direct and indirect impact on the performance of all other members within the supply chain, consequently influencing the overall performance of the supply chain (Kim and Lee, 2010).

The management philosophy of supply chain management aims to achieve the harmonisation and integration of operational and strategic skills inside and between firms, resulting in a cohesive and influential presence in the marketplace (Akdogan & Demirtas, 2014; Ross, 1998). Supply chain management, as an integrated philosophy, guides supply chain participants towards prioritising the creation of new solutions aimed at generating distinct and personalised sources of customer value. According to Stock and Boyer (2009), the primary goal of supply chain management is to achieve the harmonisation of all activities throughout the supply chain to generate value for customers. The supply chain management concept posits that the scope of supply chain management extends beyond logistics to encompass various tasks within a firm and throughout a supply chain, with the aim of generating customer value and pleasure. In the present situation, it is vital to comprehend the values and demands

of customers (Mentzer et al., 2001). Supply chain management, as a management concept, can be characterised by three distinct attributes.

- A systems approach to viewing the supply chain as a whole and managing the total flow of goods inventory from the supplier to the ultimate consumers.
- A strategic orientation towards cooperative efforts to synchronise and converge intra-organisational and inter-organisational operations and strategic capabilities into a unified whole.
- A customer focus to create unique and individualised sources of customer value, leading to customer satisfaction.

2.2.3 Supply chain management as a set of activities to implement management philosophy

In adopting a supply chain management philosophy, firms must establish management practices that permit them to act or behave consistently with the philosophy. As such, many authors have focused on the activities that constitute supply chain management (Lysons and Farrington, 2020). This previous research has suggested various activities necessary to successfully implement a supply chain management philosophy.

The implementation of a management philosophy necessitates the incorporation of the following seven activities:

• Integrated behaviour refers to the harmonious alignment of actions and attitudes among individuals or entities involved in a collaborative endeavor.

• Mutually shared information denotes the exchange and dissemination of knowledge and data among all relevant parties.

• Mutually shared risks and rewards pertain to the equitable distribution of both potential hazards and benefits among collaborators.

• Cooperation signifies the collaborative efforts and coordinated actions undertaken by all participants.

• The presence of a common aim and a shared dedication to serving customers underscores the collective focus and purpose of the involved entities.

• Integration of processes refers to the seamless amalgamation and synchronisation of operational procedures and workflows.

• Partnerships are established and maintained with the intention of fostering enduring connections that endure over the long term.

Akdogan and Demirtas (2014) posited that to achieve effectiveness in the contemporary competitive landscape, companies must enhance their integrated activities by including customers and suppliers. The phenomenon of expanding integrated behaviour by means of environmental integration is popularly known as supply chain management. Within this environment, the philosophy of supply chain management undergoes a transformation into the practical implementation of supply chain management. This process encompasses a series of activities that effectively execute the underlying concept. The process of integrating the activities is referred to as supply chain management, which also involves a collaborative approach among many stakeholders throughout the supply chain, including suppliers, freighters, and manufacturers. The main objective of this coordinated effort is to efficiently meet the demands and satisfaction of the final consumers (Akdogan & Demirtas, 2014; Mentzer, 2001).

To effectively apply the supply chain philosophy of management, it is necessary for members of the supply chain to engage in the procedure of exchanging information among themselves. This practise is particularly crucial for the planning and monitoring processes within the supply chain (Ellram and Cooper et al., 2014). The importance of regular information updating among chain members for the purpose of efficient supply chain management was highlighted by Lysons and Farrington (2020). According to Mentzer (2001), the concept of information sharing can be defined as the voluntary act of providing strategic and tactical data to fellow members within the supply chain. According to Salcedo and Grackin (2000), the practise of openly exchanging information, including inventory levels, predictions,

sales promotion methods, and marketing strategies, serves to mitigate uncertainty among supplier partners and ultimately leads to improved performance.

According to Ellram and Cooper (2014), the achievement of a competitive advantage in supply chain management is contingent upon the establishment of a mutually beneficial arrangement wherein risks and rewards are shared among the involved parties. The allocation of risk, safety and reward should ideally occur over an extended period, as shown by previous studies (LeMay et al., 2017; Cooper et al., 1997). The establishment of risk and reward sharing mechanisms has a crucial role in fostering long-term orientation and collaborative behaviour within the supply chain participants (Mentzer, 2001; Schilling and Seuring, 2022).

Effective supply chain management demand cooperation among the elements of supply chain (Hussain et al., 2023; Christopher, 2023). Cooperation can be defined as the collaborative and corresponding efforts undertaken by businesses in a mutually beneficial partnership, with the aim of achieving superior outcomes that are either collectively anticipated or individually desired over a sustained period (Lysons and Farrington, 2020). Cooperation extends beyond the immediate requirements of a given transaction and occurs across several levels of management, encompassing both high-level and operational managers. This includes the coordination of activities across different functions within the supply chain, as highlighted by Mangan and Lalwani (2016).

The concept of joint action within intimate relationships pertains to the collaborative and synchronised execution of commercial endeavours (Ploetner and Ehret, 2006; Heide and John, 1990). Cooperation commences with collaborative planning and culminates in collective control activities aimed at assessing the performance of individual supply chain participants, as well as the overall supply chain (Christopher, 2023; Mangan and Lalwani, 2016; Mentzer, 2001). According to Lysons and Farrington (2020), joint planning and evaluation encompass continuous procedures that span across several years. According to Ellram and Cooper et al. (2014), achieving a reduction in supply chain stocks and pursuing cost efficiencies across the entire supply chain requires not just effective planning and control, but also a high degree of cooperation. In addition, it is imperative for supply chain participants to

collaborate in the realm of new product development and product portfolio decisions (Christopher, 2016). According to Slack et al. (2023), the design of quality control and delivery systems is a collaborative endeavour.

According to the research conducted by Murphy and Knemeyer (2018); La Londe and Masters (1994), the achievement of supply chain success is contingent upon the alignment of goals and customer-centric emphasis across all participants within the supply chain. Policy integration refers to the process of aligning the objectives and priorities of many participants within a supply chain towards a common purpose. Also, Christopher (2016) proposed that to achieve success in partnerships, there should be an integration of supply chain strategy to prevent redundancy and overlap. Additionally, a certain level of cooperation should be sought, which enables participants to enhance their effectiveness at reduced cost levels. Policy integration can be achieved when there is a presence of comparable cultures and management approaches among the various components of the supply chain.

According to Ellram and Cooper (2014), the successful application of supply chain management necessitates the continuous integration of many processes spanning from sourcing through manufacturing, and ultimately to transportation and distribution along the whole supply chain. The process of integration can be achieved by utilising various firms, supplier, retailers, and other service providers (Flynn et al., 2010).

In his study, Christopher (2022) advocated for four distinct stages of supply chain integration and examined the corresponding planning and operational ramifications associated with each step.

- Phase 1 corresponds to the first or baseline scenario. The supply chain is a result of the fragmented processes occurring within the individual organisation, which is distinguished by the presence of staged inventories, control systems and procedures that are autonomous and incompatible with one another, and functional segregation.
- Phase 2 is marked by a shift towards internal integration, with a primary focus on reducing costs rather than enhancing performance. This phase involves

the implementation of buffer inventory, conducting first assessments of internal trade-offs, and providing reactive customer service.

- Phase 3 is characterised by internal corporate integration, with a focus on fully visible purchasing through distribution. It involves medium-term planning and a shift towards tactical rather than strategic decision-making. Efficiency is emphasised, and there is an increased reliance on electronic support for linkages. Additionally, the approach to customers remains reactive.
- Phase 4 activates supply chain integration by exploring the scope of integration to the external environment to embrace suppliers and customers.

The effectiveness of supply chain management is dependent upon the arrangement and sustainability of enduring partnerships, as evidenced by scholarly works such as those by Ellram and Cooper et al. (2014) and Kollberg and Dreyer (2006). According to Ellram and Cooper (2014), it is argued that the relationship time horizon should continue beyond the duration of the contract, perhaps indefinitely. Additionally, they suggest that a small number of partners is preferable to enhance cooperation.

According to Brekalo and Albers (2016) as well as Gentry and Vellenga (1996), it is not conventional for a single firm to undertake all primary activities within a value chain, including from sourcing procurement up to transportation and delivery logistics to optimise customer value. Therefore, the establishment of strategic alliances with various supply chain partners, including suppliers, consumers, and intermediaries consciuosely ensuring adequate risk and safety assessment on critical elements of supply chain such as transportation and warehousing services, can offer a competitive edge by generating customer value (Goksoy et al., 2013, Ren et al., 2005).

2.2.4 Supply chain management as a set of management processes

Contrary to the emphasis placed on the operational aspects encompassing the management of supply chain, alternative scholarly perspectives have directed their attention towards the management processes involved. According to Hill (2005), processes can be defined as a systematic and quantifiable series of actions that are

intended to generate precise outcomes for a specific client for exchange. Slack et al. (2023) propose that management of supply chain encompasses the systematic planning and control of inter-organizational interactions, information exchange, and movement of goods, with the objective of providing improved customer service and economic value. This is achieved by the coordinated administration of the physical movement of goods and services across company boundaries. Phase 2 is typified by a shift towards internal integration, with a primary focus on reducing costs rather than improving performance. This is accompanied by the implementation of buffer inventory, first assessments of internal trade-offs, and a customer service approach that is mostly reactive in nature.

Phase 3 reaches toward internal corporate integration and characterised by fully visibility of purchasing through distribution, medium-term planning, tactical rather than strategic focus, emphasis on efficiency, extended use of electronics support for linkages, and a continued reactive approach to customers.

Phase 4 achieves supply chain integration by extending the scope of integration outside the company to embrace suppliers and customers.

Effective supply chain management is made up of a series of partnerships and, thus supply chain management requires partners to build and maintain long-term relationships (Ellram and Cooper et al., 2014; Kollberg and Dreyer, 2006). Ellram and Cooper, (2014) believe the relationship time horizon extends beyond the life of the contract – perhaps indefinitely – and, at the same time, the number of partners should be small to facilitate increased cooperation.

Brekalo and Albers, (2016); Gentry and Vellenga (1996) argue that it is not usual that all the primary activities in a chain – inbound and outbound logistics, operations, marketing, sales, and service – will be performed by any one firm to maximise customer value. Thus, forming strategic alliances with supply chain partners such as suppliers, customers, or intermediaries (e.g., transportation and/or warehousing services) provides competitive advantage through creating customer values (Goksoy et al., 2013).

2.3 Information and Communication Technology

The term "Information and Communication Technology (ICT)" constitutes of a range of technologies that are utilised for the purpose of processing, storing, and distributing information. These technologies play an important role in enabling various information-related activities undertaken by individuals, as well as serving the needs of the public, institutions, and businesses (Zhang et al., 2010). This study incorporates the allocation of resources towards investment in Information and Communication Technology (ICT) and the necessary infrastructures. This comprehensive definition also allows for the differentiation of various forms of ICT while also encompassing all diverse types and methodologies that fall within this categorization. Furthermore, it appears that numerous pertinent studies employ a comprehensive interpretation of Information and Communication Technology (ICT).

2.3.1 Types of ICT

Typically, scholars have identified two distinct classifications for ICT resources: internal and external (Savitskie, 2007; Liang et al., 2010). According to Bhakoo and Choi (2013, p. 432), inter-organisational ICT can be defined as the technological infrastructure that serves as a medium for enabling transactions, exchanging **information with business partners, coordinating activities, and building governance** mechanisms across enterprises. According to Savitskie (2007, p. 456), internal-organisational ICT refers to the utilisation of communication technology and practices within a firm for the purpose of sharing information. Broadly speaking, this encompasses the databases that enable continuous integration of accounting, and supply chain functions, with a specific emphasis on logistics systems. Internal-organisational information and communication technology (ICT) systems are employed to regulate and coordinate internal operations through facilitating the computerization of procedures. Systems such as Enterprise Resource Planning (ERP) are included inside this category. In contrast, the utilisation of external resources, specifically external-organizational information, and communication technology (ICT), enables firms to effectively respond to the external environment and enhance their capacity to collaborate and exchange information with external partners (Liang et al., 2010). This is achieved through the establishment of electronic connections

between various organisations within a supply chain, surpassing conventional enterprise boundaries, as exemplified by network-based systems (Hong, 2002; Rajaguru and Matanda, 2013).

Enterprise resource planning (ERP) refers to a comprehensive software system comprising many modules that enables organisations to effectively manage their business operations. This system offers various advantages, such as enhanced process flow, decreased inventory levels, greater data analysis capabilities, superior customer service, and increased profit margins (Fan et al., 2000). The objective of Enterprise Resource Planning (ERP) is to effectively merge the information systems of various functional areas within an organisation into a unified, enterprise-wide network that is accessible over the internet (Palaniswamy and Frank, 2000).

Enterprise resource planning (ERP) refers to a comprehensive application software system comprising many modules, which enables organisations to effectively manage their business operations. The implementation of ERP offers various advantages, including enhanced process flow, decreased inventory levels, improved data analysis capabilities, enhanced customer service, and increased profit margins (Fan et al., 2000). The objective of organisation Resource Planning (ERP) is to effectively consolidate the information systems of various functional areas within an organisation, creating a unified and interconnected network that spans the entire organisation and is accessible through the internet (Palaniswamy and Frank, 2000).

Enterprise Resource Planning (ERP) is an expansion of the Manufacturing Resource Planning II (MRPII) system, incorporating various supplementary integration functions. These functions include Human Resource Planning, Decision Support systems Applications (Shehab et al., 2004), Distribution and transportation, Maintenance, Quality Control, Regulatory framework, Health, and Safety Compliance (Wolfenden, 1994). The optimisation of the four key components of an organizational resources, namely human resources, financial capital, physical resources, and technological assets, is fundamental for achieving maximum coordinated benefit. Automated Resource Planning (ERP) systems play a crucial role in assisting organisations meeting various objectives, such as the optimisation of cycle-time, prioritising customer satisfaction, and facilitating the prompt exchange of

information throughout the global company. Organisations that have successfully deployed Enterprise Resource Planning (ERP) systems have demonstrated enhancements in cross-functional collaboration and achieved enhanced company performance across multiple dimensions.

Waters (2002) describe the following areas as some of the benefits of integrating an ERP package:

- Reduced stock and inventories idleness, lower stock levels, thus saving in capital space and warehousing cost.
- Higher return on stock, reduced cycle-time, and improved productivity level.
- enhanced communication with customers and suppliers.
- More valid, reliable, and fast delivery.
- Higher utilisation of facilities, ensuring materials availability when needed.
- Better business control.

There is a growing trend towards the adoption of enterprise policies that encompass the use of comprehensive information systems, including enterprise resource planning (ERP) systems. Yusuf and colleagues (2004). The study findings revealed that a significant proportion of the most successful and financially lucrative organisations had used the Enterprise Resource Planning (ERP) system. The integration of enterprise resource planning (ERP), customer relationship management (CRM), and supply chain management (SCM) modules is currently a prevailing trend in the field (Ruivo and Mestre, 2017). Similarly, vendors specialising in Supply Chain Management (SCM) and Customer Relationship Management (CRM) are expanding their operations to encompass domains traditionally addressed by Enterprise Resource Planning (ERP) suppliers (Ruivo and Mestre, 2017).

According to Yusuf et al., (2006) Ammar, (2017) customer involvement for broader ERP reach includes extending the core activities of vendor products beyond ERP into the so-called ‘initial-ERP’ applications that offer complete functionalities in two main areas:

- CRM: Automating various functional arears of identifying, attracting, servicing, and retaining customers.
- SCM: controlling the flow of product, or services producing processes to, and from, partner organisations.

ERP, CRM, and SCM systems are the E-Enterprise major information system structural design (Serova, 2012).

Enterprise Resource Planning (ERP) has undergone significant advancements since its inception as Material Requirements Planning (MRP) systems. The concept of Material Requirements Planning (MRP) underwent further development and transformation, resulting in the emergence of Manufacturing Resource Planning II (MRPII). This progression involved the integration of additional elements from enterprise resource planning (ERP) and supply chain solutions, which aimed to enhance the efficiency and integration of electronic enterprise operations. These enhancements encompassed various aspects, including internal procurement and payroll processes, as well as facilitating global communication within the supply chain (McGaughey et al., 2007). Electronic-Enterprise derives its competitive edge from the uninterrupted integration of Enterprise Resource Planning (ERP) and Supply Chain Management (SCM) systems, both of which are founded on internet technology. The potential for Electronic-Enterprise to outperform traditional enterprise is expected to be higher, mostly because to the advantages derived from the implementation of Enterprise Resource Planning (ERP) and Supply Chain Management (SCM) systems. Lee and Lo (2003) conducted a study.

According to the findings of Somers and Nelson (2001) in their literature survey, it is evident that most researchers have arrived at similar conclusions regarding critical success factors (CSFs) in the context of enterprise resource planning (ERP) issues. These CSFs include top management support, project team configuration, skilled personnel, project management, consultants, business vision, business process reengineering, and training. Before implementing an Enterprise Resource Planning (ERP) system, it is imperative for the participants involved to carefully assess several key criteria.

According to Davenport and Short (1990), business process is 'a set of related activities designed to achieve a defined business objective. Business Process Rre engineering has long been considered one of the key success factors in integrating major IT projects, such as ERP, especially in organisations that have a strong organisational pattern that rely on legacy systems (Al-Mashari et al., 2001; Grover et al., 1995). ERP is a systemic architecture of enterprise management unlike the other information system projects. Because the whole planning system is not based on the concept of ERP, system project, and IT but also essentially indicates the necessity of ERP integration for implementing enterprise management and innovation, change, and reengineering concurrently while enhancing the competitiveness of enterprise.

Enterprise Resource Planning (ERP) represents a recent and noteworthy advancement stemming from the evolution of Material Requirements Planning (MRP) and Manufacturing Resource Planning (MRP II) (Al-Mashari et al., 2001). While Material Requirements Planning (MRP) facilitated the monitoring of supplies, work-in-progress, and the production of finished goods to fulfil sales orders, Enterprise Resource Planning (ERP) is a comprehensive system that can be implemented across all types of organisations. ERP enables managers from various functions or departments to access a unified and comprehensive overview of the activities and events occurring within the entire enterprise. The majority of enterprise resource planning (ERP) systems are specifically developed to cater to the needs of various business functions such as finance, logistics, manufacturing, human resources, and supplier management (Lysons and Farrington, 2016).

2.3.2 ERP

ERP can be defined as an enterprise management system that is supported by various innovation IT application software that integrates all the departments or functions of an enterprise (Lysons and Farrington, 2016). ERP systems were enterprise oriented. The development of the internet and e-business has, however, made the sharing of valid and timely information across the whole supply chain essential to business success. The consultancy that defines the term ERP now uses ERP II to refer to systems that facilitate combined electronic transactions in which a key requirement

is the sharing of information outside the enterprise (Koh et al., 2008). Some difference between ERP and ERP II are shown in table 2.1 below.

Table 2.1 Differences between ERP and ERP II

Factor	ERP	ERP II
Functionality	Focused on optimising process within an enterprise	Concerned with optimising across the whole supply chain by collaborating with business partners
Area	Facilitates manufacturing process and distribution.	Intersects all sections and units of business, including service industries, government, and other industries, such as mining and agriculture
Purpose	Operational applications.	constructed to satisfy the requirements of of specific industries, thereby providing reliable aid for users.
Procedure	Enhancing control and monitoring Internal system	Externally focused on monitoring trading partners, irrespective of their location
Design	Specific functionality and closed focus	Internet based and flexible to accommodate other systems. Built around elements that allow users to choose the application they require.
Information	Information on ERP systems is created and used within the enterprise	Information available across the whole supply chain to authorised stakeholders

2.3.3 The advantage of ERP

Azevedo et al., (2012) summarised the benefits of ERP as:

- Faster stock turnover: - producers and distributors may increase stocks turnover tenfold and reduce inventory costs by reasonable percent.

- The implementation of an Enterprise Resource Planning (ERP) system has the potential to significantly enhance fill rates, reaching appreciable percentage through the efficient allocation of products to their respective locations and timely delivery. Consequently, this improvement in fill rates is expected to positively impact customer satisfaction.

- An Enterprise Resource Planning (ERP) system has the potential to significantly enhance inventory accuracy, beyond a threshold of 90 percent, hence diminishing the necessity for conducting frequent physical inventory audits. Additionally, the implementation of an ERP system can result in a reduction in the number of personnel required to carry out inventory-related tasks.

- An Enterprise Resource Planning (ERP) system has the potential to significantly decrease set-up periods in production. By consolidating related production jobs, coordinating personnel, tools, and machines, optimising equipment utilisation, and implementing effective maintenance practices, an ERP can achieve a reduction in set-up time ranging from 25 to 80 percent.

- A superior level of work can be achieved by the utilisation of an Enterprise Resource Planning (ERP) applications that possesses a strong industrial component. This application has the capability to identify quality issues in a practical manner, thereby availing organisations with the necessary information to enhance production efficiency and reduce the need for work duplication.

- ERP system can increase fill rates to a maximum percent by allocating the right product in the right place at the right time, thus increasing customer satisfaction.

- ERP system can significantly increase inventory accuracy while reducing the need for physical inventory audits.

- ERP can reduce operational setting by grouping similar production jobs together, ensuring coordination of people, tools, and machinery, together with the efficient use of equipment and minimising idle time through efficiency of maintenance.

- ERP applications, with a strong manufacturing component, reliably identify and describe quality issues, providing the information required to increase production efficiency and reduce work duplicate.

Al-Mashari and Al-Mudimigh, (2003) highlights the obstacles of implementing ERP systems as.

- ERP implementation is difficult because implementation involves a structural change from a functional to a process method to business.

- When the customisation of standard modules is required to accommodate different business processes ERP implementations fail to deliver the anticipated benefits and the cost is often unjustified for small enterprises.

- Cost of training employees on ERP applications and systems can be high.
- There may be numerous negative consequences such as employee stress and resistance to change and sharing information that was closely guarded by departments of units
- ERP systems tend to concentrate on operational decisions and have relatively inadequate analytical capabilities.

Although ERP systems can provide a great deal of planning capability, the various material capacity and demand constraints are considered in relative isolation from one another, and ERP systems have a multitude of tasks to perform (Wu et al., 2000). However, analytical supply chain management systems can consider all pertinent factors simultaneously and adjust the relevant constraints in real time. Consequently, obtaining decisions or information from an overburdened ERP system can take hours, whereas a distinct SCM system may provide the necessary response in minutes (Misra et al., 2010). SCM systems, such as digital technologies and manugistics, span the entire supply chain and have the analytic capabilities to provide planning solutions and conditions at the strategic level. Gattorna (Editor), 2017. However, analytical systems rely on legacy or ERP systems for the information upon which the analysis is based. Because of this, ERP and SCM software are rapidly converging.

MRP MRP was devised in the 1960s as a technique to aid in production planning. Williams et al., (pp. 21-26; (1986) and possesses the following features:

It is optimised for assembly operations.

It is a dependent demand technique and an information system founded on computers.

MRP aims to make secured or make assemblies products available just before they are needed for the next stage of production (Lee,1993). MRP enables visibility of items throughout the entire production process and assists procurement and control departments in moving the appropriate supplies to manufacturing or distribution points at the appropriate moment (Lee, 1993).

2.3.4 MRP I and JIT

MRP is comparable to just-in-time (JIT) in many ways. JIT is a manufacturing philosophy based on the planned elimination of all waste and the continuous enhancement of productivity (Aghazadeh, 2003). It encompasses the successful execution of all manufacturing activities required to produce a final product, from design engineering to delivery and including all stages of conversion of raw material onward. The primary elements are to have the required inventory when needed; to improve quality to zero defects; to reduce lead time by reducing set-up times, queue lengths, and lot sizes; to revise the operations themselves; and to do all of this at the lowest possible cost (lean manufacturing). In a nutshell, just-in-time (JIT) production entails producing exactly what the consumer needs, when they need it, and in the quantity, they need using the minimum amount of people, materials, and machinery. In table 2.4, comparisons between MRP I and JIT are presented.

According to Gupta and Snyder (2009), JIT and MRP should not be viewed as competing systems. In numerous businesses, the two systems are combined. Importantly, a comprehensive MRP I (see below) planning environment should facilitate JIT execution. (2009) Gupta and Snyder. The two systems are complementary rather than alternative. The key sections of an MRP system are depicted in Figure 2.4.

Table 2.2 Comparison of MRP and JIT

Operating system characteristics	MRP I	JIT
Applications	Job Push system	Job Pull system
Application sections	Blockages variable plan	Quality level plan
Work control and stock level	Controlling production schedule of Inventory level accurate. The less the level the better	Dropping inventory to zero level
Capacity of personnel	Increased	Fewer
Control sections	Organisational report	Shop floor graphics

Application flexibility	Capital requirement scheduling-overdue	Visualisation immediate request triggered
Job scheduling	MRP says which job next	Make it now

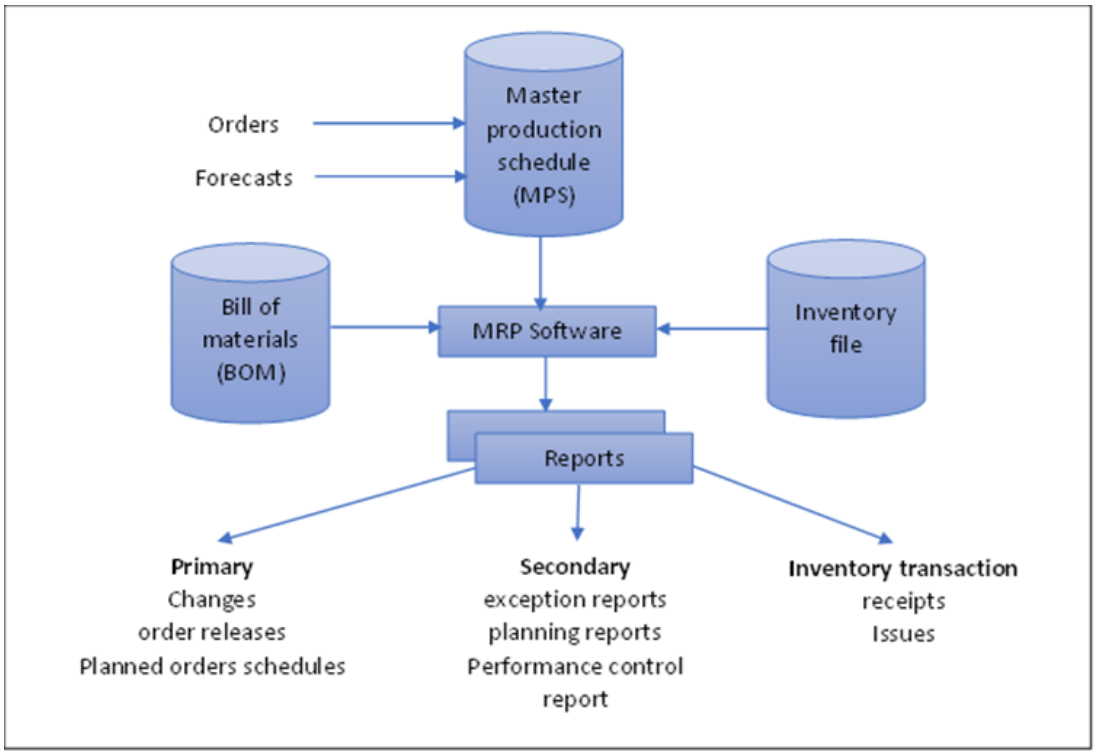

Figure 2.2 Essential elements of an MRP I system

2.3.5 MRP II

Manufacturing resource planning (MRP II) is the extension of computerised MRP that integrates production planning and control, engineering, procurement, marketing, financial/cost accounting, and human resource management into a single decision support system (Rondeau and Litteral, 2001). (See more information in Figure 2.4). In MRP II, the production process is still governed by a master production schedule, but production control, procurement, and engineering provide additional inputs. In addition to supporting financial or cost accounting, marketing, and human resource management, the computerised system also collects data to support financial or cost accounting.

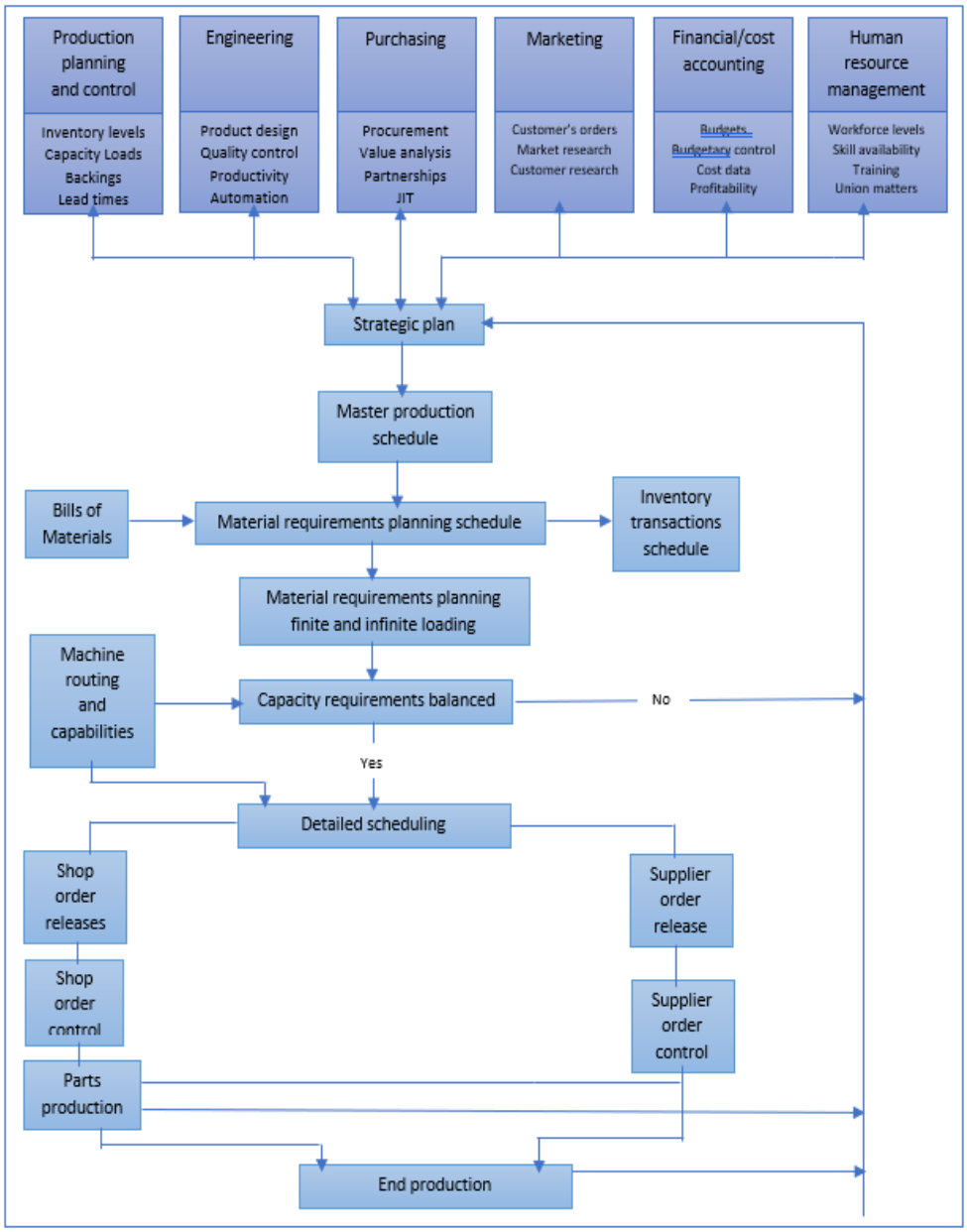

Figure 2.3 An overview of an MRP II system (source: Lysons and Farrington, 2020)

2.3.6 Advantage of MRP II

Figure 2.3 and Lysons and Farrington (2020) provide an overview of the MRP II, respectively.

• It coordinates the efforts of production, engineering, procurement, marketing, and human resources to achieve a unified business strategy or plan.

• Managers can analyse the "what if...?" implications of their decisions, such as "what if the marketing department's sales projections cannot be met by the available production capacity?" What financial implications would outsourcing have?

• Improved use of marketing, financial, and human resources in addition to plant and equipment.

• Changes, such as rush orders, can be readily incorporated into the system as they occur.

• The cost of used or prospectively used resources can be converted into monetary values, which facilitates budgeting and budgetary control.

• Coordination of production with procurement, marketing, and human resources, including the scheduling of supply deliveries, the use of sales forecasts to determine master budgets, and the planning of recruitment or layoffs.

2.3.7 Electronic Data Interchange

Electronic data interchange (EDI) enables standardised electronic business messages to replace manual paper-based processes, such as customer order schedules, purchase orders and invoices (Deshmukh, 2006). In the past EDI was plagued with issues relating to computer system incompatibility between companies which often caused the data being transmitted to be corrupted (Adam and Fazekas, 2021). Today EDI systems are operated on the internet and are therefore platform independent, allowing much greater accessibility and easier access (Alonsoet al., 2004).

The electronic data interchange for administration, commerce, and transportation (EDIFACT) standard provides an agreed message format, directives, and guidelines for multi-industry EDI communication, thereby enabling standardised EDI communications throughout the global supply chain (Alonso et al., 2004).

EDI has also been implemented throughout automotive supply chains between component manufacturers, sub-assemblers, and the primary automotive assemblers to enhance coordination and synchronisation of material flow by transmitting call-off and delivery schedules (Damak, 2018). Today, EDI is used to enhance the integration between vehicle manufacturers and their hundreds of dealerships that

sell vehicles and supplies to end-users (Damak, 2018). According to Ambe and Badenhorst-Weiss (2010), EDI can enhance demand visibility from the manufacturer's perspective in terms of customer orders and supply visibility for the end-customer in terms of specifications, stock availability, prices, and delivery information. While Lee and Whang (2000) highlighted the limitations of EDI, the data sourced from either the manufacturer or the dealership is not transferred in real time, but instead is batched and retained overnight for processing, resulting in a delay of up to 24 hours in data transmission. According to Damak (2018) and Ambe and Badenhorst-Weiss (2010), this is of little importance when the order lead time for automobiles is measured in weeks or months as opposed to days. According to Somapa et al. (2018), these types of systems can enhance the precision of vehicle specifications and delivery tracking so that customer deliveries are made on time.

Diverse information systems with which EDI must interface continue to be a challenge for EDI implementations across multiple companies, necessitating significant time and effort to enable the integration of the systems and the accurate and automatic transfer of data fields (Themistocleous et al., 2004).

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Radio Frequency Identification (RFID)

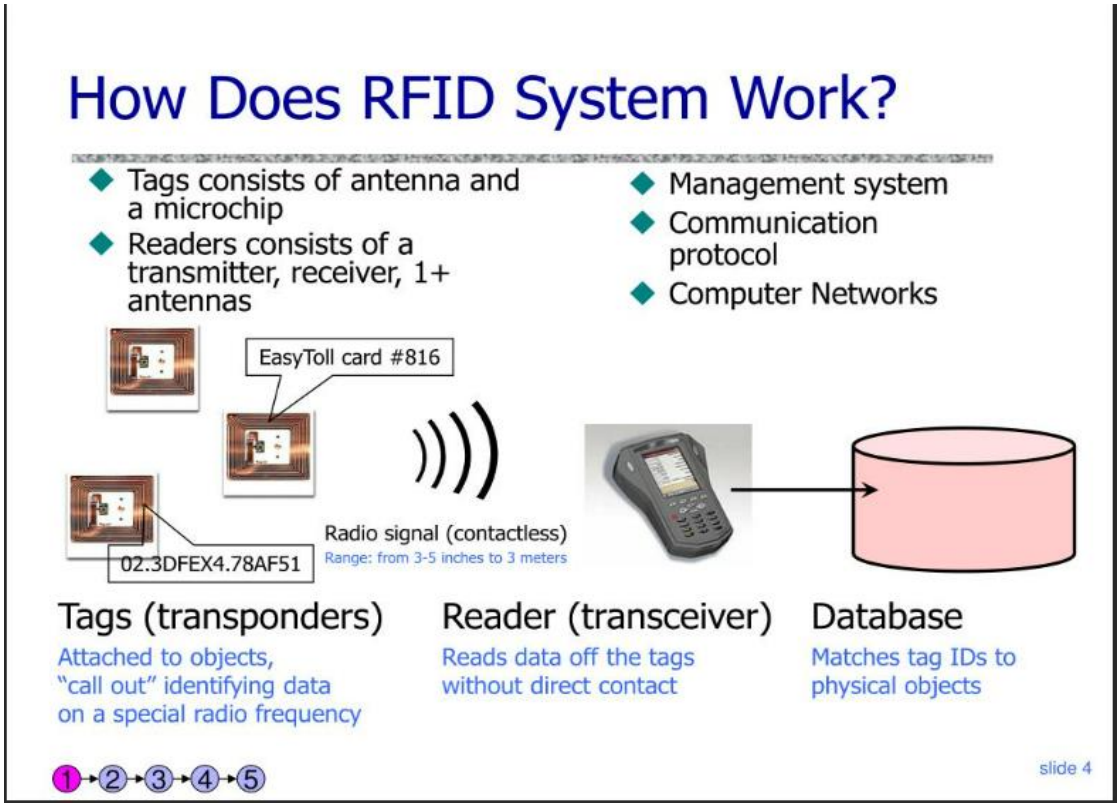


Figure 2.4. How RFID system works

Radio frequency identification devices (RFIDs) are utilised in supply chains to monitor products (Angeles, 2005). An RFID, also known as a tag, can be affixed to an item of merchandise and provides information about its nature and location to a reader. Fig. 2.4 illustrates how the reader can transmit this information to a management system that can create a detailed image of what merchandise is located where.

A passive tag lacks a power source, whereas an active tag has one. Active tags require a battery, with a limited lifespan, and are more expensive. An antenna is a device that employs radio waves to receive and/or write data to tags. The reader manages the antenna to management system interface. RFID technology has a significant advantage over barcodes in that the tag does not need to be in direct line of sight with the reader; readers can detect tags remotely because radio waves can travel through many materials. Trials of varying frequency have been conducted, but standards are still being debated in numerous industries. The management system

enables the collection and classification of data from identifiers for the purposes of management information and action.

The electronic product code (EPC), which is unique to each tag, is the most important piece of data stored on a tag. The unique number can be linked to information about the product to which it is affixed, such as the date and location of production, the origin of its components, and its shelf life. Some categories may contain this information. Nonetheless, it is anticipated that many identifiers will contain the EPC and that additional data will be stored remotely in a database linked to the management system.

Readers describe the product and its position in the supply chain. This information is compiled by the management system, allowing users to determine how many products are present at each location for each time segment. This translates to dynamic data that enables the determination of consumption rates, stock data at a given moment in time, and necessary actions. One can imagine that such data will transform supply chain planning and management.

Los Angeles, 2005 Product identification enables several intriguing applications, such as:

• monitoring products throughout the distribution pipeline (asset monitoring) to provide continuous SKU-level quantities and positions.

• Monitoring products from the rear of the store to the shelves.

• Intelligent shelves, whereby'sweeping' of merchandise from store shelves by criminals is automatically detected and alarms are activated.

• Recording transactions without the assistance of a cashier.

• The ability to understand when products are in the store but not on the shelf (an uncontrollable source of lost sales for manufacturers) and the reduction of larceny opportunities.

• Benefits for retailers include the ability to monitor products in the pipeline against delivery schedules, as well as the automation of the checkout process.

• Capability to expand customer purchasing information.

Products can be tracked all the way to and within the customer's residence. Benetton's plan to monitor products after the sale with an eye on returns was met with customer opposition on the grounds of privacy invasion. This caused Benetton to delay the implementation of this concept. Another significant barrier to implementation is the cost of the identifiers. (Roberts and Berg, 2012) Due to the price/margin levels of many consumer-packaged goods, the cost of identifiers must be low enough to be affordable at the individual product level.

In addition to product-level tagging in retail channels, many other applications exist at the case or raw material level, as well as in higher-value goods such as automotive parts (Roberts and Berg, 2012).

2.3.8 Inter-organisational ICT

2.3.8.1 Big data Analytics

(Chen et al., 2015) Big data analytics has recently gained prospective prominence because of the increased ability to both capture vast quantities of data and apply more powerful analytical techniques to vast data sets. According to Jagadish et al. (2014), the recent ability of firms to collect big (and diverse) data and apply powerful analytical techniques to such data enables the organisation to automate highly complex decisions that have historically relied on human judgement and intuition.

Recent industry reports indicate that many chief information officers (CIOs) and business executives have been reluctant to make significant investments in big data analytics, particularly after directly experiencing or indirectly observing (i.e., other firms) unsuccessful initiatives aimed at gathering business intelligence (often from terabytes of data). Some CIOs and business executives may question whether BDA is solely a repackaging of traditional business intelligence or whether it truly embodies new capabilities that justify significant investments and provide competitive advantages (Jagadish et al., 2014).

2.3.8.2 Internet of Things

According to Ben-Daya et al. (2019), the Internet of Things (IoT) refers to a network of physical objects that are digitally connected and possess the ability to sense, monitor, and interact both within a company and across its supply chain. This interconnectedness facilitates various advantages such as enhanced agility, visibility, tracking, and information sharing. Consequently, it enables the timely planning, control, and coordination of supply chain activities. Xu et al. (2014) propose a conceptual framework for the Internet of Things (IoT) network, consisting of four fundamental layers. The first layer, known as the sensing layer, encompasses the integration of pre-existing hardware components that facilitate the sensing of the physical environment and the acquisition of relevant data. The second layer, referred to as the networking layer, is responsible for establishing connections and facilitating the transfer of data across both wireless and wired networks.

The third layer, known as the service layer, plays a crucial role in the integration and management of various services and applications through the utilisation of middleware. Lastly, the interface layer serves as the interface between the IoT system and the user, providing information display capabilities and enabling user interaction with the system. The adoption of services and apps allows for the collection and processing of Big Data by the Internet of Things (IoT). The scalability of these systems can be improved by easily integrating additional sensors and external data (Xu et al., 2014). Furthermore, data collection has witnessed an increase in scale, accompanied by a notable improvement in the speed at which data can be gathered from diverse sources.

The set of attributes associated with Big Data, namely volume, variety, and velocity, is commonly known in scholarly literature as the triple "V" framework (Arunachalam et al., 2018). The Internet of Things (IoT) possesses the capability to gather various data such as locations, temperatures, shocks, and other factors. This data collection facilitates the improvement of data sharing, agility, and visibility, ultimately leading to an elevated level of transparency (Miorandi et al., 2012). According to Whitmore et al. (2015) and Ben-Daya et al. (2019), The enhancement of Supply Chain Relationship Management (SCRM) can be observed through the collection,

generation, processing, and exchange of data using mobile applications or information systems situated in data centres or cloud platforms. These elements contribute to improved data availability and process management within SCRM.

2.3.8.3 Artificial Intelligence

AI has been utilised effectively for projections and forecasts. Organisations are perpetually concerned with balancing supply and demand (Antonopoulos et al., 2020). Therefore, a more accurate forecast is required for its manufacturing and supply chain. As AI can process, analyse (automatically), and most importantly, predict data, it provides accurate and reliable demand forecasting, allowing businesses to optimise their sourcing in terms of purchases and order processing, thereby reducing costs associated with transportation, warehousing, supply chain administration, etc (Desmond et al., 2021). In addition, it identifies trends and patterns that facilitate the development of superior retailing and manufacturing strategies. Businesses utilise this tool in a variety of methods, including stocking only the required quantities. (Bughin et al., 2017) Robotics, one of the advanced branches of AI, has assumed a prominent role in production. Technological advances in object recognition and semantic segmentation have altered the behaviour of robotics, particularly in terms of how they recognise the properties of the materials and objects with which they interact.

AI has played an important role in production due to a) improved optimisation of assets and processes, b) designing the best teams, i.e., people and robots, c) improvement in quality and reliability, i.e., error-free, and d) prevention of maintenance downtime. The automation process has advanced significantly due to AI technologies. (Bughin et al., 2017) Robotics, one of the advanced branches of AI, has assumed a prominent role in production. Robots' behaviour has been altered by technological advances in object recognition and semantic segmentation, particularly in terms of how they recognise the properties of the materials and objects they interact with. The newly developed AI-enhanced, camera-equipped robots are programmed to identify vacant shelf space. This results in a significant speed advantage over conventional methods of object selection (Bughin et al., 2017). Multiple channels are utilised by businesses to reach consumers via digital content,

which has become the norm. Digital advertising buys (programmatic buying), website operation and optimisation, search engine optimization, outbound email marketing, lead filtering and scoring, and numerous other marketing duties are supported by AI (Dash et al., 2019).

2.3.8.4 Blockchain

Bitcoin is supported by the blockchain technology, which was proposed in 2008 resolve to the two-fold-spend problem (Vijayalakshmi and Murugan, 2021). The occurrence of double-spend occurs when digital currency used in one transaction is duplicated to finance additional transactions. Blockchain technology is a fusion of transaction consensus within a decentralised peer-to-peer network with cryptographic mechanisms that guarantee the verification of each transaction and prevent any subsequent modifications after consensus has been achieved (Nakamoto, 2008).

Nevertheless, despite the anticipated potential, due to the immaturity of the technology, there are few, if any, large-scale deployments in a commercial setting, and the benefits are therefore unproven. In 2018, IBM collaborated with several major corporations to implement blockchain technology.

How do blockchains work?

Consortium and permissioned networks, which find application in corporate or supply chain contexts, occupy a position in the middle of the spectrum due to their relatively heightened level of centralised control.

Centralised ledgers, akin to existing database technology,

According to Li et al. (2020), the fundamental element for establishing identification on public blockchains is public keys, as opposed to personal information. In the context of a blockchain, every participant possesses a pair of cryptographic keys, namely a public key and a private key. These keys function in tandem to facilitate the encryption and decryption processes of data. Asymmetric cryptography guarantees that the generation of a public key from a private key is feasible, whereas the reverse process is not possible. Therefore, it is imperative to ensure the security of private keys to prevent potential compromise of data (Lim et al., 2018).

Transactions that have been digitally signed but have not yet been added to the blockchain are organised in a sequential manner to create a block. These blocks are subsequently distributed to the network for the purpose of validation. After the completion of this process, the block is affixed to the preceding block in the sequence, so establishing a timestamp indicating the moment of its inclusion. Therefore, it can be shown that every participant in the blockchain possesses an indistinguishable replica of the ledger (Lim et al., 2018).

2.3.8.5 Benefit of Blockchain

Gallacher (2017) enumerated the advantages of blockchain technologies in supply chains on which there is consensus among researchers:

Have confidence Blockchain technology and associated data management processes can instill confidence within the supply chain. However, while this is advantageous for supply chain partners with few or no established relationships, it could be argued that trusting blockchain asks people to trust the system rather than each other, which could have a negative impact on the existing level of trust within established, mature relationships.

The safety of It is anticipated that blockchain will improve data security and reduce fraud in general, particularly due to the resilience and redundancy offered by the distributed or decentralised nature of the networks.

Transparency and source of origin Blockchain can provide transparency and traceability that guarantees provenance throughout the supply chain. However, providing end-to-end transparency and provenance requires the provision of digital representation at each handoff point throughout the supply chain.

Cost and operations effectiveness: Following the resolution of a dispute, there are direct cost reductions resulting from accelerated transaction cycle times and the release of working capital. Transparency and the coupling of physical products, digital representations, and documentation as they flow through are expected to result in operational efficiencies.

Change Blockchain will continue to bring about change, particularly in terms of new processes and prospective business models, the way businesses and supply chain partners collaborate, the required skill sets, and organisational transformations.

Given the immaturity of blockchain technology, it is not surprising that there is resistance to change regarding: - A new form of relationship (increased data sharing) with supply chain partners and consortium members (who may be competitors).

- The elimination of legacy systems and processes.

- Educating individuals to perform new roles to facilitate successful transformation and widespread adoption. - Uncertainty regarding which processes should be migrated to the blockchain and how this migration will occur.

In a world where geopolitical, economic, and natural disaster-related risk factors are on the rise, it is difficult to conceive that blockchain will not be adopted on a large scale.

2.3.8.6 Cloud Computing

Cloud computing can be integrated as a software to enhance performance, and relational benefits among organisations. Security and data vulnerabilities are currently one of the prime obstacles to cloud computing (Subramanian and Jeyaraj, 2018). This further emphasises the significance of trust among firms (a form of social investement) among supply chain participants to improve cloud computing-based information sharing. Given this study's emphasis on the social investment implications of cloud computing, social capital theory provides a valuable theoretical foundation for examining the merits and demerits of cloud computing and the processes in which organisations can enhance cloud computing to provide an atmosphere for strategic information sharing and supply chain performance.

Cloud computing has enabled providers of supply chain management to leverage on new processes associated with delicate space (Markim, 2015). Cloud computing has enabled on-demand access to information vital for procurement practice es, stock optimisation, sales, and operations planning (Mohammad et al., 2019; SCM World, 2013). Non-conventional supply chain processes have focussed on tangible IT softwares. With cloud computing, inventory data is updated in real-time, eliminating

the need for partners to wait for central servers to release data across a supply network (Grey, 2015). Using cloud computing, businesses can share reliable inventory and sales data, leading to tighter coordination between channels and more effective supply chain and consumer analytics (Maziliauskaite, 2015). This is particularly useful for larger organisations with numerous supply chain partners, each of which utilises a different platform. When supply chain partners need to request or monitor supplies and inventory in real-time, these disparities in platforms can create complications. This issue can lead to time delays and costly mistakes, thereby increasing a company's capital and IT labour expenses. In addition, cloud computing provides server capabilities on demand. Many supply chain organisations with in-house IT systems utilise between five and ten percent of their server resources (Liu et al., 2013; Agility, 2013). With cloud computing, businesses only pay for the server resources they utilise. Additionally, new servers can be added on demand with or without extra fees. This is beneficial in situations where demand fluctuates significantly. Each additional order necessitates an increase in bandwidth and processing capacity. A provider of supply chain management can extend services with a cloud host within minutes to accommodate the expansion of capabilities (Markim, 2015).

2.3.9 ICT implementation strategy

In supply chain industries, common ICT implementation strategies revolve around enhancing efficiency, visibility, and responsiveness. These strategies include adopting advanced inventory management systems to optimize stock levels, implementing RFID and IoT for real-time tracking of goods, and employing data analytics to forecast demand and streamline logistics. Cloud-based platforms enable collaboration among supply chain partners, while automation and AI-driven algorithms improve route planning and warehouse operations. Moreover, blockchain technology is used to enhance transparency and traceability. These strategies ultimately reduce costs, minimize errors, and improve overall supply chain performance, ensuring timely delivery and customer satisfaction.

2.3.9.1 ICT implementation strategy in developed countries

In developed countries like US, UK and China, ICT implementation strategies focus on leveraging technology to enhance economic competitiveness and quality of life (Young, 2005). They typically prioritize robust digital infrastructure, widespread broadband access, and a skilled workforce. In China Governments often collaborate with private sector stakeholders to drive innovation and investment. While in UK and US Public-private partnerships, regulatory frameworks that foster innovation, and incentives for research and development are common (Xia, J. (2011). Developed nations emphasize data privacy and cybersecurity to protect individuals and organizations. Wan et al., (2022) added that Education systems are adapted in developed economies to teach digital literacy and promote STEM education, engage in continuous research and development to remain at the forefront of emerging technologies like AI, IoT, and 5G.

2.3.9.2 ICT implementation strategy in fast developing countries

In developing countries, ICT implementation strategies are tailored to address unique challenges and opportunities. Countries like India, Turkey, and Korea, prioritize building essential digital infrastructure, expanding affordable internet access, and fostering digital literacy (Jamil, 2021). Governments often collaborate with international organizations and seek foreign investments to fund these initiatives. To spur innovation, they may offer tax incentives, encourage entrepreneurship, and promote tech startups (World Bank Group. 2016). The report observe that data privacy and cybersecurity regulations are developed to protect citizens and attract foreign investment. Education is a key focus, with efforts to integrate digital skills into curricula and provide vocational training. Developing nations also seek technology transfer and partnerships to accelerate technological progress and economic growth.

2.4 Supply chain integration

The information technology system facilitates the integration of supply chain processes (Bocij et al., 2019). The administration of supply chain expands this integration across supply chain organisations. The technique of value chain analysis can be used to examine supply chain integration decisions from the perspective of

which set of activities should be undertaken, rather than from the perspective of products and services. This strategy permits for consideration of the fact that outsourcing one product or service may have cost implications for other products or services produced with the same resources. However, value chain analysis seeks to align activities to minimise cost, given a company's competitive strategy, and does not specify where activities should take place (Bocij et al., 2019). The decision must be made within the constraints of the organization's available resources for procuring supply chain elements and the difficulty of coordinating supply chain activities. Table 2.1 provides a concise explanation of supply chain integration.

Table 2.3 Definition of supply chain integration

Study	Supply Chain Integration Definition
Flynn *et al*. (2010, p59)	"The degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organisation processes. The goal is to achieve effective and efficient flow of products and services, information, money and decisions, to provide a maximum value to customer at low cost and high speed".
Kwon and Suh (2005, p26)	"A strategic tool, which attempts to minimise the operating costs and thereby enhancing values for the stakeholders (customers and shareholders) by linking all participating players throughout the system, from supplier's suppliers to the customers"
Zhao *et al*. (2016)	"The degree to which an organisation strategically collaborates with its supply chain partners and manages intra and inter-organisation processes to achieve effective and efficient flows of products, services, information, money and decisions, with the objective of providing maximum value to its customers"
Chen *et al*. (2009b, p66)	"The management of various sets of activities that aims at seamlessly linking relevant business processes within and across firms and eliminating duplicate or unnecessary parts of the processes for the purpose of building a better-functioning supply chain".
Wong *et al*. (2011, p605)	"The strategic collaboration of both intra-organisational and inter-organisational processes".
Study	**Supply Chain Integration Definition**

2.4.1 Drivers of supply chain integration

There are unprecedented pressures on business and enterprises to improve their operational efficiency for enhanced competitiveness and overall business performance. Such pressures include competition from foreign products, new product introduction by competitors, falling product life cycles, unanticipated customer shifts, and advances in information and communication technologies (Schilling and Seuring, 2022). Other pressures include the privatisation of public

enterprises, economic recessions, and shareholder demands for increased investment returns. These pressures have significantly reduced the amount of **available public and private loanable funds. In addition, the sophistication of consumers and the** emergence of intelligent products have resulted in more stringent design specifications and higher expectations regarding deliverable value added (Slack et al., 2023).

The most difficult challenge currently confronting businesses and organisations is how to integrate various outsourcing functions and delivery functions with product design and manufacture (Hill et al., 2012; Hill, 2005). (Gunasekaran and Yusuf, 2002; Yusuf et al., 1999) Integration would enable the value creation and transfer process, from supplier to customer, to operate as a chain along which information, knowledge, equipment, and tangible assets flow efficiently.

Continuous flow of physical assets of divers' nature amongst enterprises would lead to pooling synergy and optimisation of visible and invisible resources that are available to the individual entities (Christopher, 2016). The principles of job specialisation can be applied to facility operations by supply chain members. This means that design can take place in a remote location far from other plants where components are manufactured and assembled in a smaller number of factories or at the point of sale (Harrisons et al., 2019). (Yusuf et al., 2004; Quinn, 1992) Enterprises in the network will benefit from concentrating on a narrow aspect of operations where they have the greatest competitive advantage.

Information and communication technology (ICT) innovations, which have transformed the world into a global village by facilitating instant transfers of information, data, and files, are a significant factor in supply chain integration. Distributed entities can access a single data file concurrently via the Internet. The applications were extended to logistics and supply chain management (Yusuf et al., 2004). Previously, ICT applications supported the reliable and verifiable transmission of trading reports, cash, other assets, and obligations.

As well, enterprises' growth through vertical integration and search for new markets in different nations has given rise to large administrative structures (Powell, 2003).

The need to process and transfer large volumes of data in the form of designs, plans, budgets, and reports across several administrative and operation processes becomes necessary. Yusuf et al., (2004) Cost, personnel, stock, sales, and profit profile information had to be shared between businesses that merged to form integrated global businesses. In addition to being able to monitor seve ral alliance conditions, such as compliance, contribution, and attribution, this feature permits the monitoring of compliance, contribution, and attribution. The described business case necessitates sophisticated ICT applications with more functionality than electronic data interchange (EDI). Consequently, (Yusuf et al., 2004) new ICT capabilities have emerged in terms of reach and easier coding via inheritance, adding new data and generating automatic enhancements, and protecting data file components from unauthorised parties.

However, market fluctuations caused by factors such as regular introduction and customisation of new products, sophisticated design specification, and consumer shifts makes continuous contact with customers and suppliers through supply chain integration critical (Slack et al., 2023). In addition, companies' diverse functions and dispersed project divisions require increased coordination and integration. As competition intensified, efforts to reduce costs through just-in-time (JIT) purchasing, scheduling, and distribution led to routine monitoring of quality, delivery schedules, and other customer expectations. Some manufacturers have organised networks of suppliers and imposed" their organisational structures and systems for these reasons.

The introduction of sophisticated products, whose conditions are challenging for individual entities, poses the greatest challenge to supply chain integration. The need arises to collaborate with other businesses while focusing on limited product modules with the greatest competitive advantage (Jurison, 2019; Quinn, 1994). According to Soliman and Youssef (2001), the processes of conception, design, manufacture, and delivery are becoming a relay race amongst legally separate companies that work with equal vigour and dedication to contribute the most value to customers. In this regard, the sharing of design and manufacturing knowledge and competencies amongst companies is a crucial instrument for competition, as it

improves customer tracking and reduces product and process development cycle times (Yusuf et al., 2004).

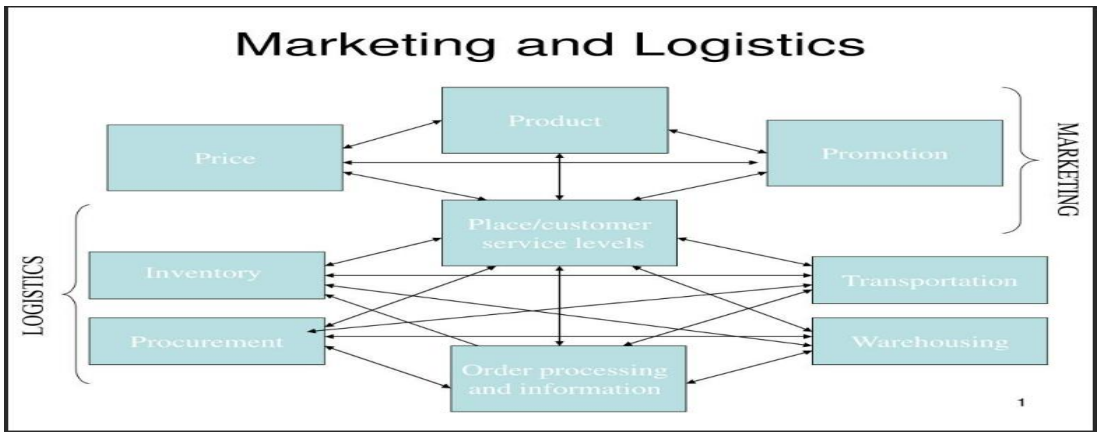
2.4.2 Types of supply chain integration

Zhang et al (2016) identified two types of supply chain integration. These include internal and external supply chain integration. In the same vein, Harrisons et al. (2019) suggested three form of supply chain integration. These are internal, external, and electronic integration.

2.4.2.1 Internal integration: function to function

Kanyoma et al. (2018) and Stank et al. (1999) investigated the integration of marketing and logistics functions within a formal organisation. They argued that the functions of sales and operations can enhance the integration between functions. Stank et al. (1999) discovered that more consistent integration practises between marketing and logistics resulted in improved performance and effectiveness within departments. This may look apparent, but the performance enhancements included a reduction in cycle time, improved in-stock performance, increased product availability, and reduced order-to-delivery lead times. This is due to the successful determination of competing objectives when related alignment factors for marketing and supply chain management are considered.

Figure 2.5. describing Marketing and Logistics function to function



Zhao et al. (2011) exhibited that firms with greater internal integration proved superior logistics performance in comparison to firms with lower levels of internal integration. There was no difference between variations in integration within firms in terms of fundamental service, defined as the consistent delivery of requested data and the notification of delays and shortages in advance. However, there was a significant disparity in 'higher value' service elements, such as delivery reliability. Companies with a high level of integration performed better in terms of meeting customer requirements, accommodating special customer requests, and introducing new products. This resulted in improved customer perception of the companies. Similar conclusions were reached by Windahi and Lakemond (2006), namely that the company is developing integrated products and services, such as "power for life."

Gimenez (2006) studied manufacturing sectors and found that firms with the highest levels of internal integration between logistics, production, and marketing attain the highest levels of external integration. The implications of the study are that businesses must continue to improve their internal integration. The following scenarios may result from functional barriers between purchasing, production, and distribution:

- Purchasing purchases castings at a low price, but the supplier has a poor reputation for delivery reliability and product quality. The manufacturing industry faces unreliable deliveries and high rejection rates.

In order to maintain high machine and labour productivity, batch sizes are maintained large. Distribution struggles with limited availability, particularly of class B and class C components.

- Distribution opposes any post-manufacturing operations to maintain a high throughput warehouse operation. Customization of products increases the difficulty of manufacturing.

Internal integration is the essential beginning point for broader supply chain integration. According to Robert Lynch (quoted in Kirby, 2003, p. 69), alliance professionals find it simpler to form partnerships with their major competitors than with other divisions within their own companies. We are not responsible for our

internal integration. How can we integrate externally if we are unable to integrate internally?

2.4.2.1.1 Alignment between supply chain company and other businesses

Key functions that comprise the supply chain or impact supply chain performance must be aligned regarding their respective priorities, opportunities, and strategies. This is frequently not the case, which hinders supply chain efforts and may be the difference between "great plan" and "great successes."

2.4.2.1.2 Alignment between supply chain and new product development

New product development is a key partner function that deserves internal operational alignment focus. Harrison et al. (2019) considered product design for usability from the product designer's perspective. However, it is pointed that the impact of the supply chain on new product launch and new product development is important in areas such as: transportation of products to market fast enough (before product launch dates); Ensuring sufficient stocks level at the launch date; and ensuring a flow of parts for new product manufacturing (see van Hoek and Chapman, 2006 for details).

2.4.2.2 External integration: company to company

If internal integration could achieve significant improvements, potential for the benefits of external integration could be even higher (Harrison et al., 2019). Analysis of the supply chain reveals that production delay times are frequently measured in weeks as opposed to days. This is the result of excessive inventories of raw materials, packaging materials, and intermediate products held against the ultimate manufacturing point. There are three levels of service that could improve coordination and reduce inventories. These include collaborative planning, vendor-managed inventory, and just-in-time or supplier in plant (Harrison et al., 2019).

2.4.2.2.1 Electronic linkages and integration

Visibility throughout the entire supply chain is of paramount importance in the struggle for competitive advantage. Business-to-customer (B2C) integration have been transformed by the rapid growth of Internet technology and the increased computing utilisation of personal computer. Electronic linkages provide organisations with a cost-effective method for integrating information systems throughout the supply chain in business-to-business (B2B) relationships (Harrisons et al., 2019).

Internet provides an independent communications infrastructure that can be utilised as an inter-business interface to facilitate electronic commerce. Consequently, it promotes operationally efficient, connected, and cooperative relationships between manufacturers, suppliers, and distributors (Harrison et al., 2019). The Internet can provide a simple and cost-effective solution that is accessible to partners electronically integrated. Trading partners can be electronically connected in three possible ways:

Sharing of information

Transactional visibility, and

Stakeholder collaborative planning.

2.4.2.2.2 Sharing of Information

Supply chain vendors are granted access to a system containing shared data. However, partners frequently transmit shared information to one another. Product descriptions and prices, inventory levels, and shipment tracking and tracing are examples of information that may be shared (Lee et al., 2000). This type of platform facilitates each collaborator's independent planning. Each participants awareness of the other's actions reduces uncertainty. However, the architecture does not permit trading partners to provide feedback or alter the system.

The concept of information sharing was realised through the visibility of continuous replenishment in the supply chain. (Min et al., 2005) Continuous replenishment logistics is a pioneering method of utilising advances in information technology (IT)

to rapidly supplement supply and demand from the manufacturer. Using electronic point-of-sale data to monitor customer demand through the cash register, stock update ensures shared information between retailers and suppliers. The objective is for the supplier to rapidly replace today's sales to maintain stocks availability at the retailer level (Harrison et al., 2019).

2.4.2.2.3 Electronic transactions (ET)

Electronic transaction in the form of business-to-business (B2B) e-commerce, is a form of supply chain collaboration performed on the automation of business transactions such as purchasing orders, invoices, order, advanced shipment notices, tendering, freight invoices and payments. These forms of transactions entail the information fields outlined in electronic data interchange (EDI). Chang et al., 2019 More recently, blockchain has emerged, allowing for more secure and traceable transactions between supply chain participants, facilitated by various forms of electronic integration such as electronic data interchange (EDI), radio frequency identification devices (RFIDs), and blockchain, among others.

2.4.2.2.4 Antecedents to supply chain integration

The factors that facilitate or hinder the implementation of a supply chain integration philosophy are the antecedents to supply chain management. Lysons and Farrington (2020) identified 19 factors that contribute to the failure of supply chain integration. These elements were:

• Poor communication • Lack of management support • Lack of trust • Lack of quality commitment from suppliers

• Changes in market environment • Too many customers for effectively management

• Cultural barriers • Differences in management approach • Decentralisation of procurement function • Un reliable status of customer's • location barriers

Ryciuk and Nazarko, (2020). proposed that cooperation arise from both trust-based relationship and commitment is key factor of supply chain integration. According to Sahay (2003), trust is the disposition to rely on an exchange partner in whom one has confidence. Though both trust and commitment are necessary for cooperation to

succeed, trust is a significant predictor of relationship commitment (Zineldin and Jonsson, 2000). Thus, there are direct and indirect relationships between trust and cooperation. Bstieler, (2006); Johnston et al., (2004) highlighted the role of trust to solve mutual problems such as power, conflict, and poor investment returns. Thus, it is proposed that trust effect the sharing of risks and rewards.

The definition of commitment by Dhyan et al. (2006) is "an implicit or explicit pledge of relational continuity between exchange partners." Commitment is essential for the successful long-term relationships that are a component of supply chain management implementation. Dhyani et al. (2006) also note that supply chain management implementation requires the commitment of resources and empowerment to achieve stated objectives.

Combining the effects of trust-based relationship and commitment, Hess, and Story, (2005); Morgan, and Hunt (1993) state, "commitment and trust-based relationship are essential because they encourage vendors to:

• Work at sustaining relationship investments by collaborating with exchange partners.

• Resist desirable short-term options against the expected long-term benefits of staying with existing partners; and

• Perceive high-risk actions as profitable because of the expected long-term benefits of staying with existing partners."

Therefore, alliances founded on trust and commitment result in cooperative behaviour in the implementation of supply chain integration across multiple companies to achieve supply chain management.

The shared dependence of a firm on a partner refers to the firm’s need to sustain a relationship with the partner to achieve its goals (Xia, 2011). Established dependence is a superior factor in the development of supply chain alliance (Rogers et al., 2020). In addition, this dependence is what encourages partners to negotiate functional transfer, share relevant data, and engage in joint operational planning (Rogers et al., 2020; Bowersox and Closs, 1996). Finally, Gil-Saura et al., (2011) proposes that

reliance of a supply chain firm on another firm is positively related to the firm's long-term inclination of the relationship.

For successful supply chain management, the business philosophies and management techniques of each firm in a supply chain must be compatible (Tien et al., 2019; Tan, 2002). Organisational compatibility is defined as complementary objectives and similar operating philosophies and business principles (Sarkar et al., 2001); proven that organisational alliance between the firms in an business relationship has a significant positive impact on the relationship's efficiency. Tummala et al. (2006) argued that the significance of business practise and supply chain members' compatibility cannot be overstated. Organisational compatibility in a supply chain implies that all companies must integrate to implement supply chain management.

Tummala et al., (2006) suggest there should be an agreement on supply chain management vision and key processes. Ross (2002) contents that the creation and communication of a market-winning competitive supply chain management vision shared not just by individual firms but also by the whole supply chain. Visioning provides firms with specific objectives and strategies on how they plan to identify and realise the opportunities they expect to find in the marketplace (Ross, 2002).

From the perspective of supply chain's organisational structure, a company must undertake the role of leadership (Ross, 2002). Mentzer et al. (2001) argued that supply chains companies require leaders. According to Kozlenkova et al. (2015), a supply chain leader is corresponding to a channel commander in the marketing channels literature and plays a crucial role in coordinating and monitoring the entire supply chain. (Yu et al. (2013) suggested that in many instances, a particular firm may function as a supply chain leader due to its size, economic power, customer loyalty, trade alignment and establishment of inter-firm relationships.

Recent Research proves that the success of supply chain management is directly correlated to the presence of constructive leadership capable of stimulating cooperative behaviour between participating firms (Torfing, 2019). However, forced

participation by a strong supply chain leader will encourage exit behaviour where the option exists (Gattorna, (Ed.). 2017).

Lastly, many scholars argue that the support of top management is crucial in determining an organization's values, orientation, and direction (Hunt and Baruch, 2003; Smith et al., 2006). Furthermore, top managers have a significant impact on organisational performance. According to Durach et al. (2015), top management support, leadership, and commitment to change are crucial preconditions for supply chain management implementation. In the same context, Durach et al. (2015) argue that a lack of support from upper management is an obstacle to supply chain management. A company's recognition of the significance of these antecedents is a prerequisite for supply chain integration. When all firms in a supply chain achieve integration, they can initiate the supply chain management implementation process. In other words, supply chain integration represents a company's willingness to address strategic issues and systemic perspectives. Management of the supply chain is accomplished when several firms in the supply chain are integrated and progress towards implementing the supply chain alignment management philosophy.

For instance, a supply chain is comparable to a whole production system with products and services constituting linked units of interdependent production and marketing activities. Irrespective of a company recognising the systemic and strategic implications of the supply chain in which it operates, the chain exists. Handfield et al. (2005) state that supply chain management can only result in a well-managed supply chain if several firms directly linked within the supply chain have supply chain integration and actively manage to that alliance. Chain integration is a company's deliberate plan to confront strategic and systemic issues. Management of the supply chain is accomplished when several firms in the supply chain are integrated and progress towards implementing the supply chain alignment and management philosophy.

2.4.3 Consequence of supply chain integration

The purpose of supply chain integration is to increase competitive advantage in the supply chain (Gunasekaran and Ngai, 2004). Two kinds of competitive advantage are

described by Wang et al. (2011): cost leadership and differentiation. According to Markley and Davis (2007), a company can increase its competitive advantage and profitability through supply chain management by boosting consumer satisfaction overall. Similarly, Chandra and Kumar (2000) proposed that supply chain management seeks to deliver enhanced customer service and economic value by integrating and/or synchronising the management of the flow of materials, products, and associated information from sourcing to consumption. According to Hemmatfar et al. (2010), a firm's competitive advantage stems from the customer value it creates and seeks to establish a profitable and sustainable position in opposition to the forces that determine industry competition. Thus, it is proposed that the implementation of supply chain management increases customer value and contentment, leading to an increase in competitive advantage for the supply chain as well as for each member company. This ultimately increases the supply chain's and its members' profitability.

Specific objectives to improve profitability, competitive advantage, and customer value/satisfaction of a supply chain, as well as its participants, are suggested by several researchers (Walters and Lancaster (2000); Mentzer et al., 2001). A key objective of supply chain management is to lower the costs required to provide the necessary level of customer service to a specific segment (Lambert and Schwieterman 2012). The other key objective is to improve customer service through increase stock availability and reduced order cycle time (Mason et al., 2003). Customer service objectives are accomplished through a customer-enriching supply system focused on developing innovative solutions and integrating the flow of products, services, and information to create unique, individualised sources of customer service value (Ross, 2002). Finally, low cost and differentiated service help build a competitive advantage for the supply chain (Militaru and Şerbănică 2008; Baroto and Abdullah2011; Hemmatfar et al., 2010). As such, supply chain management is concerned with improving both efficiency (i.e., cost reduction) and effectiveness (i.e., customer service) in a strategic context (i.e., creating customer value and satisfaction through integrated supply chain management) to obtain competitive advantage that brings profitability (financial performance). Figure 2.3

represents the summary of antecedents and consequences of supply chain integration.

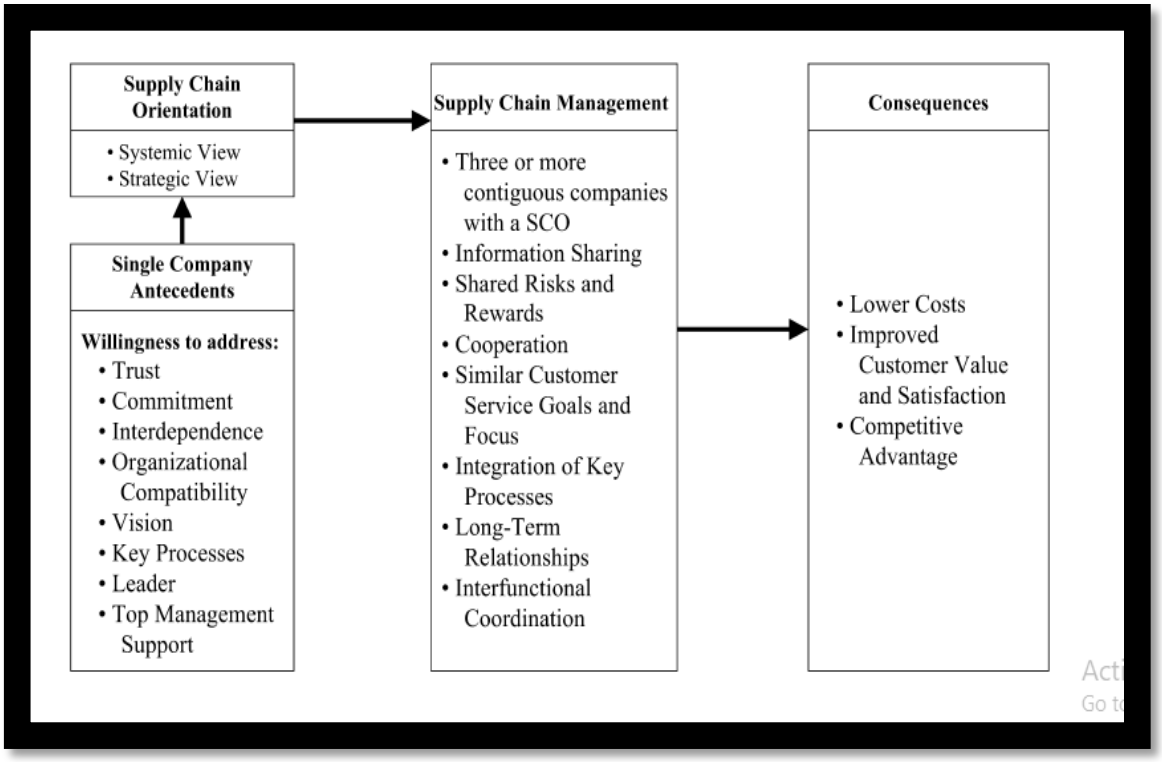


Figure 2.6 Supply chain integration antecedents and consequences

2.5 Supply chain performance measurement system

A performance measurement system can be characterised as a collection of metrics utilised to estimate the efficiency and effectiveness of actions (Sharahi and Abedian, 2009). The concepts of efficiency and effectiveness are employed within this setting. Efficiency can be defined as the quantification of the economical utilisation of a firm's resources in relation to the provision of a specific level of customer satisfaction. On the other hand, effectiveness refers to the degree to which client demands and expectations are fulfilled. This statement delineates two primary aspects of performance while also emphasising that there exist both internal and external motivations for undertaking courses of action (Sharahi and Abedian, 2009; Neely et al., 1995). Performance measurement encompasses the procedure of quantifying the efficiency and effectiveness of actions. A performance measure, as defined by Sharahi and Abedian (2009), is a statistic employed to quantify the efficiency and effectiveness of an action.

The performance measurement for supply chains is equivalent to that of individual activities. As previously said, the primary aims of these objectives are to effectively provide end customers with products and services that align with their expectations (Slack et al., 2023). Customers engage in the process of making purchasing decisions based on a multitude of factors, including but not limited to pricing and service aspects associated with the intended purchase. To effectively cater for client wants, it is imperative for firms to strategically position themselves (Hines, 2014). Hence, the competitive position in the market environment is influenced by various crucial operational tactics. These factors encompass cost, supply reliability, quality, speed, adaptability, and resources management efficiency (Slack et al., 2023; Hines, 2014). Based on a comprehensive examination of surveys conducted in the field of supply chain management (Van der Vaart and Van Donk, 2008), it has been observed that there is a shift towards utilising broader, less operational metrics to assess the effectiveness and efficiency of supply chain activities. These metrics encompass indicators such as return on investment, market share, and other financial performance measures, which are considered pivotal in evaluating supply chain performance. In addition, there has been considerable interest in exploring alternative performance measures such as social and environmental indicators. However, it is important to note that these measurements are not the primary focus of the present study.

According to the information shown in Table 2.3, it can be observed that supply chain performance assessment systems are comprised of multiple distinct performance metrics. There exist a multitude of methods via which these performance measurements must be situated within a strategic framework, as they possess the capacity to impact the actions undertaken by organisations. Measurement is the act of quantifying, and its impact is to generate activity inside the supply chain. The realisation of supply chain plans, however, can only be achieved via the consistent implementation of actions.

Based on an extensive examination of the existing body of literature on supply chain strategy, Yusuf et al. (2007) put forth the notion that there is a consensus regarding the identification of business and supply chain activities, which consequently serve as crucial benchmarks for evaluating manufacturing and supply chain performance.

These benchmarks include quality, delivery speed, delivery reliability, price/cost, flexibility, innovation, and responsiveness.

2.5.1 Cost

According to Slack et al. (2023), the actions carried out by operations and supply chain managers have an impact on costs. The evaluation of organisational success is mostly determined by the dimension of cost. Maintaining a low cost for products or services enables the company to enhance consumer value by means of competitive pricing (Hines, 2014). Emphasising this attribute will be crucial when the company is engaged in competition with low-cost rivals. According to Hines (2014), relying solely on low cost may not be adequate in attracting and retaining clients, necessitating the organisation to compete on more dimensions. Maintaining the position of the lowest cost provider may not be sustainable in the long run. It is imperative to acknowledge that inside each given market, there exists a singular supplier that offers the lowest cost. The feasibility of competing with the lowest cost supplier is contingent upon the size and competencies of the organisation (Hines, 2013). Commodity markets are characterised by product marketplaces that primarily compete based on price, with customers unable to discern significant differences in the offerings of competing enterprises. Competition in the market is frequently intense, and the ability to generate profit is contingent upon attaining significant levels of sales volume.

In addition to the operational costs associated with the transformation of inputs into outputs within individual operations, the supply chain also incurs additional costs resulting from inter-organizational transactions (Slack et al., 2023). The consideration of transaction costs associated with engaging in trade with a supplier holds significance, particularly when compared to the pricing of the products or services being exchanged (Slack et al., 2023).

2.5.2 Quality

Quality involves meeting customers' expectations, which is an essential task for an organisation (Hill, 2005). Here what an offering comprises (the specification) needs to consider what customer want and expect and what an organisation decides it

wishes to offer. In this way organisations could position themselves in different markets ad seek to attract customers whose wants and expectations match the specification an organisation offers. The quality objective for operations and supply chains is to consistently meet the agreed specification of the product and services an organisation offers (Slack et al., 2023; Hine, 2005). Hines (2014) identified two aspects of quality: first, product/service quality specification, and second, process quality conformance. Improving quality of the products and services offered may be important in the market being served. The organisational objective must be to specify product/service quality at the appropriate level acceptable to the market (Hine, 2014). Overspecification may add cost but not necessarily value from the customer's perspective. Consistently meeting the product specification is referred to process quality conformance. It is important for all firms competing in the market because no customer wants products with defects. Process quality determines the reliability of the product/service and its reliability. Error-free products are the result of 'zero-defect' processes.

According to Slack et al. (2023), the level of quality exhibited by a product or service upon reaching the client is contingent upon the quality performance of the various operations along the supply chain responsible for its provision. The upshot of this phenomenon is that any errors occurring at any stage of the chain have the potential to amplify their impact on the quality of service provided to the end-customers. According to Cagnazzo et al. (2010), the quality management of suppliers plays a significant role in determining the overall level of quality, reducing variations in quality performance, and minimising costs. The metrics pertaining to quality encompass several aspects such as product quality, service quality, quality of delivered products, and quality of documentation.

2.5.3 Speed of delivery

The competitive advantage in certain markets can be influenced by the delivery speed of a product or service (Hines, 2014). The metric of delivery speed is employed as a means of evaluating an organization's capacity to provide products and services within the designated timeframe (Ketchen & Hult, 2007). According to Yusuf et al. (2014), it is one of the competitive strategies. In the realm of supply chain

management, the term "speed" pertains to the efficiency with which consumers may be provided in terms of promptness. Therefore, the attainment of prompt customer response can be accomplished by using strategies such as over-resourcing or over-stocking within the supply chain. Another viewpoint regarding speed pertains to the duration required for items and services to traverse the supply chain (Slack et al., 2023). This will result in a reduction of resource requirements and inventory expenses throughout the supply chain. The ability to strike a balance between the promptness of addressing consumer needs and the efficiency of quick throughput is contingent upon the strategic choices made by the supply chain in terms of competition (Slack et al., 2023). In situations when multiple procedures are involved, a delay in one operation might have an impact on subsequent occurrences. The factor will have an impact on the level of customer satisfaction and result in an escalation of supply costs. The performance metric is influenced by several aspects, such as truck speed, delivery reliability, delivery frequency, and the placement of depots (Gunasekaran et al., 2004).

2.5.4 Delivery reliability

Delivery reliability refers to the ability to deliver goods or services either on schedule or in advance, which can contribute to the establishment of delivery reliability within an organisation. This aspect is of utmost importance as it plays a crucial role in securing repeat business (Hines, 2014). The failure to meet delivery deadlines may have significant consequences, including the potential loss of current contracts and the exclusion from future contract discussions, bidding processes, or tendering opportunities. Supplier performance measurement is a crucial indicator of effectiveness, encompassing the timely and accurate delivery of requested products and/or services at the designated location, in the specified quantity and quality, as per the agreed-upon terms (Huang and Keskar, 2007). According to Cagnazzo et al. (2010), the delivery reliability measures encompass the amalgamation of delivery performance, fill rate, and perfect order fulfilment. According to Yusuf et al. (2014), the measure was identified as the second most significant competitive objective in the supply chain, behind quality. According to Kim (2009), the attainment of delivery reliability can be accomplished by means of supply chain integration. According to

Ho (2007), the measurement of performance is crucial for evaluating supply networks.

2.5.5 Flexibility

Flexibility refers to the capacity of a company to modify its operations or products (Hines, 2014). Flexibility in the supply chain context refers to the capacity of the supply chain to effectively adapt to and manage various alterations and disruptions (Slack et al., 2013). The importance of flexibility cannot be overstated, as it plays a crucial role in enabling organisations to effectively adapt and respond to unpredictable fluctuations in demand within the contemporary business landscape. The concept of a flexible supply chain can be defined as the ability to effectively adapt to the dynamic demands of customers, as discussed by Gunasekaran et al. (2004) and Ketchen and Hult (2007). This encompasses adaptability inside the supply chain process as well as in the final products or services provided to clients. The establishment of a flexible supply chain is of utmost significance to effectively address specific demands by offering a diverse range of products or services. According to Chan (2003), promoting new product introductions is likewise of utmost importance. According to Boule and Scherrer-Rathje (2009), flexibility, from an operations viewpoint, can be described as the capacity of operations to effectively manage uncertainty arising from diverse sources while maintaining the ability to produce various products or product volumes within acceptable parameters of quality, cost, and timeline. Several metrics of flexibility have been identified by Gunasekaran et al. (2004):

- The duration of the product development cycle
- The quantity of products ordered in each lot
- The time required for machine setup
- The frequency at which inventories are turned over

2.5.6 Responsiveness

The capacity to effectively manage fluctuations in demand. Retail businesses sometimes implement promotional strategies to incentivize clients and generate increased demand for specific products or product ranges. Consequently, suppliers must possess the capability to effectively adapt and accommodate these fluctuations in demand. The ability to engage in capacity planning and effectively adapt to fluctuations in demand patterns is a critical capability necessary for the long-term sustainability of an organisation (Hines, 2013).

2.5.7 Innovation

According to Chima and Hills (2007), innovation refers to an organization's capacity to develop novel strategies, goods, services, or operational approaches to gain a competitive edge over their rivals. The rise in customers' expectations serves as a significant catalyst for the innovation of products and services (Bhagwat and Sharma, 2007). The initial scholarly literature pertaining to the concentration of innovation mostly focuses on advancements in technological innovation. The focus subsequently broadened to encompass the development of value-added innovation (Lin et al., 2010). Although enhancing supply chain management is of significant relevance, Gunasekaran and Kobu (2007) discovered that only 27% of businesses incorporate innovation as a metric when evaluating supply network performance. There are two potential factors that may contribute to the current state of affairs: the oversight of the innovation measure by researchers and its limited implementation throughout the industry (Gunasekaran and Kobu, 2007).

According to Thakkar et al. (2009), there is a higher prevalence of innovation activities in larger organisations compared to small and medium enterprises. The innovation of small and medium-sized enterprises (SMEs) is impeded by several obstacles, including impediments related to information and communication technology, as well as limitations in capital and labour resources. Thakkar et al. (2009) conducted a study. According to Halman and Voordijk (2012), a study on performance assessment in the construction industry revealed that the primary factor hindering innovation is the absence of seamless integration across the supply

chain. The researchers claim that the relevance of new product introduction to their business may be limited, since it may not rank among the primary priorities.

Other suggested metrics of innovation include the duration and cost of building development, the adoption of new techniques and materials, and the enhancement of skills. Consistent with the findings of Halman and Voordijk (2012), another study conducted by Lin et al. (2010) demonstrates a favourable correlation between innovation, supply chain integration, and the competitive advantage of firms. Furthermore, Lin et al. (2010) posited that the attainment of innovation is possible by means of supply chain activities. In their study, Bhagwat and Sharma (2007) put out a set of indicators to assess innovation. These indicators include the extent to which suppliers contribute to resolving technical issues, their capacity to address quality concerns, their initiatives in cost reduction, and the level of perceived value of products by customers.

2.5.8 Financial measures

Financial metrics primarily concentrate on the monetary goals and objectives of a company. Financial metrics encompass several indicators such as cost savings, return on investment (ROI), and return on assets (ROA). The significance of these indicators in assessing performance was acknowledged well in advance of the introduction of non-financial measurements, such as operational measures, as highlighted by Kaplan and Norton (2001). Varma et al. (2008) stated that a sole emphasis on financial metrics is inadequate for supply chain management implementations. However, it is imperative to implement these methods in order to assess the financial status of companies. This is particularly crucial as it facilitates the provision of pertinent information to stakeholders and possible investors. According to Gunasekaran and Kobu (2007), financial indicators remain the predominant criteria employed for assessing the success of enterprises. This demonstrates their significant contribution to the overall performance of the supply chain, particularly in relation to the decision-making process. The measures encompassed in this study consist of profitability, return on investment, return on equity, increase in market share, and revenue growth (Yusuf et al., 2007).

2.6 Factors influencing Supply chain practices in Nigeria.

The following are the likely factors to influence supply chain practice in the developing economies.

Table 2.4 decsribing factors impacting supply chain Practices.

Factors	Impact on Supply chain practice
Technological factors	Technological factors significantly impact supply chain practices in Nigeria. Challenges such as limited access to advanced technology, underdeveloped infrastructure, and inconsistent power supply can disrupt logistics and inventory management (Kessides, 2004). However, the increasing adoption of digital platforms, mobile technologies, and e-commerce solutions is gradually improving supply chain visibility and efficiency. Furthermore, the emergence of blockchain and IoT (Internet of Things) technologies holds promise for enhanced traceability and transparency in the supply chain (Venkatesh et al., 2020). Bridging the digital divide, investing in infrastructure, and fostering tech innovation are crucial for Nigeria to optimize its supply chain practices and compete globally.
Economic factors	Economic factors exert a significant influence on supply chain practices in Nigeria. The country's susceptibility to economic volatility, fluctuating exchange rates, and inflationary pressures can disrupt supply chain operations and increase costs. Furthermore, the dependence on oil exports makes the supply chain vulnerable to global oil price fluctuations. High logistics costs due to inadequate infrastructure can also hinder supply chain efficiency (Silvestre, (2015). To address these challenges, businesses in Nigeria must focus on diversification, local sourcing, and robust risk management strategies. Additionally, improving infrastructure, trade policies, and economic stability are crucial for fostering a more resilient and competitive supply chain ecosystem in the country
Environmental factors	Environmental factors are increasingly affecting supply chain practices in Nigeria. Climate change-related issues like extreme weather events and unpredictable rainfall patterns can disrupt agricultural and manufacturing supply chains. To mitigate these factors, companies are adopting eco-friendly practices, sustainable sourcing, and renewable energy solutions. Moreover, regulatory changes and international commitments like the Paris Agreement are pushing for greener supply chains (Rausch-Phan & Siegfried, 2022). Adapting to these environmental factors not only ensures supply chain resilience but also aligns with global sustainability goals, enhancing competitiveness in the long run.
Social factors	Social factors play a significant role in shaping supply chain practices in Nigeria. The country's diverse and growing population affects demand patterns, necessitating tailored supply chain strategies. Societal issues like income inequality, cultural diversity, and varying education levels impact workforce availability and skill sets. Ensuring fair labor practices and ethical sourcing is crucial (Awan et al., 2018). Moreover, social unrest and security concerns in certain regions can disrupt supply chain operations. To navigate these challenges, companies often engage in community development initiatives and collaborate with local stakeholders to build trust and ensure supply chain stability, fostering long-term success in the Nigerian market.
Political factors	Political factors significantly influence supply chain practices in Nigeria. The country's political landscape is marked by regulatory changes, corruption challenges, and periodic shifts in government policies. Inconsistent trade regulations and customs procedures can lead to delays and increased costs in the supply chain. Moreso, security concerns in some regions pose risks to transportation and distribution networks (Tripoli, & Schmidhuber, (2018). To adapt, businesses often engage in active government relations, regulatory compliance, and risk mitigation strategies. Developing a deep understanding of the political environment and fostering strong relationships with authorities are essential for maintaining supply chain stability and resilience in Nigeria's complex political context.

Investment in ICT	According to Collier and Dollar, (Eds.). (2002). Infrastructure efficiency and improvement, notably in the realm of ICT, is a key factor in sustaining inclusive economic growth and development. ICT infrastructure reduces transaction costs, enhances productivity and firm output, and has positive macroeconomic and microeconomic spillover effects. Infrastructure development promotes equality by enhancing the impoverished and disadvantaged's access to productive opportunities. Conventionally, physical infrastructure facilities provide the necessary links between underdeveloped regions and areas of core economic activity, thereby enhancing the income distribution between the rich and the impoverished. The analysis presented in Outlook (2020) suggests there is hope for Africa to attain inclusive development. There is a growing consensus that ICT investment can be used to reduce poverty and inequality while also improving the standard of living for the most vulnerable populations. Serra, G. (2018) even though Africa's infrastructure has been improving, albeit slowly, the continent has not addressed all its infrastructural challenges and will require more and improved infrastructure investments to achieve the desired inclusive growth. Due to underdeveloped regional road links, complex airport procedures, poor rail networks and ports, inefficient ICT, and missing electricity infrastructure networks, many economies in Africa remain isolated Ondiege et al., (2013). Even in countries and regions with basic infrastructure, the benefits are not directed to marginalised populations due to market structure constraints, particularly in the ICT sector, which impacts the affordability of services. According to the Outlook (2020), despite Africa's robust growth performance, only one-third of the continent's countries have attained inclusive growth, which reduces poverty and inequality. Outlook (2020) emphasises the need to create jobs and improve the quantity and quality of education, such as by increasing access to schools in remote areas and by investing in ICT infrastructure to resolve binding constraints. Investing in ICT infrastructure through digitization could contribute to inclusive growth by addressing market imperfections such as information asymmetry between sectors. For instance, digital identities could aid banks in identifying creditworthy debtors and reduce the time required for job searches and matching on the labour market. These can be combined to improve market efficiency, reduce uncertainty in crucial investment decisions, and promote security in Africa, where information transmission is essential for inclusive economic growth. Digital reforms are beneficial to the impoverished because they improve access to information about job and wealth creation opportunities, thereby enhancing the standard of living. Across the African continent, financial services such have seen significant improvements. Nevertheless, the lack of the necessary infrastructure to fuel the digitization process at a rapid and massive scale remains a challenge (Tafese, T., 2022). The COVID-19 pandemic outbreak has increased the importance of ICT in facilitating economic activities within and across international borders. It is anticipated that the impact of ICT infrastructure at the macroeconomic and microeconomic levels will be positive due to the dynamic gains resulting from increased productivity and economies of scale. Some studies used measures as proxies for infrastructure development, including fixed telephone density; (Loayza et al. 2010). access to water and sanitation (Brenneman et al. 2002; and telecommunications, energy, roads, and railways and (Ghani et al., 2012). Other studies (Portugal-Perez and Wilson, (2012) incorporated infrastructure quality and quantity indices using the principal component estimation method. This study contributes to the existing literature because it focuses on the ICT sector and employs factor analysis to develop a robust indicator of inclusive growth.
IT Infrastructure	Information Technology infrastructure consists of computers, software, and all components of telecommunication systems necessary to facilitate efficient data transfer and management (Enakrire and Onyenania, 2007). It also includes IT experts to design, install, maintain, and fix systems, and skilled IT personnel to operate the system efficiently (Ejiaku, 2014). Poor Basic Information Technology infrastructure is the major cause of stagnation to the development of Information Technology in African and other developing countries (Omekwu, 2003). The essential infrastructure and networks to facilitate IT transfer, implementation and development is lacking in developing countries. This has made the accessibility to affordable telecommunication, computer, and Internet difficult (NEPAD, 2003). Basic national IT infrastructure which is accessible to the people and connected to the world is of utmost importance in any country and should be effectively integrated into the socio-economic and business life of the country (Omekwu, 2003). These IT resources are still scarce in many developing countries including access to hardware and software. Omekwu, 2003 noted that inadequate telecommunication infrastructure poses a major hindrance to IT adoption in developing countries. Some developing countries have only a few telephone lines. These are only in the big cities, and they are unreliable.

	These telecommunication problems vary from one country to another, depending on the level of development. Nigeria has a comparatively low teledensity in sub–Saharan Africa even though there has been a substantial increase recently (Akpan-Obong, 2007).
Training and development	Developing countries lack enough skilled IT persons who can design, program, install, configure, and maintain Information Technology in this constantly changing industry (Ejiaku, 2014). Lack of qualified and globally recognized IT professionals in this region is seriously hampering IT adoption and development (Ejiaku, 2014). The acquisition of some professional and technical skills by few professionals in developing countries, or the relocation of advanced technical equipment from industrialized nations to developing countries does not constitute technology transfer. Udo and Edoho (2000) noted that technology transfer takes place when the recipient country has corresponding technical information to enable it to use the hardware in an effective and efficient manner. This would make it easy for effective communication and interactions with the transferring agents. It may be easy to relocate equipment; it is more difficult to transfer capacity which is human-embodied. Development skills should be aligned with development goals, and both require human skills. Developing countries do not have enough graduates and technologists in science and technology, though there is now a growing awareness of the importance of Information Technology for development (Ejiaku, S.A., 2014).

2.6.1 Enablers of ICT adoption

In several developing nations, standards are already codified in national legislation or international treaties and conventions that have been ratified by member states (Sthiannopkao and Wong, 2013. For instance, by encouraging the adoption and certification of the global environmental system standard ISO 14001, these policies have significantly contributed to the adoption of sustainable ICT practices, such as incorporating environmental considerations into consumer selection (Zhu et al., 2005). Therefore, rule makers frequently refer to national laws when developing ICT integration policies (pros and disadvantages).

To transform an extant supply chain into a sustainable supply chain, suppliers must alter their current production methods. They must invest time and money in acquiring new skills and enhancing infrastructure. These are frequently unavailable (Koppenjan and Enserink, 2009). If government programmes exist in developing nations, they may not reach minor producers. Often, they cannot afford necessary investments. In other instances, when suppliers comply with new standards, they are unable to locate markets for their products. Uncertainty about the advantages of upgrading can pose a problem (Perez-Aleman and Sandilands, 2008).

2.7 The impact of ICT adoption and Integration practices on developed economies

Information and Communication Technology (ICT) adoption and integration practices have a profound impact on developed economies, shaping various sectors and influencing overall socio-economic dynamics. The widespread use of ICT enhances productivity, efficiency, and innovation across industries. In the business sector, digital technologies streamline operations, facilitate global connectivity, and foster agile decision-making, contributing to economic growth.

E-government initiatives leverage ICT to improve public services, reduce bureaucratic inefficiencies, and enhance citizen engagement, promoting transparency and accountability. The digitalization of financial services, known as FinTech, transforms the banking and financial landscape, increasing accessibility and driving economic transactions.

In education, ICT integration revolutionizes learning methods, providing access to online resources, virtual classrooms, and collaborative platforms. This fosters a skilled workforce capable of navigating the demands of the digital age.

Healthcare systems benefit from ICT through telemedicine, electronic health records, and data analytics, improving patient care, resource allocation, and overall efficiency.

Despite the positive impacts, challenges such as digital divides, cybersecurity threats, and privacy concerns need addressing to ensure equitable benefits. Overall, ICT adoption in developed economies propels technological advancements, economic development, and societal transformation, creating a foundation for sustained growth and competitiveness in the global arena.

2.8 The statistics models and further examination of their concepts in the related research area

Two predominant statistical models used in investigating the effects of ICT adoption and integration practices in supply chain management are Structural Equation

Modeling (SEM), Regression Analysis and Exploratory factor analysis. SEM allows researchers to analyze complex relationships among multiple variables, such as the impact of ICT adoption on various aspects of supply chain performance. Regression analysis, on the other hand, helps quantify the strength and direction of relationships between dependent and independent variables, offering insights into specific factors influencing ICT adoption and integration outcomes in supply chains. Exploratory Factor Analysis (EFA) is used to identify underlying factors or constructs influencing ICT adoption in supply chains. By analyzing survey data on ICT usage across different supply chain activities, EFA helps uncover patterns and relationships, guiding the development of effective strategies for ICT integration and optimization in supply chain management. These models enable rigorous empirical analysis and provide valuable insights for decision-making in supply chain management.

2.9 Methodologies for this research

The concept of objectivism in the field of management research pertains to the use of an objective and unbiased standpoint in the examination of managing phenomena (Cecez-Kecmanovic & Kennan, 2013). The process entails a concerted effort to adopt an objective and impartial methodology in the gathering, examination, and understanding of facts. The philosophy of Objectivism places significant emphasis on the maintenance of a neutral position and the reduction of personal biases or subjective interpretations (Junjie and Yingxin, 2022). Management researchers strive to improve the dependability and accuracy of their findings through the application of objectivism. This approach enables them to provide unbiased information that may inform decision-making based on facts and contribute to the progress of the discipline. The concept of objectivism in the field of management research is consistent with the overarching principles of scientific inquiry. It emphasises the importance of conducting thorough and methodical investigations, while also recognising that researchers' views and assumptions can influence the study process.

2.10 Justification for the methodology adopted.

The chosen methodology for this study is justified by its alignment with the research objectives and the complex nature of the phenomenon. Venkatesh et al. (2003) argues for a mixed-methods approach, combining field interview with survey questionnaire provides insights to comprehensively address the various dimensions of ICT adoption. This methodology enables a thorough exploration, capturing both numerical trends and contextual characteristics. The integration of diverse data sources enhances the robustness of findings and provides a more nuanced understanding of the challenges and opportunities associated with ICT adoption, contributing to the overall validity and relevance of the study.

2.11 Exploratory Factor Analysis (EFA)

Exploratory Factor Analysis (EFA) aids in understanding ICT adoption and integration by identifying underlying factors influencing these practices in supply chains. For instance, in a study by Lee et al. (2013), EFA revealed key factors such as organizational readiness, ICT infrastructure, and perceived benefits, influencing ICT adoption in supply chains. Similarly, in research by Gunasekaran et al. (2015), EFA helped identify factors like technological capabilities and inter-organizational relationships affecting ICT integration. EFA offers a structured approach to uncovering essential dimensions driving ICT adoption and integration, enhancing decision-making processes in supply chain management.

2.12 Confirmatory Factor Analysis (CFA)

Confirmatory Factor Analysis (CFA) validates and refines models of ICT adoption and integration in supply chains. For example, in research by Chou et al. (2012), CFA validated a conceptual framework of ICT adoption, affirming the significance of factors like perceived usefulness and compatibility. Similarly, in a study by Lai et al. (2015), CFA verified the dimensions of ICT integration, including data integration and process integration. CFA ensures the robustness of theoretical models, enhancing the

understanding of ICT adoption and integration practices in supply chain contexts, thus guiding effective strategies for implementation and optimization.

2.13 Structural Equation Model (SEM)

Structural Equation Modeling (SEM) offers a comprehensive approach to examining the complex relationships among variables in ICT adoption and integration. For instance, in research by Chang et al. (2015), SEM elucidated the causal relationships between ICT adoption factors and supply chain performance. Similarly, in a study by Lin et al. (2016), SEM revealed the mediating role of organizational learning in the relationship between ICT integration and supply chain flexibility. SEM enables researchers to assess both direct and indirect effects, providing a nuanced understanding of how ICT adoption influences supply chain dynamics, thus guiding strategic decision-making in supply chain management.

2.14 Research Gaps

In the literature, the issue of Information and Communication Technology (ICT) adoption and integration has received considerable critical attention. More so, in the literature, there has been little agreement on the effect of various dimensions of ICT integration practices between the degree of ICT adoption and the performance of supply chain. However, Studying ICT adoption in Nigeria is essential due to the unique contextual factors and developmental challenges it faces. Empirical research is needed to understand how ICT adoption interacts with the country's specific economic, social, and infrastructure conditions. Nigeria's diverse population, varying levels of digital literacy, and infrastructural disparities require localised insights to inform effective policy and investment decisions. Additionally, cultural distinctions and regulatory environments differ significantly from developed economies, necessitating a distinct focus. Timely research of this persfective is needed to clearify a mulidemensional foundation for adapted strategies to bridge the digital divide, project economic growth, and harness the full potential of ICT in Nigeria's digital development journey. Consequently, the need arises to describe and understand the

individual and combined effect of the level of ICT adoption and integration practices and their impact on the performance of supply chains in Nigeria.

Also, it can be suggested that the implementation of the respective dimensions of ICT adoption integration practices including sustainable information sharing, employee's coordination and coordination of supply chain network are supporting organisations to reach expected sustainable competitive objectives. This result has important implications both for strategic, operational, and tactical performance outcome. Thus, this study contributes to the wider literature in operation strategy and sustainable ICT adoption by providing empirical evidence on the influence of a set of internal and external communication technologies on the overall organisational performance. More importantly, it breaks new grounds by examining the role of integration practices as a mediator in the relationship between Internal and external ICT adoption practices and the duo of strategic and operational performance outcome of supply chain organisations.

Several researchers investigated the link between the application of ICT and supply chain performance. Such research includes Vickery et al. (2003); Frohlich and Westbrook (2002); Prajogo and Olhager (2012); Da Silveira and Cagliano (2006); Paulraj et al. (2008) who have shown a positive effect of ICT on supply chain performance. But there are conflicting results Jeffers et al. (2008); Li et al. (2009) of intra- and inter-organisational ICT having a damaging effect on the performance of supply chain, suggesting a need to find ways of boosting the performance effect of investments in ICT within supply chains. Hence, the purpose of this research is to explore investments in ICT and the resultant roles integration practices in the enhancement of supply chain performance. Bridging this gap is vital for advancing the field operation and supply chain management. Overcoming the issue is also crucial to unlock the full potential of supply chain integration practice within the Nigeria's digital economy.

2.15 Summary of the chapter

This chapter outlined the importance of supply chains and supply chain management. It presents the perspective of Information and Communication Technologies (ICT),

and their influence on supply chain integration, and performance. The chapter investigated ICT transformation, drivers for ICT adoption, types of ICT, and the challenges and difficulties of the adoption of ICT in general and Nigeria in particular.

The chapter also explored the importance of supply chain integration and the different types of supply chain integration practices; the antecedent and consequences of supply chain integration have been highlighted and discussed, why supply chain integration fails. The final part of the chapter considered key performance indicators within the supply chain context.

A number of the literature on ICT adoption and integration practices in developed and fast developing economies was reviewd, and despite the increasing number of research work conducted on developed economis like UK, US China etc. emerging economies reveals many differing barriers hindering the widespread adoption of new technologies (Dang et al., 2018; Ejiaku, 2014; Datta, 2011). Some of the main challenges of technology adoption are related to limited infrastructure, affordability, digital literacy, and regulatory challenges, all of which impede the effective deployment of ICT for socio-economic growth. This research, therefore, aims to identify the benefits and obstacles to the adoption of ICT and their effect on the performance of supply chain in Nigeria.

Chapter three: Conceptual Model Development

3.1 Introduction

This chapter provides the explanation on the theoretical lens and conceptual model in this study. It started with the justification of organisational theories (such as the Porter five forces, the resource-based view of the firm, resources dependence theory, stakeholder theory, and network theory). Following the discussion on these theories, the description of the conceptual model was presented. That is, the conceptual model of this study and the link between the research constructs are discussed.

The conceptual model in this study was drawn from the extant literature in chapter (two) and the theoretical perspectives presented therein. Here, the model presents the conceptual idea and direction of this study. The model will be tested with a statistical analysis as will be presented in chapter 5. Exploratory interviews were also carried out to provide support for the developed conceptual model (see chapter 6).

In this research, the key constructs of the model are ICT adoption, supply chain integration, environmental dynamics, firm level, industry level, and supply chain performance. The conceptual framework will be used to provide confirmation of the research objectives, which will be performed in the form of survey by questionnaire in chapter 5.

3.2 Theoretical perspectives

This study used several organisational theories to investigate the influence of information and communication technology (ICT) on the supply chain performance in the dynamic environment. The Porter's five forces of competitive position model provides a framework for assessing and analysing the performance of supply chains (Mugo, 2020). the following explained the five forces: the existing competitive rivalry between suppliers; the threat of new market entrants; the bargaining power of

suppliers; and the threat of substitute products/services (Dälken, 2014). Even though this model does allow organisations to understand competition and helps to predict changes in profitability, it has been criticised. Ghoshal, (2005); Mugo, (2020) argued that the theories behind the five forces model are flawed and that the resource-based view provides a more robust framework for analysis (Kozlenkova et al., 2014; Rivard et al., 2006).

There was an agreement that the aim of supply chain management is to create, deliver, and capture customer value (Zokaei and Hines, (2007). Hult et al., (2006) added in doing so the entities within the supply chain should use and capitalise on their resources, (i.e., the combination of technology, assets, knowledge, financial resources, and expertise). For a long time, the resource-based view was the most dominant paradigm in management field. The resource-based view suggests that an organisation's unique resources, are its competences to deploy those resources and its capabilities that are derived from bundled resources provide a source for growth and competitive advantage (Ketchen and Hult, 2007). Some researchers argued that possessing and having access to valuable, rare, inimitable, and non-substitutable resources would provide competitive advantage (Newbert, et al., 2008; Mweru, M. C., & Maina, T. M. (2016). But other researchers suggest that value is created when these resources are evaluated, manipulated, and deployed within the context of business environment (Choi, J., Nazareth, D.L. and Jain, H.K., 2010). Thus, resources require a purpose to be structured, bundled, and leveraged. Purpose and value are given to an organisation's resources through directing them with an external orientation, i.e., an orientation towards the needs of customers and society.

The resource-based view is in essence internally oriented and implicitly embeds supplier resources and capabilities in the process of structuring, bundling, and leveraging resources to obtain competitiveness and meet the needs of customers and society. Therefore, other researchers have suggested that rather than internal resources, the firm also needs to deal with its external resources, i.e., its external dependencies to achieve competitive advantage (Hillman et al., 2009; Radhakrishnan et al., 2018; Kim et al., 2020). This ideal is reflected in dependency theory, which looks beyond the boundaries of an individual firm. It argues that firms are not self-

contained in fulfilling demands and therefore need to establish effective linkages with suppliers, and other partners to access resources and capabilities required to deliver customer and societal value (Van Weele, 2018). It centres on how some firms become reliant on others for needed inputs such as goods and materials, and how firms can manage such relationships (Ketchen and Hult, 2007). The asymmetric interdependence that exists in these inter-firm relationships is critical to reduce environmental uncertainty for some firms (Ketchen and Hult, 2007). Developing effective relationships with the most qualified suppliers seems to be a prerequisite to secure the external resources that are required to create customer value and, hence, foster the firms' competitiveness (Van Weele, 2018). As supply chain members work together, they often become more dependent on each other. Thus, resources dependence theory has a high level of importance in the supply chain context (Ketchen and Hult, 2007).

The dependency theory is explicit about the purpose of the firm: satisfying external stakeholders, i.e., customers, investors, and other stakeholders (organisations) that are affected by the supply chain activity. This idea is acknowledged and elaborated on by stakeholder theory. Stakeholder theory suggests that each stakeholder represents different values that the focal firm should try to realise. The aim of stakeholder theory is to satisfy a broad array of stakeholder groups based on their specific demands. Stakeholder orientations result in firm competitiveness because focus on stakeholder satisfaction allow a firm to develop trusting relationships with their stakeholders, giving these firms the opportunity to deal better with changes in the environment and consequently spur innovation.

A stakeholder can be any group or individual who can affect or is affected by the achievement of the organisation's objectives. These include employees, communities, customers, political groups, investors, governments, suppliers, and trade associations. When adopting this perspective, suppliers should not only create value for the firm's market (customers), but also for society (all stakeholders representing social and environmental concerns) and for those who invested financial resources in the firm (shareholders, investors).

Another organisational theory relevant to this research is network theory, which explain relationships among linked entities (Moro Visconti, (2019). Supply chains are in essence, a form of network, thus, network theory has the potential to reveal interesting truths about chains (Ketchen and Hult, 2007; McCarter and Northcraft, 2007). Strong and week ties are key concepts with network theory. As the name suggest, strong ties involve firms that are coupled, and loose ties involve firms with more tenuous links (Ketchen and Hult, 2007). Each type presents certain advantages to supply chains. strong ties offer greater reliability, while loose ties enhance flexibility. In the traditional supply chains, strong and weak ties are formed without concern for the overall network alignment. In contrast, best value supply chains approach these issues strategically. A combination of strong and weak ties that matches supply chain needs is created to maximise supply chain performance.

In the end, the Porter theory, resource-based view of the firm, the dependence theory, and stakeholder theory each emphasise a different element of how firms may create value through supply chain collaboration. The resource-based view of the firm is more concerned with the management of a firm internal resources and capabilities that may satisfy external stakeholders of the firm. In the resource dependency theory, the firm's dependence on other external parties, such as suppliers, is critical. Finally, the stakeholder theory focuses on the diverse stakeholder perspectives a firm needs to balance, weigh, and respond to. It argues that for achieving competitive advantage, a firm and its supply chain partners should create in parallel customer value, society value and shareholder value. This is what sustainability and sustainable purchasing is all about.

The study is grounded in the resource-based view (RBV) of the firm as the theoretical lens for the interrelations among the adoption of ICT, integration practices and performance outcome of supply chains. The main argument of the RBV is that the firms' resources are the source of competitive advantage (Barney, 1991). These resources can be both assets and capabilities, which reflects on the one hand, tangible technologies, and other things to be used in offering products and service to customers, and on the other hand, it refers to repeatable patterns of actions in the use of resources (Choi and McNamara, 2018). Following Wade and Hullan (2004) and

Jeffers et al. (2008), this research considers the ICT as such potential assets, which are complemented by supply chain integration capabilities. Having resources is not enough as a source of competitiveness. However, the combination of assets and capabilities into what is labelled a bundle of assets could be a source of competitive advantage of supply chain performance. The RBV helps to understand how some companies gain better performance returns than others from the same adoption of ICT. The next section specifies the underlying mechanisms that explain how the adoption of ICT, together with integrative practices could help to improve supply chain performance.

3.3 The relationship between the adoption of ICT, integration practices, and supply chain performance

Inter-firm ICT allow information access to other organisations, which in fact redefines and redesign the supply chain (Hong, 2002). It helps a firm to share data, information, and business intelligence with supply chain members; it also provides the ability of electronic transactions including buying and selling products and services; while allow communication and fast decision making for increasing efficiency, effectiveness, and profitability for the entire supply chains (Wiengarten et al., 2013). The ICT in terms of intra-organisational ICT falls into the domain of office and factory automation systems that organise work more efficiently (Ryssel et al., 2004). It is used for planning, tracking, and ordering materials and products through operations function in the supply chain (Vickery et al., 2003). The ERP and MRP help support different transaction-based functions within an organisation. Inter-organisational ICT serve as a medium to transfer information across the supply chain thus directly increase supply chain performance (Rosenzweig, 2009). While intra-organisational ICT, is required to be embedded within the firm to be effective. (Jeffers et al., 2008; Zhou et al., 2009). Wade and Hulland (2004) shows the difference between the impact of internal and external ICT competencies on performance outcomes. Wade and Hulland (2004) stated that external ICT assets has impact on performance, while the internal ICT asset do not, which appears to be consistent with Da Silvera and

Cagliano (2006) and Olson and Boyer (2003). Zhou et al. (2009) report significant effects of intra-organisation ICT on high product quality and lower product cost, but no significant effects on supplier performance (Ward and Zhou, 2006). Other studies such as Jeffers et al (2008), Vickery et al. (2010) Li et al. (2008) and Tan et al. (2010) do not support the positive effect of the ICT adoption on the supply chain performance. Sanders and Premus (2002) said that the use of ICT directly influence operational performance but does not influence strategic performance. These findings suggest the examination of the ICT – SC performance via supply chain integration.

Following the RBV, the effect of inter-organisational ICT can be increased when combined with integrative practices of the supply chain. Using inter-organisational ICT could be imitated, building relationship cannot and will thus enhance performance outcomes of the supply chain. Li and Lin (2006) demonstrated that the use of inter-organisational ICT among supply chains, could increases the level of information sharing. Sander (2007) argued that new technologies have an impact on supply integration via information sharing. Information sharing enable supply chain partners to enhance flexibility, delivery reliability and speed of decision making (Wang and Wei, 2007). Information sharing, enabled through electronic connections improves performance outcome and regarded as difficult to copy integrative capability.

The ICT help supply chain partners in streamlining links, reaching quick joint decisions, synchronised communication, and easy access to data (Saeed et al., 2011). Sanders (2007) argued that cooperation among entities could be limited by the costs of managing the supply chain integration. The use of ICT will minimise the costs and will promote collaborative relationships among firms (Choon Tan et al., 2010). Implementing ICT, partners can reduce the change of miscommunications when formulating strategic plans, and quicker in decision making (Kim and Lee, 2010). It was indicated that improved flow of information in terms of speed, quality, and the level of confidentiality across the supply chain ensures collaborative performance (DeGroote and Marx, 2013; Chen et al., 2001). Johnston et al. (2004) said that a high level

of collaborative relationship behaviours has strong effect on buyer satisfaction and administrative performance, which can be associated with supplier performance. The above literature, suggest that the adoption of ICT could contribute to better supply chain performance through collaborative relationship, which together can consider as complementary assets.

Following from above discussion, the performance improvement in the context of resource-based perspective stems from the cumulative effective of the ICT adopting and integrative practice within the supply chain. Here integration practices are modelled as a moderator of the relationship between the adoption of ICT and SC performance. Another line of thinking is closely related to contingency theory (Donaldson, 2001; Betts, 2003). This view follows the idea that the effectiveness of the ICT implementation and integration practices depend on some environmental characteristics (Flynn et al., 2010), such as organizational size or supply chain uncertainty. The above theoretical background leads to the need to define the concepts of this study: the adoption of ICT, integration practices, supply chain performance, and contextual factors. The next paragraph looks at the conceptual model result from the different theoretical perspectives in the literature.

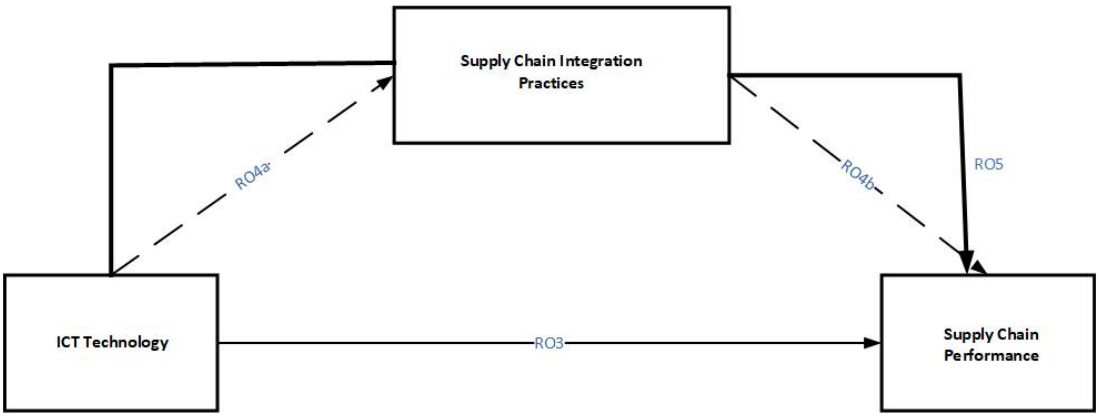


Figure 3.1 proposed conceptual model.

Figure 3.1 above, depict the most important connections among ICT, SC integration, and SC performance, resulting from the literature as described above. The model presumes that the implementation of ICT will have an impact on supply chain performance. The reason for this association is that the use of ICT in terms of intra- and inter-organisational ICT could directly increasing supply chain performance through, e.g, better information accessibility, accuracy, or direct connectivity. In the

model, the relationship between ICT and supply chain performance is expected to be mediated by integration practices of supply chain. It might be that the use of ICT will increase information sharing and/or collaboration across supply chains. It also suggests that the relationship between the level of ICT adoption and performance outcomes of supply chains could be moderated by environmental dynamism or uncertainty. The line of reasoning is that the use of ICT become effective under a certain market condition: a high level of supply chain uncertainty and turbulence, while the ICT adoption can have limited or no effect if supply chain dynamism is low. Lastly the research model investigates the linkages/synergy between ICT adoption and integration practices. Such research can be done in the context of a moderation model De Silva et al., (2021), which belief that increases in supply chain integration will lead to better supply chain performance. Based on the above, the connections between the three key constructs ICT, integration practices, and performance outcomes, the research will investigate the effect of contextual factors. Different factors have been considered as contextual factors such as firm size and competitive environment. The belief is that such factors might positively or negatively influence the relationships. Thus, the adoption of ICT in large firms will have an impact on performance on outcomes of supply chain companies.

Assessing the effect of ICT adoption on supply chain performance

Inter-organisational ICT enable information access to other organisations, which in fact redefines and extends the organisational boundaries of the extent to which organisations need to be redesigned (Hong, 2002). It can help the organisation share data, information, and business applications with its supply chain partners; it provides the capabilities of electronic transactions including buying and selling goods and services; and facilitate communication and decision making for the purpose of increasing efficiency, effectiveness, competitiveness, and profitability for participating organisations (Wiengarten et al., 2013). In contrast, intra-organisational ICT falls into the domain of office and factory automation systems that organise work more efficient (Ryssel et al., 2004). It is used for planning, tracking, and ordering

components and products throughout the manufacturing operations within the firm (Vickery et al., 2003). Intra-organisational ICT such as the ERP and/or MRP II, EDI, CAD, and RFID are well-known examples of such systems that support a variety of transaction-based functions within an organisation. The different orientation of both types of ICT has consequences. Inter-organisational ICT can be regarded as a medium to transfer information across organisational boundaries and therefore directly increases supply chain performance (Rosenzweig, 2009). In contrast, intra-organisational ICT needs to be embedded in the organisation to be effective (Zhou et al., 2009; Jeffers et al., 2008). This is also reflected in Wade and Hulland (2004) who indicate a fundamental difference between the impact of internal and external ICT resources on performance. Wade and Hulland (2004) propose that external ICT resources will have a stronger direct impact than internal ICT resources on performance, which seems to be confirmed by empirical studies, such as Da Silveira and Cagliano (2006) and Olson and Boyer (2003). About intra-organisational ICT, studies report significant effects in terms of higher product quality and lower product cost (Zhou et al., 2009), but no significant direct effects on supplier performance (Ward and Zhou, 2006; Powell and Dent-Micallef, 1997). Therefore, the objective stated:

3.3.1 The effect of ICT adoption on supply chain integration practices

Following the resource-based view, the effect of ICT on supply chain performance can be increased when combined with supply chain integration practices. While using ICT might be imitated, building collaborative relationship cannot and will thus improve performance. Li and Lin (2006) demonstrated that the use of ICT among organisations increases the level of information sharing. Sanders (2007) revealed that advanced technologies have a direct and positive impact on inter-organisational integration via information sharing. Information sharing facilitates supply chain members to improve flexibility and responsiveness, synchronise production and delivery speed, and coordinate inventory-related decisions (Wang and Wei, 2007). Information sharing enabled through ICT-related technologies improves operational performance.

Inter-organisational ICT help supply chain partners in streamlining links, reaching joint decisions, synchronised communication, information recollection, and standardisation (Saeed et al., 2011). Sanders (2007) indicated that collaborative relationship among organizations is limited by the operation costs of managing the interaction. The use of inter-organisational ICT reduces operation costs: it develops a collaborative relationship among firms (Tan et al., 2010). Through supporting inter-organisational ICT, partners can reduce the chance of miscommunications when formulating strategic plans and be more effective in joint planning and decision making (Kim and Lee, 2010). Cheng et al. (2001) indicated that an improved flow of information in terms of speed, quality, and the level of confidentiality across the parties 'boundaries ensure a collaborative relationship among parties. A higher level of collaborative relationship behaviours is found to be strongly linked with customer satisfaction and the consumer's evaluation of relationship's performance (Johnston et a., 2004), which can be associated with supply chain performance. The above argument, suggest that inter-organisational ICT contribute to better supply chain performance via collaborative relationship and visibility in the supply chain. Thus, we suggest that:

3.3.2 Integration practices mediate the relationship between the adoption of ICT and supply chain performance.

Intra-organisational ICT is supposed not to change external processes directly, but if it is combined with other organisational capabilities, it can be an important resource in the relationship between supply chain integration and performance (Wong et al., 2011). Intra-organisational ICT improves the capability for data processing within an organisation and provides high quality information. Information quality includes aspects such as accuracy, timeliness, adequacy, and credibility of information (Wiengarten et al., 2010). While supply chain visibility, information sharing and collaborative relationship are important, the significance of their impact depends on information quality (Li and Lin, 2006). Information sharing within the entire supply chain can create flexibility and responsiveness, but that accurate and timely information is required (Wiengarten et al., 2010). A collaborative relationship reflects how supply chain partners incorporate decision making and are flexible in

contractual arrangements to solve mutual problems (Johnston et al., 2004; Handley and Benton, 2013). Accurate and timely information will provide a basis for such collaboration behaviour. A more accurate, timely and adequate operational information managers have, the better they know what happens within the organisation, and the better they can work together in joint decision making. It has been indicated that information extremely suffers from delay and distortion as it moves up the supply network (Li and Lin, 2006). To reduce information distortion and improve the quality of information in the supply chain, the availability of data must be as accurate as possible. Li and Lin (2006) suggested that the higher the use of intra-organisational ICT, the higher the level of information quality in the supply chain. The combination of two resources results in higher information quality and makes buyer-suppler visibility, information sharing and collaborative relationship between partners more effective and lead to improved supply chain performance, which cannot be reached through investment in ICT alone. As a result, the next objective statement is recommended that Supply chain integration practices mediate the relationship between the adoption of ICT and supply chain performance measures.

3.4 Conceptual model of the study

As mentioned earlier, this study uses the resource-based view as its theoretical angle to define the construct relationship for the interactions of ICT, SC integration and Performance. The main argument of the RBV is that the firm's resources are the source of competitive advantage (Barney, 1991). Such resources can be both assets and capabilities (Wade and Hulland, 2004), which reflects on the one hand, tangible technologies, and other things to be used in offering products to the markets, and on the other hand refers to repeatable patterns of actions in the use of assets (Sanchez, 1996). Following Jeffer et al. (2008) and Wade and Hulland (2004), this research regards ICT as such potential assets, which are complemented with supply chain integration as capability. Having resources is not a source of competitive advantage. However, the combination of assets and capabilities into what is labelled a bundle of resources might. The RBV helps to understand why some companies obtain better performance returns than others from similar ICT usage. Below the research

constructs from the conceptual model specify the underlying mechanisms that explain how intra- and inter-organisational ICT, together with supply chain integration help to improve supply chain performance.

In the light of the discussion above, competitive pressures and uncertainty threaten the implementation of ICT strategies and provide justification for integration mechanisms (Yusuf et al. 2014). Figure 3.1 show a conceptual model consisting of the relationships between the ICT and integration practices and their impact on supply chain performance, and the influence of integration capabilities in intensifying the ICT adoption and increasing supply chain performance.

Block 1 depicts the link between the ICT adoption and supply chain performance. Two types of ICT were most discussed in the literature. They are intra- and inter- ICT technologies. This study argued that the potential negative effects of ICT adoption on supply chain performance necessitate integration practices as a means of supporting the later against the former.

Block 2 represents key performance indicators. These include cost, product quality, delivery reliability, speed of responsiveness, flexibility, innovation, return on investment, net profit, market share, customer service and other performance relative to competitors (Yusuf et al. 2004). Finally, Block 3 denotes supply chain integration mechanisms. It is to neutralise the negative effects of the ICT adoption on performance measures of supply chains, which suggest positive attainments on a wide range of capabilities. These include low cost, quality, speed, reliability, flexibility, innovation, and financial measures (Yusuf et al., 2007).

The arrows in figure 3.1 shows the direction of impact. It is proposed that the integration practices neutralise the impact of ICT adoption on supply chain performance measures. The following objective statements were investigated, based on the literature and theoretical framework in figure 3.1 above.

3.5 Conclusions

In implementing sustainable supply chain practices, organisations must fully understand the benefit of adopting sustainability in their supply chain; some obstacles have prevented the widespread implementation. This chapter outlines the research objectives that form the context of the conceptual model development. It highlighted the key organisational theories in the study; the Porter five forces theory, the resource-based theory, resources dependence theory, stakeholder theory and network theory. The resource-based theory and resources dependence theory were used to explain the relationships between the adoption of ICTs, supply chain integration and performance. These links will address research objectives two to five.

The stakeholder theory and network theory were used to explain the use of firm level, strategic groups, and industry level, and their influence on the supply chain performance. These theories also help to explain the role of environmental dynamism in enhancing or not enhancing the effect of ICT adoption and supply chain integration on supply chain performance. The basis of each construct in the conceptual model was explained. The model is the guiding principle of the research process, philosophical approach and methods adopted as in chapter 4 below.

Chapter four: Research methodology

4.1 Introduction

Research methodology refers to the systematic approach employed to address a research challenge. The term "research methodology" can be defined as the scholarly examination of the processes and techniques employed in scientific inquiry (McCutcheon and Meredith, 1993; Kothari, 1990). The research methodology can be defined as a systematic approach encompassing the gathering, processing, and interpretation of data (Creswell, 2011). This research methodology places emphasis on the utilisation of suitable techniques to address research inquiries and accomplish research goals. This study will employ both quantitative and qualitative research approaches for examination, as suggested by Easterby-Smith et al. (2012). Survey questionnaires are typically well-suited for achieving statistical generalisability, however their capacity to precisely reflect the specific conditions of a particular situation may be limited. As a result, after the administration of the questionnaire survey, case studies will be undertaken to validate the outcomes of the statistical analysis and explore the findings within specific contextual settings. According to Forza (2002), questionnaire surveys and case studies are the predominant approaches employed in research pertaining to operations strategy and supply chain management.

Fig 4.1 Structure of the chapter

4.2 Research Onions

The research onion, introduced by Saunders et al. (2007), provides a structured framework for understanding the layers of research methodology. Comparable to peeling layers of an onion, it emphasizes the iterative and multi-faceted nature of research. Starting with the outer layer of research philosophy, such as positivism or interpretivism, researchers delve into the layers of research approaches, strategies, data collection, and analysis methods. Each layer builds upon the previous, influencing the overall research design. This metaphorical onion offers researchers a systematic guide to navigate the complexities of their study. As Saunders et al. (2009) argue, the research onion helps researchers make informed decisions at each layer, ensuring methodological rigor and coherence in their studies.

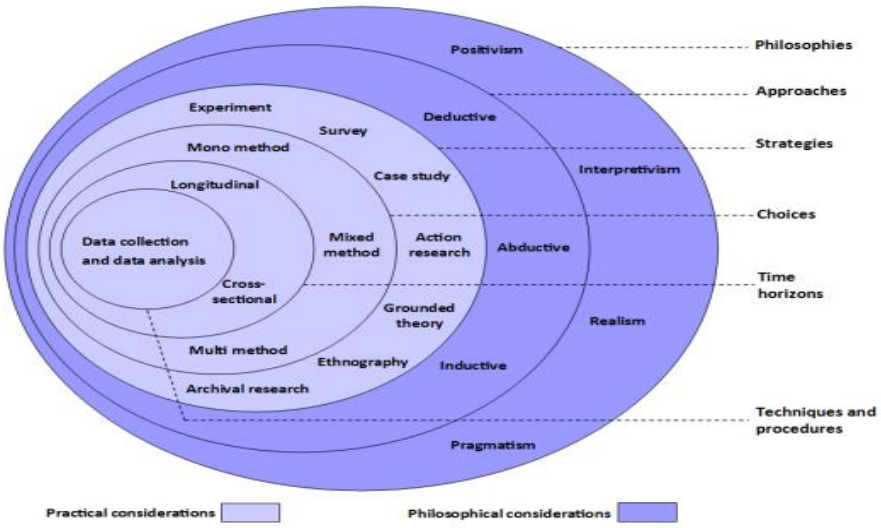


Fig 4.2 the research onions

4.3 The philosophy of this research

Table 4.1 The four major philosophical stances in social sciences

Philosophies	Research approaches in social science
Positivism	Positivism in social sciences entails an empirical and objective approach, emphasizing quantifiable data and scientific methods. Auguste Comte's positivism framework emphasizes the application of natural science methods to social phenomena (Giddens, 1971). Positivist researchers aim for objectivity, seeking observable and measurable patterns. Quantitative research methods, such as surveys and experiments, align with this approach, facilitating the testing of hypotheses and generalizable findings (Bryman, 2016). The positivist stance assumes a reality external to the observer and strives for value-neutrality, contributing to the foundational principles guiding research in the social sciences.

Interpretivsm	Interpretivism in social sciences adopts a subjective and context-dependent perspective, emphasizing understanding and interpretation of human experiences. Max Weber's interpretive sociology and Alfred Schutz's phenomenology influenced this approach (Denzin & Lincoln, 2018). Researchers employing interpretivism rely on qualitative methods like interviews and participant observation, aiming to grasp the meanings individuals attribute to their actions (Bryman, 2016). This approach acknowledges the subjective nature of social reality, encouraging rich, context-specific insights that contribute to a deeper understanding of diverse perspectives and social phenomena in their natural settings.
Realism	Realism in social sciences adopts an ontological stance that acknowledges an objective reality independent of human perception. Bhaskar's critical realism distinguishes between the empirical, actual, and real, emphasizing the need to uncover underlying structures and mechanisms (Bhaskar, 1978). Researchers using realism aim to uncover causal relationships and identify social structures that influence outcomes. This approach blends both quantitative and qualitative methods, recognizing the complexity of social phenomena (Sayer, 2000). By acknowledging the existence of a reality beyond immediate observation, realism contributes to a more nuanced understanding of the social world and its underlying mechanisms.
Pragmatism	Pragmatism in social sciences advocates for a flexible and problem-solving approach, emphasizing practical solutions to complex issues. Influenced by Peirce, James, and Dewey, pragmatism encourages the integration of diverse research methods to address specific research questions (Creswell & Creswell, 2017). This approach values the utility and applicability of research findings in real-world contexts. Pragmatist researchers navigate between quantitative and qualitative methods, prioritizing the effectiveness of their research in informing practice. By embracing a pragmatic philosophy, social scientists can adapt their methodologies to suit the dynamic and context-dependent nature of social phenomena, enhancing the relevance and impact of their work.

However, in exploring ICT adoption and integration practices in emerging economies, a crucial philosophical stance is pragmatism. Drawing from Dewey's pragmatic philosophy, the emphasis lies on practical, context-specific approaches that address the unique challenges of these economies. The dynamic and evolving nature of ICT requires an adaptable methodology, aligning with the social science approach in problem-solving and experiential learning. Grounded in this philosophy, this study blends quantitative and qualitative methods, acknowledging the diverse socio-economic contexts within emerging economies. Hughes and Sharrock (2016) suggest that this approach delivers a comprehensive understanding of the intricacies surrounding ICT adoption, offering insights that go beyond a one-size-fits-all solution. By embracing a pragmatic philosophy, this investigation gains a holistic perspective, enriching the discourse on effective ICT strategies for sustainable development in these evolving contexts Nigeria as a case study.

4.4 Research approaches

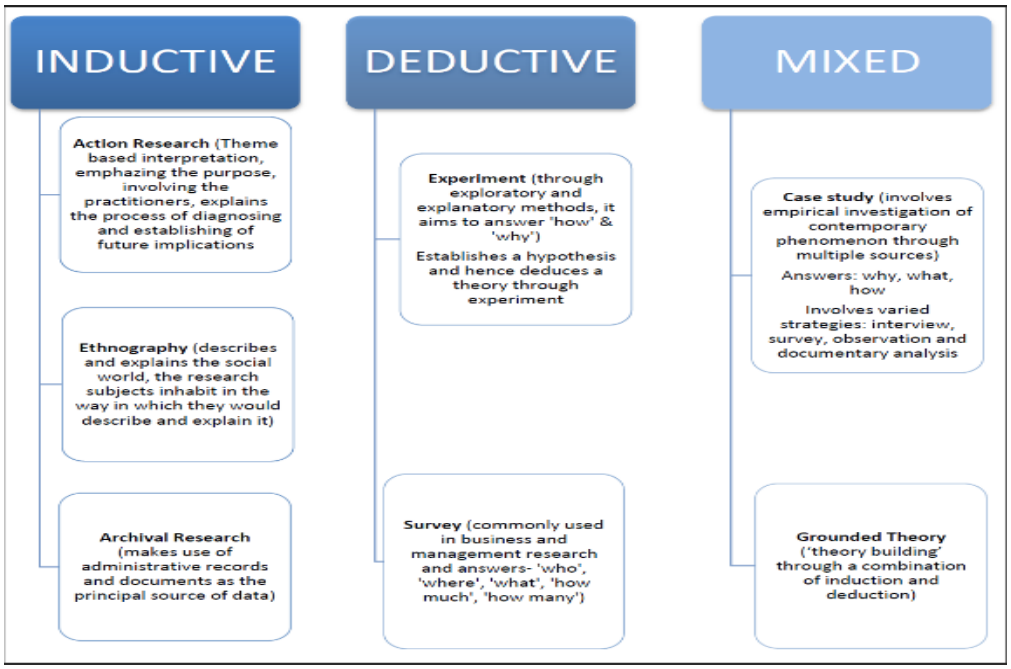


Fig 4.3 adopted from; Benbasat, I., Goldstein, D.K. & Mead, M., 1987.

Inductive research in social sciences involves moving from specific observations to broader generalizations. Grounded Theory, developed by Glaser and Strauss (1967), exemplifies this approach, emphasizing the emergence of theories from data. Inductive research utilizes qualitative methods such as interviews and content analysis to identify patterns and themes (Charmaz, 2014). This bottom-up process allows for a deeper understanding of social phenomena as it unfolds in natural settings. By building theories based on empirical evidence, inductive research contributes to the generation of new insights and conceptual frameworks, enriching the understanding of complex social dynamics.

Deductive research in social sciences involves testing existing theories or hypotheses through systematic data collection and analysis. It follows a structured, top-down approach where researchers start with a theoretical framework and then gather empirical evidence to confirm or refute hypotheses. Positivist research often employs deductive reasoning, emphasizing the pursuit of objective knowledge (Bryman, 2016). Quantitative methods such as surveys and experiments align with this deductive approach, enabling researchers to draw generalizable conclusions (Creswell & Creswell, 2017). By systematically applying deductive logic, social

scientists contribute to the cumulative development and refinement of established theories in the field.

Mixed research in social sciences combines both qualitative and quantitative methods within a single study, aiming to provide a comprehensive understanding of complex phenomena. Creswell and Plano Clark (2017) advocate for a sequential or concurrent design, allowing for triangulation and complementarity of data. This approach recognizes the strengths of both approaches, offering a more holistic perspective and enhancing the validity of findings. By integrating qualitative richness with quantitative rigor, mixed research contributes to a nuanced and well-rounded exploration of social phenomena, capturing the depth and breadth of variables involved in each research objectives.

4.5 Research strategy

Research strategy is crucial as it outlines the systematic plan guiding the entire research process, from data collection to analysis. It ensures clarity in achieving research objectives, enhances methodological rigor, and determines the overall validity of findings. Selecting an appropriate research strategy aligns with the nature of the research question, guiding the choice of methods and ensuring the study's relevance and impact. A well-defined research strategy provides a roadmap for researchers, facilitating efficient and effective investigation, ultimately contributing to the advancement of knowledge in the chosen field.

4.5.1 Qualitative research methods

Qualitative research methods involve a non-numerical exploration of phenomena, emphasizing the understanding of context, meaning, and subjective experiences. Grounded Theory, introduced by Glaser and Strauss (1967), involves the systematic generation of theory from data, capturing the emergent patterns and themes. Another approach is Phenomenology, as advocated by Husserl, which seeks to understand and describe the essence of human experiences (Moustakas, 1994). Ethnography, developed by Malinowski and Boas, involves immersive observation within a cultural setting to comprehend social phenomena (Denzin & Lincoln, 2018).

These methods often employ techniques like interviews, participant observation, and content analysis to gather rich, qualitative data. Qualitative research is valuable for exploring complex social dynamics, providing depth and context to phenomena that quantitative methods alone may not capture.

4.5.2 Quantitative research methods

Quantitative research methods involve the systematic collection and analysis of numerical data to identify patterns and relationships. Surveys and experiments are common techniques within this approach. In his work, Comte emphasized the application of scientific principles to social phenomena, influencing the development of quantitative methods (Giddens, 1971). Positivism, associated with Auguste Comte and later scholars, supports the use of quantitative methods for objective inquiry (Bryman, 2016). Statistical analysis and hypothesis testing are integral components, providing empirical evidence for generalizable conclusions. Survey research, as exemplified by Gallup's pioneering work, gathers numerical data through structured questionnaires to measure attitudes and behaviors (Gallup, 2011). Quantitative research offers precision, replicability, and the ability to draw statistical inferences, contributing to evidence-based decision-making and understanding social phenomena on a broader scale.

4.5.2.1 Benefits of the Quantitative Research Method

The utilisation of survey methodologies on a large sample of persons enables the process of generalisation. For example, in the context of policymaking, the implementation of a mentor training policy would typically include substantiating evidence of its efficacy (Chinn & Rinehart, 2016). Conducting interviews with a select number of persons or organising a focus group consisting of forty pairs of mentors and mentees may offer insights into the effectiveness of mentoring training in certain cases. However, it is important to note that these methods alone do not yield sufficient empirical evidence to establish the overall benefits of such training. The utilisation of quantitative methodologies would provide more robust evidence in favour of the effectiveness of training.

Quantitative research enables the acquisition of data from a comparatively substantial sample size of participants. Furthermore, this methodology enables the researcher to carry out the investigation across many groups, hence facilitating a comprehensive analysis and comparison of the outcomes (Jabareen, 2009). The methodology employed enables the extrapolation of data to a broader population, so yielding quantitative or evaluative data and augmenting the knowledge available for policy or guideline implementation. Plonsky and Gass (2011) assert that quantitative research methods provide a foundation for employing statistical techniques to ascertain the associations among variables under investigation.

4.5.2.2 Quantitative data collection methods

According to Cresswell (2003) and Bryman (2016), self-administered questionnaires and interviewer-assisted questionnaires are widely utilised as the predominant means of data collecting. Both methodologies involve the researcher being detached from the real activities. Despite the occasional interchangeability of these two procedures, they possess notable distinctions, particularly in relation to the instrument's construction. The design of the questionnaire should facilitate independent completion by the participant, without any involvement or guidance from the researcher. On the other hand, the utilisation of a questionnaire facilitated by an interviewer requires the active involvement of the interviewer throughout the entirety of the data collection process (Blaikie, 2007). Structured observation is a somewhat infrequent approach to data collecting within quantitative research contexts. Examples of this methodology include examining the reaction of an individual following specific durations of isolation or studying a cohort of children engaged in recreational activities. The numerical representation of the observation will be utilised (Cresswell, 2003). Video recording is commonly used in this research to aid in the analysis process. This allows for the possibility of re-evaluating the video if any observations are missed or delayed during the coding phase (Blaikie, 2007).

4.5.3 Research strategy in this study

In researching ICT adoption and integration practices, this study involves employing a mixed-methods approach. This allows for a comprehensive exploration of both quantitative factors, such as adoption rates and technological infrastructures, and qualitative aspects, including organisational dynamism and user perceptions. Venkatesh et al. (2003) argues for the significance of mixed methods in understanding the complexities of ICT adoption practices. The quantitative component aids in statistical analysis, providing numerical insights, while the qualitative dimension captures the contextual attributes that influence adoption behaviors. This integrated approach, as advocated by Venkatesh et al., ensures a holistic understanding of ICT dynamics, enabling researchers to derive practical implications for diverse stakeholders and facilitating a more critical interpretation of the multifaceted challenges and opportunities associated with ICT adoption and integration in various contexts.

4.5.4 The underlying principles justifying the research strategy.

The research strategy for ICT adoption and integration is justified by the need for a comprehensive understanding, aligning with the principles of mixed methods. Venkatesh et al. (2003) emphasises on the significance of combining quantitative data for adoption rates with qualitative insights into organizational dynamics. This approach allows for triangulation, enhancing validity and capturing the strategic interplay of technological and contextual factors. By integrating diverse methods, the research strategy ensures a holistic exploration, contributing to practical implications and a clear interpretation of challenges and opportunities in ICT adoption contexts.

4.5.5 Qualitative approach

Qualitative research methods place a strong emphasis on subjectivity and the comprehension of participants' perspectives, ideas, feelings, and thoughts. According to the study conducted by Ormston et al. (2014), qualitative research is concerned with exploring and understanding the nature, importance, or purpose of a certain setting. The design allows for the investigation of a certain research subject by gathering subjective data from participants. Tracy (2019) identifies case studies,

interviews, ethnographic works, and qualitative surveys as prominent methodologies for gathering qualitative data. The qualitative research methodology is differentiated from the quantitative approach due to its focus on subjectivity and the active participation of the researcher in the study (Yilmaz, 2013). Qualitative research involves the researcher and participants engaging in an unstructured environment, fostering a naturalistic setting that allows for a study with flexible parameters. According to Yilmaz (2013), the results obtained from a qualitative research design are expected to exhibit variation while examining a similar research topic. This phenomenon can be attributed to the involvement of distinct researchers across multiple investigations, as well as the unrestricted interaction between these researchers and study participants, which is likely to exert an influence on the conclusion of the study.

The likelihood of replicability and generalizability of findings derived from a qualitative study design is low. The primary objective of qualitative research is to gain insight into specific phenomena or events within a defined research context (Liamputtong & Ezzy, 2005). The presence of contextual factors and potential researcher bias contribute to the distinctiveness of the findings within the specific research setting. Furthermore, it should be noted that the involvement of the researcher in direct contact with the study participants has the potential to introduce bias, hence limiting the replicability of the information obtained in the study (Liamputtong & Ezzy, 2005). The likelihood of generalizability of qualitative research findings is diminished across various types of studies.

The major approach in qualitative study design is inductive reasoning. This observation suggests that the researcher transitions from specific empirical evidence to the development of a broader theoretical framework. The researcher can utilise the data obtained from the study participants to formulate a theory, generate an objective research statement, or conceptualise the offered material with the aim of offering a comprehensive explanation of the phenomena under investigation. The qualitative research approach assumes that researchers are incapable of completely separating their personal emotions and thoughts from the study, hence inevitably exerting an influence on the study's outcomes. In qualitative research, the major

emphasis is not on objectivity, but rather on the collection of comprehensive qualitative data.

4.5.5.1 Benefits of Qualitative Research Method

The utilisation of open-ended inquiries and interviews provides researchers and practitioners with the opportunity to gain insights into individuals' well-being, experiences, and to identify significant factors and outcomes that may not be apparent through surveys employing closed-ended questions (Schensul and LeCompte, 2012). While qualitative research may be perceived as anecdotal, its aggregation across numerous participants yields a conceptual comprehension and substantiates the occurrence of phenomena among groups or individuals (Schensul & LeCompte, 2012).

The utilisation of a qualitative research strategy enables the exploration and discovery of previously unidentified and innovative phenomena (Queirós et al., 2017). Furthermore, the design has the potential to enhance comprehension of systems, as well as generate particular and anecdotal data. This qualitative research approach not only yields verbal data, but also allows for occasional conversion into mathematical form. Furthermore, this approach offers distinct benefits in terms of uncovering information that may not be readily revealed by pre-determined survey questions (Queirós et al., 2017).

4.5.5.2 Qualitative data collection

Interviews provide researchers with the opportunity to directly interact with participants, enabling them to pose open-ended questions and delve further into their experiences or viewpoints (Queirós et al., 2017). Interviews can be categorised into three types: structured, semi-structured, or unstructured, based on the required level of supervision.

Focus groups are a research methodology that involves a limited number of participants, typically a small group, in order to facilitate and encourage open discussions centred around a given issue. The role of a moderator is to promote the discourse by promoting active participation and encouraging individuals to express their perspectives and interact with one another. According to Hove and Anda

(2005), this approach facilitates the generation of diverse viewpoints and enables the examination of collective experiences and dynamics within a group.

Case studies are a research method that involves doing an in-depth examination of a single case or a limited number of examples. This approach allows for a comprehensive comprehension of intricate phenomena. Scholars gather and examine many data sources, including interviews, observations, documents, and artefacts, in order to obtain a full understanding of the case(s) being investigated (Bowen, 2009).

The process of document analysis involves the examination of various forms of textual, visual, or audiovisual documents, including but not limited to reports, diaries, letters, photographs, films, or social media posts. This method of study can yield significant and informative findings. Scholars conduct an analysis of these materials in order to get insights into cultural, historical, or social contexts, as well as to examine the perspectives or discourses of individuals (Souto-Manning, 2014).

Surveys and questionnaires are commonly linked with quantitative research; however, it is worth noting that they can also serve as valuable tools for gathering qualitative data. Open-ended inquiries provide participants the opportunity to furnish elaborate comments, so capturing their subjective viewpoints, convictions, or personal encounters in their own verbiage (DeJonckheere and Vaughn, 2019).

The advent of digital technologies has facilitated the collection of qualitative data from various online platforms, including forums, social media platforms, blogs, and online communities. According to Levina and Arriaga (2014), these platforms provide a substantial amount of user-generated content that may be examined in order to gain insights about online behaviours, attitudes, and experiences.

Considering the research objectives, the characteristics of the data, and the available resources, Various approaches are employed in order to gather data, with the aim of attaining both validity and reliability in the collected data.

Differences	QUALITATIVE	QUANTITATIVE	Sources
Type of Data	focuses on non-numerical, subjective data such as narratives, interviews, observations, or textual materials.	gathers numerical, significant data through structured surveys, experimental, or statistical analyses	(Antwi, S.K. and Hamza, K., 2015).
Research Structure	implements an exploratory and inductive approach through open-ended questions, flexible methods, and in-depth analysis	Focus on deductive approach, testing assumptionsS or correlation using pre-defined variables, structured methods, and statistical analysis	(Gelo, O., Braakmann, D. and Benetka, G., 2008).
Population, Sample size and Generalisation	involves average sample sizes, emphasising on detailed information from a selected group of participants.	often utilizes larger sample sizes to achieve statistical power and aims to generalize findings to the broader population	(Glasow, P.A., 2005).
Data Evaluation	involves activities of coding, labeling, and interpretation of visual data	Quantitative analysis adoptss statistical techniques to summarize and analyse numerical data	(Williams, C., 2007).
Researcher's Role	the researcher plays an important role, working with participants, conducting interviews, and interpreting the information.	the researcher typically maintains a more detached role, aiming for objectivity and minimizing personal bias	(Darawsheh, W., 2014)
Density vs. Accuracy	exploring complex social experiences, understanding independent experiences	uses precise measurement, estimation, and statistical inference	(Vishnevsky, T. and Beanlands, H., 2004).

Table 4.2; Summary of the Differences between qualitative and quantitative approaches.

4.5.5.3 Similarities between quantitative and qualitative methods

Within the realm of supply chain management research, it is well acknowledged that objectivism is a frequently embraced ontological stance (Flynn et al., 1990; Micheli & Mari, 2014). Quantitative and qualitative research methodologies exhibit discernible differences and approaches.

however, they also share certain commonalities.

The research process encompasses both quantitative and qualitative research methodologies, which are characterised by systematic and rigorous approaches to inquiry (Fishman, 2013). Both activities necessitate meticulous planning, data gathering, analysis, and interpretation to effectively meet research inquiries or objectives (Fishman, 2013).

Data Collection: Both strategies utilise diverse methodologies for the purpose of gathering data. There are distinctions in the sorts of data acquired in quantitative and qualitative research. Quantitative research primarily deals with numerical data, whereas qualitative research focuses on non-numerical data. However, researchers employing both approaches interact with participants and employ various methods, such as interviews, surveys, observations, or document analysis, to acquire relevant information (Apuke, 2017).

Research Ethics: Ethical considerations are upheld in both quantitative and qualitative research methodologies. It is imperative for researchers employing any approach to consider the welfare, confidentiality, and informed permission of participants (Corti and Backhouse, 2000). In addition, it is their duty to uphold the integrity of the study process and ensure the ethical utilisation of data.

Research Validity: Both methodologies share the common objective of ensuring research validity, albeit through distinct strategies. Quantitative research attempts to achieve both internal and external validity, which are crucial in ensuring that the study accurately measures its intended constructs and can be extrapolated to a broader population (Onwuegbuzie, 2000). Qualitative research places emphasis on the concepts of credibility, dependability, and transferability, with the aim of establishing the trustworthiness and representativeness of the study findings.

Research Contributions: Both methodologies make valuable contributions to the existing body of knowledge within a certain topic or profession. Quantitative research offers statistical data, identifies patterns, and generates findings that can contribute to the development of theories and support decision-making processes. According to Bradley et al. (2007), qualitative research offers a comprehensive comprehension, detailed explanations, and contextual perspectives that can enhance the development of theories, formulation of hypotheses, and a more profound comprehension of intricate phenomena.

Mixed-methods research refers to a research approach that combines both qualitative and quantitative methods to gain a comprehensive understanding of a particular There is a growing acknowledgment of the significance of integrating

quantitative and qualitative methodologies in mixed-methods research. It is common for researchers to combine different approaches to use the unique advantages of each approach, validate their findings through triangulation, and achieve a more comprehensive comprehension of the study inquiries (Creswell & Creswell, 2005).

Quantitative and qualitative methods exhibit distinctions in terms of the types of data they employ, the tools employed for analysis, and the designs employed for research. However, they converge in their overarching objectives of knowledge generation, ethical research conduct, and the advancement of comprehension regarding phenomena. By comprehending the similarities and distinctions between the two approaches, researchers can enhance their decision-making process in choosing the most suitable ways to achieve their study objectives (Kastner, 2012).

Similarities	Quantitative	Qualitative	Sources
Research Process	systematic and rigorous approaches to inquiry	systematic and rigorous approaches to inquiry	(Sofaer, S., 1999).,
Data Collection	surveys, observations, or document analysis to gather information	surveys, observations, or document analysis to gather information	(Apuke, O.D., 2017).
Research Ethics	consider the well-being, confidentiality, and informed consent of participants	consider the well-being, confidentiality, and informed consent of participants	(Corti, L., Day, A. and Backhouse, G., 2000).
Research Validity	Quantitative research strives for internal and external validity	Qualitative research emphasizes credibility, dependability, and transferability	(Onwuegbuzie, A.J., 2000).
Research Contributions	Quantitative research provides statistical evidence, patterns, and generalizable findings	Qualitative research provides in-depth understanding, rich descriptions, and contextual insights	Bradley, E.H., Curry, L.A. and Devers, K.J., 2007).
Mixed-Methods Research	generating knowledge, conducting ethical research, and contributing to the understanding of phenomena	generating knowledge, conducting ethical research, and contributing to the understanding of phenomena	(Creswell, J.W. and Creswell, J.D., 2005).

Table 4.3; Summary of the similarities between qualitative and quantitative approaches

4.5.6 Mixed methods

The existence of divergent perspectives regarding the most effective study design for different research inquiries has prompted the emergence of the mixed study design.

Many scholars encounter difficulties while deciding between qualitative and quantitative research approaches to achieve more precise and dependable outcomes for a predetermined set of research inquiries (Chinn and Rinehart, 2016). The integration of qualitative and quantitative research methods has become feasible for researchers because of the emergence of mixed study designs.

Mixed methods research has been a subject of study for several decades, and in recent times, it has experienced a surge in popularity as a viable approach to conducting investigations. Scholars who choose to employ mixed methods studies encounter various challenges, such as establishing clear definitions for mixed methods, designing research frameworks that incorporate both qualitative and quantitative data, employing appropriate sampling techniques, and utilising mixed methods research to advance social justice, among others (Schoonenboom and Johnson, 2017). It is imperative to acknowledge that mixed methods research constitutes a distinct academic discipline characterised by its own set of approaches and methodologies. The domains of quantitative and qualitative research have attained a level of maturity, with scholars having established consensus on methodology, sample procedures, and other related aspects. However, within the field of mixed methods, there is limited agreement on certain aspects, including various stages of the research process and the availability of several mixed methods study designs (Chinn & Rinehart, 2016). There is a consensus among scholars that this discipline is through a process of continuous development and growth. This situation poses several challenges for researchers.

Proficiency in both qualitative and quantitative methodologies is a prerequisite for doing mixed-methods research, posing a considerable challenge for researchers. One potential approach is to engage in collaborative work, as suggested by Schoonenboom and Johnson (2017). In the realm of mixed methods research, it is imperative for researchers to acquire the skill of effectively integrating qualitative and quantitative components. This integration is essential to yield full insights into the phenomenon under investigation.

Mixed methods research is highly suitable for the purpose of confirming or supporting the findings obtained from alternative research methodologies. Moreover, in situations where a researcher requires the utilisation of one

methodology to inform another methodology, the adoption of a mixed research technique might be considered (Tashakori & Teddie, 2008). For instance, in situations where there is limited knowledge on a certain subject matter, it becomes imperative to initially acquire an understanding of the factors to be examined through qualitative research. Subsequently, these identified variables are then subjected to quantitative research methods, involving a substantial sample size of individuals, for further investigation.

Triangulation is a theoretical framework that posits the necessity of achieving convergence or corroboration in research. By doing so, the focus shifts from highlighting differences to emphasising the integration of various research approaches. Furthermore, the concept of complementarity involves the pursuit of either expanding upon or merging the outcomes of one methodology with those of another. Thirdly, the concept of development underscores the importance of utilising the findings derived from one approach to either inform or enhance another method. Additionally, the process of initiation aims to uncover instances of irony and incongruity through the modification of inquiries, which are formulated depending on the outcomes of one approach and the reproduction of another research methodology. Furthermore, the objective of expansion is to enhance the scope and diversity of investigation by implementing unique methodologies for each of its constituent elements. According to Niglas (2009).

A mixed research strategy is employed while endeavouring to formulate and afterwards evaluate a hypothesis pertaining to a phenomenon of interest. According to Alaka et al. (2016), qualitative research is better suited for theory formation, while quantitative research is better suited for theory testing. Therefore, it is necessary to employ both methodologies when developing and testing a specific theory. Moreover, when seeking to extrapolate the outcomes of qualitative research, employing a mixed research methodology is deemed more favourable. Although mixed research methods have been found to be adaptable to various study designs, researchers who choose to utilise this strategy may encounter certain challenges (Kutner, et al., 2008). The utilisation of the mixed research approach incurs significant costs and requires a substantial investment of time. To integrate qualitative and quantitative elements in research, it is imperative for the researcher to acquire a

comprehensive understanding of the subject matter. This elucidates the seldom utilisation of the design among most researchers.

4.5.6.1 Significance of mixed method in social science

Mixed methods in social science research holds immense significance as it combines the strengths of both quantitative and qualitative approaches, offering a more comprehensive understanding of complex social phenomena. By integrating numerical data and narrative insights, researchers can triangulate findings, enhancing the validity and reliability of results. Creswell and Plano Clark (2017) highlight the versatility of mixed methods in addressing diverse research questions and fostering a deeper exploration of the subject matter. It allows for a nuanced examination of context, contributing to a richer interpretation of social dynamics. The combination of statistical evidence and in-depth narratives provides a more holistic perspective, catering to the complexity of real-world social issues. Ultimately, the significance of mixed methods lies in its ability to bridge the gap between the breadth of quantitative data and the depth of qualitative understanding in social science research.

4.5.7 Case study

Case studies frequently employ a blend of qualitative and quantitative techniques for data collecting, encompassing interviews, observations, document analysis, surveys, and archive research. Academic researchers collect comprehensive and contextually relevant data to obtain a deeper understanding of the intricacies, dynamics, and distinctive attributes of the subject under investigation. The principal objective of a case study is to investigate, depict, and analyse the case within its authentic context, encompassing the subtleties and complexities of the research subject (Roller and Lavrakas, 2015). This methodology enables researchers to identify and analyse patterns, themes, and underlying mechanisms, hence facilitating the generation of theories or hypotheses that can be explored in subsequent investigations.

Case studies are of special significance in the examination of intricate or exceptional phenomena, whereby a comprehensive comprehension is required (Halkias et al.,

2022). These instruments are frequently employed in various academic disciplines, including psychology, sociology, anthropology, business, and healthcare. Case studies offer a comprehensive examination of actual circumstances, including thorough descriptions that might enhance the development of theories, influence policy and practise, and contribute to the current knowledge base. Nevertheless, it is crucial to acknowledge that case studies are sometimes constrained by their specific context and may not readily lend themselves to generalisation in alternative environments.

4.5.8 Grounded theory

The qualitative research methodology known as grounded theory was originally formulated by sociologists Barney Glaser and Anselm Strauss. The approach utilised is of an inductive nature, with the objective of constructing theories or conceptual frameworks derived from facts, as opposed to relying on prepared hypotheses (Hallberg, 2006). Grounded theory is a research methodology that emphasises the generation of explanations and hypotheses directly from the data, enabling the emergence of novel insights during the research process.

The fundamental tenet of grounded theory is the practise of constant comparison, wherein data is methodically examined to discern patterns, categories, and relationships (Ng & Hase, 2008). Academic researchers employ a process of repetitive cycles involving data gathering, analysis, and theory creation to enhance and broaden their comprehension of the subject being investigated. The approach of grounded theory is distinguished by its focus on theoretical sampling, wherein the process of collecting and analysing data takes place concurrently. Researchers intentionally choose participants or sources of data in a deliberate manner, with the aim of obtaining a wide range of perspectives that are both varied and in-depth. This approach facilitates a thorough investigation of the study issue, enabling a comprehensive analysis.

During data analysis, researchers employ coding methodologies to classify and arrange the data into coherent and significant units. The development of initial codes is derived from the analysis of data, and as further data are examined, these codes

undergo refinement, categorization, and ultimately integration into overarching theoretical constructs. The primary objective of grounded theory is to construct a substantive or formal theory that elucidates the fundamental processes and interconnections inherent in the phenomenon under investigation (Jeon, 2004). Substantive theory elucidates a particular facet or occurrence, but formal theory possesses a wider scope of relevance encompassing several settings.

Grounded theory is a commonly employed research methodology across a range of social scientific fields, encompassing disciplines such as sociology, psychology, nursing, and management. The methodology provides a methodical and rigorous framework to produce hypotheses, enabling researchers to extract concepts and theories directly from the data while maintaining a strong foundation in empirical evidence. The utilisation of grounded theory research serves to enhance the progression of knowledge by facilitating a more profound comprehension of social processes and phenomena (Hallberg, 2006).

4.5.9 Survey research

Survey research is a form of quantitative research that entails the collection of data from a sample of individuals or a population via the utilisation of structured questionnaires or surveys. The primary objective of this study is to collect data pertaining to individuals' perspectives, attitudes, actions, and personal attributes. Surveys commonly have a sequence of pre-established inquiries that respondents address using a standardised structure (Roopa & Rani, 2012). The questions presented might be classified as either close-ended or open-ended in nature. Surveys can be conducted using a range of methods, such as face-to-face interviews, telephone interviews, postal surveys, internet platforms, or mobile applications (Fink, 2003).

One of the primary benefits of survey research is in its capacity to efficiently gather data from many participants. Surveys facilitate the acquisition of data from a wide range of people, allowing researchers to make inferences and extend their findings to a broader community, so augmenting the external validity of the results. Survey research is a methodological approach that enables the measurement of variables, hence yielding quantitative data that can be subjected to statistical analysis (Fink,

2003). Data analysis approaches, including descriptive statistics, correlation analysis, and inferential statistics, enable researchers to discern patterns, trends, and relationships.

Surveys find application in diverse domains, encompassing social sciences, marketing, public opinion research, and healthcare. Surveys are valuable tools for analysing public sentiments, consumer inclinations, market patterns, and demographic attributes (Fink, 2003). It is imperative to exercise meticulous consideration when designing surveys in order to guarantee the integrity and consistency of the collected data. It is imperative for researchers to prioritise the clarity and pertinence of the inquiries, employ suitable sample methodologies, utilise appropriate approaches for survey administration, and safeguard the privacy and confidentiality of participants.

According to Sukamolson (2007), survey research is an advantageous method for collecting quantitative data and gaining understanding of individuals' views, behaviours, and traits. This tool facilitates the ability of researchers and organisations to make well-informed decisions, formulate policies, and gain insights on demographic trends.

4.5.10 Industrial interviews

Industrial interviews in the field of management research pertain to the systematic undertaking of interviews with individuals employed in diverse industries or organisational contexts (Watson, 2011). The purpose of conducting these interviews is to collect valuable ideas, diverse viewpoints, and personal experiences that are relevant to certain management subjects or research inquiries. Industrial interviews offer researchers the opportunity to obtain primary information directly from specialists in the sector, so enabling a more comprehensive comprehension of managerial practises, organisational dynamics, difficulties, and strategies. According to Veile et al. (2020), the data obtained from industrial interviews can play a crucial role in influencing decision-making processes, advancing theoretical frameworks, and offering valuable suggestions for enhancing management strategies within certain industries or organisational settings. Interviews are a highly beneficial qualitative research approach since they provide researchers with the opportunity to

get comprehensive and contextualised data directly from individuals who possess insider knowledge within a specific business.

4.5.10.1 Sample selection

Participants for the interview were carefully and randomly selected as was adopted from the views of (Lambert and Lambert, 2012). Five interviews were conducted among senior managers from NITDA, supply chain companies and other ICT service providers who are based in different states in Nigeria. The national policy of digitalising the economy as well as the strategic economic role of the regions in ICT deployment practices Nigeria is selected and the respective states within the federation. Furthermore, NITDA and the ICT service providers were chosen because of the accessibility, contact and the interest indicated earlier by the participants in the research.

The participants for the interview were professionals and academicians in ICT adoption and integration activities and deployment services within their respective organisation/ institutions and across the country (Banaeianjahromi and Smolander, 2019). To encourage respondents to participate in this study, they were assured that the results would be shared with them. In accordance with ethical standards, the respondents and their respective employers were anonymised.

4.5.10.2 Interview processes

The researchers-initiated contact with the participants using electronic mail, wherein they sought their explicit agreement to partake in the interview process. The email included an appended introductory note that provided details on the research. This correspondence is crucial for the purpose of their decision-making on their attendance at the interview. To validate their consent, it was necessary for them to fulfil the requirement of completing the consent form. A mutually agreed upon day, time, and location for the interview was subsequently established. The interview was done between September 15th and October 2022. A rescheduling of the interview was coordinated with two executive managers who were unable to attend at the originally scheduled time and date due to their busy schedules. They expressed their apologies and subsequently attended the interview two weeks later. The designated duration for each interview was set at 90 minutes. A minimal amount of temporal

overlap was observed. However, the goal of obtaining pertinent information was successfully accomplished. The interview was conducted in accordance with the established clarification and guidelines, while also adhering to concurrent risk assessment practises. These procedures were informed by the study criteria outlined by Yin (1994). In the context of industrial interviews in case studies, it is imperative for the researcher to possess the following competencies.

The ability to generate and analyse relevant inquiries; the ability to actively listen and remain open-minded; the capability to adjust and be flexible by perceiving new conditions as prospects rather than challenges; possessing a comprehensive understanding of the subjects being examined. The data obtained from the interviews was gathered using two distinct methodologies.

4.5.10.3 **Recorded responses**.

The responses were recorded. The initial segment of the interview was performed via an online platform, namely using a Skype link that was shared with the participants. This link served as their unique identifier for the scheduled session. The responses that were recorded were converted into textual form and afterwards utilised as pertinent and dependable data for the development of the questionnaire.

4.5.10.4 **Written responses**

Written responses are a form of communication that involves providing written answers or feedback to a given prompt or question. This method of communication allows. The written emails containing responses were collected and subsequently deliberated upon by experts from the department of business and entrepreneurship. These experts made professional contributions on how to effectively transform the content into appropriate questions for the research questionnaire.

4.5.10.5 Interview questions

The format utilised for gathering primary data from the ICT industry involved the use of unstructured, open-ended questions that were devised and administered. A semi-structured interview refers to an interview format wherein a predetermined set of questions is prepared beforehand to act as a framework for the interview process (Blaikie, 2007). The formulation of these questions has been derived from an

extensive examination of the pertinent academic sources. The interview was conducted with a foundation on the pertinent literature on supply chain research, with a specific emphasis on the intersection of information and communication technology (ICT) and supply chain integration practises.

An initial interview was carried out utilising unstructured, open-ended inquiries with scholars and industry executives within the Nigeria Information and Communication Technology Development Agency (ICTDA). This level provided a fundamental comprehension of supply chain integration practises and ongoing industry information and communication technology (ICT) initiatives.

4.5.10.6 Data collection

The individuals involved in the study actively participated in a methodical dialogue aimed at obtaining comprehensive data, valuable insights, and diverse viewpoints pertaining to the subject of investigation. The interview was performed through both face-to-face interactions and telephone conversations, taking into consideration the preferences and practicality of the participants. The user's text is not sufficient to be rewritten in an academic manner. Please provide more Interviews provide researchers the ability to delve into the participants' experiences, beliefs, attitudes, and behaviour. The interview methodology employed in this study demonstrated a high degree of flexibility and adaptation, as the researcher effectively modified the questioning and follow-up strategies in response to the participant's answers. Semi-structured interviews afford flexibility, hence providing an opportunity for open-ended research (Green et al., 2015). The selection of the interview format was influenced by the research objectives, the desired amount of structure, and the participants' comfort and familiarity with the subject matter.

Interviews are a valuable means of gathering data, with a multitude of advantages. The establishment of rapport and trust between the researcher and participant is facilitated, hence enabling the participant to divulge sensitive personal information. In order to uphold rigour and validity, the researcher diligently formulates interview protocols that align with specific study objectives and utilises active listening and

questioning strategies. The interview material will be transcribed and analysed using thematic analysis and coding techniques.

In general, the interview is a highly effective method of data collection that allows researchers to gather comprehensive information directly from participants. This process contributes to the advancement of theory and facilitates the generation of valuable insights, thereby enhancing the overall understanding of the research topic (Charmaz & Belgrave, 2012).

4.5.10.7 Analysis of data

The initial step of the data analysis process involved the transcription of the data, transforming it from raw information into a structured and interpretable format. The transcription process involved the utilisation of equipment designed to convert recorded audio into written text.

Subsequently, a tabular format was employed to discern and distinguish the various responses obtained from the interview data. The data was entered into Microsoft Excel in a constructive and individual manner. Subsequently, it was coded to differentiate the data based on its underlying structure and construct.

The semi-structured style of the interview questions posed challenges in terms of transcription ease. Due to the absence of a specific response pattern in the questions, the answers varied in length, ranging from lengthy to medium or short, based on each respondent's individual approach to addressing the interview questions. This enabled the researcher to prioritise the research question as the central topic, while establishing connections between the responses and the specific section and question number under consideration (Braun and Clarke, 2006).

The individuals involved in the study were anonymously described as Respondent I, II, III, IV, and V, ensuring both confidentiality and anonymity. The subsequent chapter provided an exposition of the participants' characteristics and their corresponding responses.

4.5.10.8 Exploratory Research

The first stage of the data analysis procedure entailed transcribing the data, so converting it from its original form into a structured and comprehensible format. The transcribing process entails the employment of specialised technology designed to transform recorded audio into written text.

Following this, a tabular structure was utilised to analyse and differentiate the diverse responses derived from the interview data. The data was inputted into Microsoft Excel in a systematic and independent fashion. Following this, the data was encoded to distinguish it according to its inherent structure and composition.

The utilisation of a semi-structured format for the interview inquiries presented difficulties with regards to the simplicity of transcription. The replies provided by the respondents exhibited a range of lengths, which may be attributed to the absence of a consistent response pattern in the interview questions. The variation in answer length can be attributed to the distinct approaches adopted by each respondent in addressing the questions. The utilisation of this approach allowed the researcher to give precedence to the research question as the focal point, while developing correlations between the responses and the section and question number being examined (Braun and Clarke, 2006).

To maintain confidentiality and anonymity, the participants in the study were allocated pseudonyms, namely Respondent I, II, III, IV, and V. The following chapter included an analysis of the participants' attributes and their related reactions.

4.5.11 Survey by questionnaire

A questionnaire is a tool consisting of a series of questions designed to elicit replies from participants, thereby providing valuable insights into a specific issue under investigation. The selection of questions for the questionnaire is contingent upon the specific research design employed in the study. In qualitative research, the utilisation of open-ended questions facilitates the generation of qualitative findings. Conversely, in quantitative research, structured questions and the employment of a Likert scale are employed to enable the measurement of the replies produced (South et al., 2022).

The present investigation employed structured or closed-ended questions that necessitated respondents to provide binary responses in the form of either "yes" or "no." Closed-ended questions were utilised in this study due to the adoption of a quantitative research approach, which necessitated the collection of quantitative data. According to Lichtenthaler's (2011) critical literature analysis, there seems to be a lack of sufficient theoretical foundation supporting the cumulative application of information and communication technology (ICT) and its integration into management and organisational practises to achieve desired performance outcomes. During the second part of the pilot test, the questionnaire is distributed to a representative group to evaluate the efficacy of the contact-administration technique. The objective of this phase is to gather data for the purpose of conducting exploratory analysis to assess the measurement quality and sampling adequacy of the questionnaire. In continuation of the preceding discussion, the pilot interview and questionnaire of this study were administered to a diverse group of participants. This group included postgraduate students and lecturers specialising in Information and Communication Technology (ICT) at Usman Danfodiyo University, officials from the National Information Technology Development Agency (NITDA), professionals working in the ICT industry, and ICT service providers. All participants were based in Nigeria. The participants were given instructions to react to the questions as if they were possible respondents. They were also asked to provide feedback regarding the clarity, flow, and time required to answer the questions. The remarks and observations provided by participants in the survey were additionally documented. The feedback received on the clarity of instructions provided for the questionnaire prompted the necessary modifications to be made to the final version of the questionnaire. During the second part of the pilot test, the questionnaire is distributed to a representative group to evaluate the efficacy of the contact-administration technique.

The phases encompass guidelines for what to avoid or consider to ensure the inclusion of the most suitable questions in the questionnaire. The research model necessitates the consideration of the following factors during the questionnaire design process.

The act of formulating questions should prioritise simplicity. It is imperative for the researcher to ensure that the questions in the questionnaire are formulated in a manner that is easily comprehensible. It is recommended to utilise a language that is straightforward and readily comprehensible to the target audience (Dillman, 2007). Furthermore, it is imperative that the inquiries posed are concise and precise, aligning with the researcher's planned research goal. The utilisation of straightforward and unequivocal inquiries will facilitate the process for participants to furnish the intended solutions.

The questions within the questionnaire should be designed in a clear and unambiguous manner, ensuring that the intended respondents possess a comprehensive understanding of the expectations associated with their responses. According to Sekaran and Bougie (2009), the use of indeterminate questions in research may not yield the intended study outcomes. Consequently, the researcher employed straightforward inquiries during the questionnaire construction process to ensure that participants could effectively grasp the nature of the expected responses and provide suitable answers.

Due to the nature of the current study, the collection of quantitative data necessitated the avoidance of open-ended questions. Furthermore, the utilisation of open-ended questions introduces complexity to the questionnaire and extends the necessary duration for data gathering. The utilisation of closed-ended questions with minimum response time was implemented due to the higher likelihood of preference by the participants of the study (Glasow, 2005). The questions presented in this study are easily standardised, enabling the gathering of diverse responses that not only aid in the process of coding but also allow for a clear interpretation of the acquired data.

To enhance respondent motivation, the questionnaire was designed to include succinct and precise inquiries. Short questions are considered more relevant and preferable over lengthy ones due to their ability to maintain the participants' interest during the study. According to Couper's (2017) research, it is recommended that questionnaire questions should not exceed twenty words in length to increase the likelihood of obtaining more responses. The principle of adhering to a rule of thumb

was followed during the creation of the questions, leading to the inclusion of concise and straightforward questions in the questionnaire.

Furthermore, it was ensured that the questions included in the questionnaire were relevant. The researcher focused on developing inquiries that were more likely to provide answers to the research issues of the study (Glasow, 2005). The main aim was to establish a connection between the questions in the questionnaire and the research questions to ensure their utmost relevance.

The sequencing of items inside the questionnaire was an additional feature that was considered. Sekaran and Bougie (2009) suggest that it is advisable for the order of questions in a questionnaire to progress from simpler and more straightforward inquiries to more intricate ones. The utilisation of this series of inquiries effectively enhances the progression of responses from those involved in the investigation. Furthermore, the implementation of a well-designed flow facilitates the acquisition of a greater number of responses, as it mitigates the participants' potential fatigue in supplying the required information. According to Sekaran and Bougie (2009), it is crucial for study participants to transition from responding to general inquiries to addressing more specific queries as they encounter increasingly challenging tasks. The utilisation of this approach for arranging questions in the present investigation had a pivotal role in enhancing the confidence of respondents to such an extent that they diligently filled out the questionnaires with a high degree of precision.

The Likert scale was incorporated into the survey instrument to facilitate the quantification of data. The Likert scale utilised in the current investigation spanned from 1 to 5, with 1 denoting an exceedingly low degree of satisfaction and 5 signifying an exceedingly high degree of contentment. A rating of 3 suggested a neutral or moderate level of satisfaction, positioned between the two extremes (Rattray & Jones, 2007). It was assumed that each response, whether in ascending or descending order, held considerable significance. Furthermore, the diverse values observed in the study reflect different levels of engagement in sustainability and the adoption of comprehensive quality management practises (Sekaran & Bougie, 2009). Therefore, the Likert scale was deemed appropriate for assessing the extent of co-implementation of total quality management practises and sustainability practises,

as stated by the participating companies in the study, together with the performance consequences of such implementation.

4.5.11.1 Sampling technique

The targeted respondents for this study are supply chain managers, chief executive officers, and managers in the Nigerian Information and Communication Technology Development Agency (ICTDA). The desirable sample was selected using proper sampling techniques. The term "sample frame" pertains to the origin of the material from which a sample is selected (Saunders et al., 2003). The study's sample frame was derived from a diverse selection of enterprises operating in the Information and Communication Technology (ICT) sector in Nigeria, encompassing both standalone ICT companies and those that have integrated ICT into their operations across various industries. This study utilised the database of the Ministry of ICT and NITDA, along with websites and other organisations and service providers in the field of ICT, to gather pertinent, reliable, and comprehensive information about organisations and employees involved in the adoption, implementation, and integration of ICT practises in emerging economies, using Nigeria as a case study. The selection of the sample frame is facilitated by these sources, which provide a wide range of industrial diversity for the research. Due to practical limitations, it was necessary to conduct a selective process to choose the ICT enterprises that could be feasibly included in the study. This selection was made to ensure that the data collection times could be effectively managed and accommodated. The selection approach utilised the simple random sampling technique. Saunders et al. (2003) state that the simple random sampling strategy is employed when all research respondents inside the sample frame have an equal probability of being selected for participation in the study. The methodology enables the utilisation of a random sampling approach in the selection of participants, hence mitigating potential biases to a significant extent. This increases the likelihood of achieving precise and reliable results.

4.5.11.2 Questionnaire design

The researcher initiated the study by explicitly establishing the objective of the questionnaire, which involved identifying the precise information required to satisfy the research objectives. The researchers also considered the demographic

characteristics, level of knowledge, and prior experience of the participants who would be completing the survey (Kimberlin & Winterstein, 2008).

The questionnaire commenced with preliminary instructions, succeeded by parts and sub-sections that exhibit a coherent progression. Utilising Structural Elements for Content Organisation: Headings, Numbering, and Bullet Points In academic writing, employing appropriate structural elements is crucial for effectively organising content. This can be achieved using headings, numbering, and bullet points. These elements not only enhance the readability and clarity of the text but also aid in conveying information in a systematic manner. By employing these techniques, writers can ensure that their ideas are presented in a logical and coherent A range of question formats was employed to gather diverse forms of information, encompassing multiple-choice, rating scales, open-ended, and Likert scale questions. The survey questions were thoughtfully organised in a coherent sequence, commencing with broad and less delicate subjects before progressing to more precise and individualised inquiries. Skip patterns were employed to guide participants to pertinent portions based on their responses.

To mitigate respondent fatigue and enhance completion rates, efforts were made to ensure clarity, consistency, and coherence through the utilisation of mutually exclusive and exhaustive response possibilities.

It is recommended to ensure that the questionnaire is succinct. When determining the duration for completion, it is important to consider a fair timeframe that will effectively motivate participation. In conclusion, it is evident that incorporating a closing section in academic writing is crucial for several reasons. Firstly, it provides a concise summary of the main points discussed throughout the paper, allowing readers to quickly grasp the in conclusion, it is recommended to conclude the questionnaire by expressing gratitude to the participants for their valuable time and cooperation. Additionally, it is advisable to include contact information for any further inquiries or issues that the respondents may have. By adhering to a systematic approach, a meticulously crafted and efficacious questionnaire was successfully developed to gather the intended data from the designated demographic.

4.5.11.3 Participants Consents

The participants were normally introduced to this research by means of an informed consent approach. The participants were given a participation form that explained the objectives of the research study, its intended purpose, and their designated role within it. Participants were provided with information regarding potential risks, benefits, and procedures to ensure confidentiality. The introduction was provided within the written consent form, which adhered to ethical guidelines. Prior to freely choosing to participate, the participants were provided with the option to ask questions and seek clarification on any uncertainties. This practise guarantees that individuals possess comprehensive information, skills, experience, and understanding of the study, enabling them to make an informed decision regarding their participation.

4.5.11.4 Sequence of questions

The research questions were systematically organised and presented in a manner that has the potential to significantly influence respondents' comprehension, involvement, and overall survey participation in a meaningful manner. The introduction questions were designed to be easily answerable to establish a favourable initial impression and foster a good response, hence promoting survey participation.

The relevant inquiries were organised into coherent sections according to their subject matter or thematic focus. This practise facilitates the maintenance of a coherent thinking progression and minimises the cognitive burden on individuals providing responses. Additionally, the utilisation of this approach facilitates the examination of replies pertaining to certain domains of interest (Kimberlin & Winterstein, 2008).

Throughout the survey, the questions were intentionally diversified to sustain the attention of the respondents. In this study, a variety of question formats were employed, including multiple-choice, rating scales, open-ended, and Likert scale questions. According to Adams (2015), it is often advised to commence with closed-ended questions prior to transitioning to open-ended questions.

Headings and subheadings serve the purpose of indicating a shift in topic or kind of question, so facilitating the organisation and comprehension of the text. Please ensure that there are clear and coherent transitions between distinct sections of the

questionnaire. The inclusion of smooth transitions in a questionnaire aid in enhancing respondents' comprehension of the intended goal of each section and facilitates the maintenance of their focus throughout the survey. According to Brace (2018),

The research questions for the interview were systematically organised and presented in a manner that can significantly influence respondents' comprehension, involvement, and overall survey participation in a meaningful way. The introduction questions were designed to be easily answerable to generate and attract an initial favourable impression and to motivate respondents to proceed with the survey.

To minimise any discomfort or reluctance, inquiries of a sensitive or intimate nature are strategically positioned at the conclusion of the questionnaire. This feature enables survey participants to cultivate a sense of trust and enhance their level of comfort prior to engaging in discussions that may involve sensitive subject matter. The implementation of strategies aimed at mitigating survey dropout and the provision of erroneous responses due to respondent discomfort can be beneficial. The application of skip patterns or routing logic was done in a suitable manner. To prevent misunderstanding, respondents were instructed to skip certain questions that were only relevant to them based on their past responses.

The survey was designed to commence with demographic inquiries, encompassing factors such as age, gender, and geography. These inquiries typically exhibit lower levels of complexity and offer valuable data for study. Furthermore, a concluding segment incorporating an expression of gratitude and provision of contact details for any subsequent queries was employed to conclude the session.

4.5.11.5 Social desirability

The consent form in this study placed significant focus on the autonomy and liberty of the participants. This approach aimed to mitigate any potential response bias arising from apprehension of judgement, adherence to societal norms, unethical conduct, or the fear of experiencing stigma, which may result in the distortion of reported information. Certain participants may tend to express agreement or support for claims or behaviours offered in the survey, regardless of their personal

opinions or experiences (Clayton et al., 2020). This phenomenon may result in distorted outcomes if participants furnish dishonest or exaggerated answers.

The presence of social desirability bias can provide obstacles to the credibility and consistency of study outcomes. To mitigate its influence on participant replies, researchers have used many measures, including the use of anonymity and confidentiality, as well as conducting validity, accuracy, and integrity checks (Clayton et al., 2020).

4.5.11.6 Question wordings

The formulation of questions is a critical component in the design of questionnaires, as it has a direct impact on the integrity and dependability of the gathered data. The way a question is formulated can have a substantial influence on how respondents perceive and subsequently respond to it. The use of appropriate question phrasing is crucial to achieve clarity, reduce potential bias, and enhance the accuracy of responses (Brace, 2018).

The author employed clear and succinct wording to minimise ambiguity and confusion. The questions are constructed using clear and concise language, avoiding specialised terminology or technical concepts that may be unfamiliar to certain participants. In addition, the use of specialised terminology aids in promoting a clear understanding of the intended meaning of the question and facilitates the provision of accurate responses by the respondents.

The employment of neutral language aided in the formulation of questions in a manner that minimised the potential for biassing the responses of the participants. Conscious efforts were undertaken to reduce or eliminate the use of leading or suggestive language that could potentially impact the opinions of the respondents.

Another crucial factor to consider is the utilisation of scale and reaction choices. According to Cummings et al. (2013), it is important for the language of response options to be consistent, exhaustive, and mutually exclusive. This implies the necessity of incorporating all potential responses while ensuring that each choice remains distinct from the others without any overlapping. Furthermore, it is crucial to select a scale that is suitable for the specific research issue at hand, ensuring that

it enables respondents to effectively convey their genuine ideas or experiences with precision.

It is imperative to exercise meticulous attention to the phrasing of questions when designing a questionnaire. Hence, the utilisation of clear and concise language, neutral phrasing, and well-constructed response alternatives plays a significant role in facilitating precise and meaningful data collection within the context of this study (Cummings et al., 2013). Comprehensive pre-testing and revision procedures are employed to enhance the quality of the questionnaire and guarantee that respondents accurately comprehend and react to the questions in accordance with the intended objectives.

4.5.11.7 Loaded questions

Loaded questions are a specific kind of interrogative statements that possess an inherent premise or assumption, which has the potential to exert an influence on the responses provided by individuals being questioned. It is normally recommended to refrain from incorporating loaded questions in the design of questionnaires. However, if actively implemented, loaded questions might serve the purpose of exploring perspectives or stimulating conversation. In the utilisation of loaded questions, it is of utmost importance to recognise the inherent bias and explicitly articulate the underlying premise. According to Fife-Schaw (1995), this methodology enables participants to reflect upon their own viewpoints and offer candid responses. It is important to use caution to minimise the potential for guiding or influencing respondents' ideas, as doing so may damage the objectivity and validity of the collected data.

4.5.11.8 Length of questions

The inclusion of appropriate question lengths in the design of questionnaires is crucial for effectively engaging respondents and facilitating their understanding. In general, there is a preference for short and brief questions due to their ease of comprehension and accuracy in providing answers. The utilisation of questions that

are lengthy or intricate might result in a state of bewilderment and weariness, which has the potential to impact the quality of responses (Choi and Pak, 2005). In order to enhance the efficiency of question length, it is advisable to remove extraneous words, repetitions, and technical jargon. Moreover, the process of deconstructing intricate inquiries into smaller, more feasible components might augment lucidity and alleviate cognitive load. According to Choi and Pak (2005), questionnaire designers can improve respondents' engagement, reduce dropout rates, and acquire more reliable and accurate data by prioritising brevity and simplicity in their designs.

4.5.11.9 Frequency scales

Frequency scales play a crucial role in the design of questionnaires, as they enable researchers to quantitatively assess the frequency or prevalence of behaviour, experiences, or beliefs. The utilisation of these scales facilitates the acquisition of numerical data, hence offering significant insights into various patterns and trends. Researchers can quantify and compare responses across various participants or groups by employing frequency scales. This enables them to facilitate statistical analysis and interpretation. Rovai et al. (2013) conducted the study. This facilitates a deeper comprehension of the phenomena being examined. Frequency scales offer a uniform framework, so facilitating respondents' comprehension and enabling them to deliver responses that are consistent. Data collection technologies improve the accuracy and dependability of data gathering, facilitating researchers in making well-informed conclusions grounded upon empirical facts.

4.5.11.10 Questionnaire survey administration

The method employed for the selection of enterprises operating within the Nigeria Information and Communication Technology Development Agency (NITDA) sector was simple random sampling. The NITDA database was utilised as a sampling frame for the selection of firms. The senior managers of the organisations were deemed the most appropriate individuals to respond to the survey questions due to their extensive knowledge of their companies' operations and their ability to obtain pertinent data regarding the management of ICT issues and performance metrics within their supply chain. The subsequent chapters provide a comprehensive

examination of a sample profile, encompassing the number of employees, annual turnover, and business categories of the company. The sample consists of 51 enterprises operating in the National Information Technology Development Agency (NITDA) as well as other sectors involved in production and manufacturing.

The questionnaire underwent a pretest conducted by two academic specialists affiliated with the Institute of Logistics and Operations Management at the University of Central Lancashire, prior to the commencement of data collecting. The questionnaire is subjected to evaluation by specialists to assess its organisation, readability, ambiguity, and completeness (Neuman, 2013). The final survey questions had minimal modifications based on the input received. The piloted testing was carried out utilising both mailed postal surveys and web-based survey methods, as recommended by Dillman et al. (2014).

In accordance with the adapted methodology of Dillman et al. (2014), physical copies of the questionnaire were dispatched by postal mail to recipients whose addresses were sourced from the NITDA database. The research package included a questionnaire, together with a cover letter and a participant's information sheet. The information sheet provided an explanation of the research objectives and instructions for completing the questionnaire. Additionally, a stamped and addressed envelope was included to enable the return of the completed questionnaire. A reminder was sent via email and telephone to individuals who did not answer to the questionnaire two weeks after it was initially issued, following the recommendation of Frankfort-Nachmias and Nachmias (2007). However, out of the 450 questionnaires that were distributed via mail, a total of 238 questionnaires were deemed acceptable, resulting in a response rate of 51 percent, which is considered legitimate for the purpose of analysis.

4.5.11.11 Questionnaire validation and pilot testing

4.5.11.12 Pilot study:

Pilot research was conducted to ascertain the adequacy of the questionnaire's design. Pilot studies serve the purpose of enabling researchers to assess the effectiveness of the instructions provided to respondents when they are tasked with

completing a questionnaire (Bryman and Bell, 2015). The proposal suggests distributing a total of 80 questionnaires to respondent organisations affiliated with the Nigerian Information and Communication Technology Development Agency (NITDA). These questionnaires would be specifically addressed to the Chief Executive Officers or Supply Chain Managers of the respective organisations.

4.5.11.13 Pilot testing:

The pilot study refers to the evaluation and testing of questionnaire instruments intended for data collecting in the survey procedure. The pilot study frequently uncovers and emphasises potential issues related to the phrasing and comprehensibility of the questionnaire, as well as the administrative procedures of the survey (Oppenheim, 1992; Forza, 2002).

According to Forza (2002), it is recommended to conduct a pilot test of the survey instrument with colleagues, industry experts, and the intended respondents before commencing the comprehensive field study. The evaluation of the questionnaire by colleagues is conducted to assess its effectiveness in meeting the objectives of the study. On the other hand, industry experts play a crucial role in ensuring that the questionnaire does not include questions that may expose the researcher's avoidable lack of knowledge in a specific field. Ultimately, the participants offer their comments regarding the various aspects that have the potential to influence both the response itself and the underlying intention behind the response. Furthermore, Forza (2002) put up a two-phase strategy for executing the pilot test. During the initial stage, the researcher administers the questionnaire to a cohort of prospective participants who simulate their involvement in the intended survey by completing the questionnaire. To ensure accurate data collection, it is imperative for the researcher to be physically present during the survey administration, actively observing the respondents as they complete the survey and diligently recording their responses. The researcher subsequently assesses, utilising the responses, whether the instructions accompanying the questionnaire were unambiguous, the questions were unambiguous, any difficulties arose in comprehending or responding to the questions, and the intended administration procedure would prove efficacious.

As a result, the professionals proposed the following adjustments to the questionnaire after conducting a review.

To substitute the term "degree" in the inquiry with "extent of ICT implementation"

To establish a hierarchical order for the responses, as opposed to utilising open-ended responses.

The Likert scale is often preferred over open-ended responses due to its ability to provide a quantifiable and easily scalable measure.

To differentiate and establish the categorization of ICT as either internal or external for the purpose of eliciting unique responses.

Additionally, it is important to differentiate Integration as either internal or external.

In order to assess the individual effects on performance outcomes, it is imperative to distinguish between supplier integration, customer integration, and employee integration practises. The questionnaire has ultimately been deemed suitable, comprehensive, with clear instructions, and easily comprehensible.

A questionnaire serves as the primary tool employed for data collection in the context of survey research. According to Bougie and Sekaran (2020), a questionnaire refers to a written collection of inquiries in which respondents document their answers. Questionnaires are specifically created for the purpose of gathering a substantial amount of quantitative data (Oakshott, 2016; Bell et al., 2018). The distribution methods for these materials include personal delivery, postal mail, or electronic transmission. According to Bougie and Sekaran (2020), self-administered surveys are a cost-effective and time-efficient method. Structured interview questionnaires are commonly employed for data collecting in smaller cases, although subjective data collection methods are also widely utilised (Bougie and Sekaran, 2020). In this study, data was collected by a questionnaire survey that was self-administered. Structured interviews were not undertaken due to constraints related to expertise, funding, and personnel experience, as highlighted in previous research (Forza, 2002; Quinlan and Zikmund, 2015). However, it was recognised that unstructured interviews possess the potential to enhance research outcomes by

facilitating the validation of gathered data, the acquisition of supplementary information, and the triangulation of the research methodology. One of the primary challenges inherent in interview surveys is the potential inadequacy of the collected data in effectively capturing the traits, indicators, and results pertaining to sustainable practises, agile capabilities, and performance. Consequently, a self-administered questionnaire was employed for the purpose of this study.

When the survey is restricted to a specific geographical region, conducting face-to-face interviews is a viable approach for gathering data. One key benefit of employing this approach is the researcher's ability to efficiently gather all completed replies. Additionally, immediate clarification may be provided to address any concerns that respondents may have regarding the questions posed. The researcher has the option to introduce the research topic and motivate participants to deliver sincere and open responses. Administering questionnaires to a large sample size concurrently is a more cost-effective and time-efficient approach compared to doing interviews. Moreover, the administration of questionnaires does not necessitate the same level of skill as conducting interviews. Given the advantages outlined, it is recommended that questionnaires be administered in person whenever feasible. Nevertheless, a notable drawback of surveys delivered by individuals is the potential for researcher-induced bias, as the way questions are explained may vary across various individuals. Consequently, participants may respond to different questions compared to those who received the questionnaire by mail. In addition, the process of manually conducting a questionnaire necessitates a substantial investment of time and effort. Consequently, this study included a combination of mailed and computerised surveys.

A mailed questionnaire refers to a self-administered survey instrument that is distributed to respondents via postal mail. For several decades, this approach has served as the fundamental basis for conducting research in the fields of operations and supply chain. However, with the emergence of the internet, mobile phones, and social media, the utilisation of mailed questionnaires has become obsolete. Mailed questionnaires and web-based questionnaires are commonly regarded as viable options. Questionnaires in printed format are distributed to respondents by mail for

the purpose of conducting surveys. Participants are obligated to autonomously fill out the survey by providing their own answers. Upon the completion of the questionnaire, participants are commonly instructed to return it via mail, as shown by previous studies (Saunders et al., 2009; Bell et al., 2018). Postal questionnaires offer a cost-effective solution and enable respondents the flexibility to complete them at their own time. Additional advantages encompass the lack of temporal constraints, the capacity to establish a commanding perception, the guarantee of confidentiality, and the mitigation of interviewer prejudice (Sekaran & Bougie, 2009). Nevertheless, a notable drawback of postal surveys is the lack of interviewer involvement and the absence of open-ended inquiries (Forza, 2002).

The prevalence of online or web-based surveys has experienced a notable increase. This approach allows researchers to electronically distribute a questionnaire to respondents via email or by directing them to a designated website for completion and submission. According to Forza (2002), web-based surveys offer a more cost-effective and time-efficient approach to data gathering compared to alternative techniques. Online questionnaires are commonly employed to acquire a more comprehensive comprehension of consumers' choices and preferences. One significant benefit of utilising online survey research is its utilisation of the internet's capacity to grant access to groups or individuals that would otherwise pose challenges in terms of reachability (Wright, 2005). Another benefit of internet questionnaires is their capacity to conduct surveys across vast geographical regions. Participants are provided with a hyperlink to access the questionnaire, allowing them to complete it at their own discretion. The utilisation of automated processing in surveys provides researchers with the added benefits of time, cost, and labour savings.

Nevertheless, online survey methodology is accompanied by notable drawbacks. Sampling issues may be encountered by researchers performing web-based research. The presence of self-selection and low response rates presents challenges in determining the representativeness of the sample and the generalizability of the findings. This is due to the possibility that survey respondents may not accurately reflect the characteristics of the whole population. Indeed, the response rates for

surveys of this nature tend to be very low. The acceptable response rate has been reported to be 30 percent according to Wright (2005) and Sekaran and Bougie (2009). Additional drawbacks of electronic questionnaires encompass the incapacity to address potential queries from respondents, the impracticability of employing probability sampling techniques due to the absence of appropriate population lists, and the susceptibility of online questionnaires to various elements that can influence their visual presentation.

Questionnaires are particularly well-suited for explanatory and analytical studies due to their ability to facilitate the examination and elucidation of cause-and-effect correlations between variables (Saunders et al., 2019). The selection of a questionnaire is influenced by various factors, including the research questions and objectives (Saunders et al., 2019; Creswell, 2014). Additionally, considerations such as the necessary sample size for data analysis, the type of questions needed to gather data, the significance of targeting a particular group of respondents, the timeframe available for data collection, and the feasibility of automating data collection also play a role.

Bell et al. (2018) argues that determining the most suitable approach for a survey cannot be done in a theoretical manner alone, but rather requires consideration of specific survey requirements, as well as practical considerations such as time, money, and available resources (Forza, 2002). After careful consideration, the questionnaire survey was determined to be an appropriate tool due to its cost-effectiveness, efficiency in administration, absence of interviewer effects and variability, convenience for respondents, and effectiveness in gathering the required data to address the research inquiries (Forza, 2002; Bell et al., 2018). Furthermore, the selection of the questionnaire approach was based on its appropriateness as a research instrument for investigating the mediating and moderation effects within the context of the relationship between ICT integration practise and supply chain performance in Nigeria. The creation process of questionnaires must be adequately described due to its utilisation. The subsequent enumeration presents a set of rules for constructing questionnaires.

The subsequent stage of the pilot study entails the implementation of the questionnaire to assess the impact of the administration procedure on the outcomes. The objective of this phase is to gather data for the purpose of conducting exploratory analysis in order to assess the measurement quality of the questionnaire and the sufficiency of the sampling. The pilot questionnaire for this study was administered to a sample of five participants, consisting of individuals from Usman Danfodiyo University and staff members from MTN Data Management. The participants were given instructions to react to the questions as if they were possible respondents. They were also asked to provide feedback regarding the clarity, flow, and time required to answer the questions. The remarks and views provided by participants in the survey were duly documented. The average duration necessary to complete the questionnaire has been ascertained to be 20 minutes. The final version of the questionnaire was changed in response to feedback regarding the clarity of its instructions.

In general, the outcome of the pilot test suggests that the survey instrument was perceived as clear, readable, and comprehensive in measuring the issues at hand.

• On average, participants required around 10 minutes to complete the questionnaire. • The directions provided for completing the questionnaire were unambiguous and accurate.

4.6 Analysis technique

The description of the statistical techniques used for computing and analysis is discussed in this section as well as the types of data collected for the purpose of the analysis.

4.6.1 Types of data and analysis

Numerical data refers to a category of information that encompasses quantitative measurements or observations, which are expressed in numerical form. Continuous data, such as height and weight, as well as discrete data, might be included. Statistical approaches, such as mean, median, correlation, and regression analysis, are commonly employed for the examination of numerical data (Nevill et al., 2002).

Categorical data refers to qualitative qualities or attributes that may be classified into separate categories or groupings. Illustrative instances encompass factors such as gender, profession, or level of schooling. Categorical data analysis encompasses various statistical techniques, including the examination of frequency distributions, the use of chi-square tests, and the utilisation of logistic regression. Ordinal data is a type of data that signifies the arrangement of categories or rankings in a specific order. According to Nevill et al. (2002), it conveys a relative stance or preference without exact quantification. One illustration of this concept is the utilisation of Likert scale ratings, which encompass a range of responses such as strongly agree, agree, neutral, disagree, and strongly disagree. The analysis of ordinal data sometimes entails the utilisation of statistical techniques such as rank correlation or ordinal logistic regression.

Interval data is a type of data that is characterised by numerical values that have equal intervals between them, but do not possess a meaningful zero point (Boone and Boone, 2012). Illustrative instances encompass temperature quantified in the units of Celsius or Fahrenheit. Various statistical approaches can be employed to examine interval data, such as t-tests and analysis of variance (ANOVA). Conversely, ratio data possesses all the characteristics of interval data, while additionally incorporating a significant zero point. Illustrative instances encompass variables such as age, income, or duration allocated to a particular endeavour. Various statistical methods can be employed to examine ratio data, such as descriptive statistics, correlation analysis, and regression analysis (Deeks et al., 2019).

The present study focuses on inferential analysis. Inferential analysis encompasses the process of deriving conclusions or generating inferences about a larger population by utilising a representative sample. Statistical techniques, such as

Research objective testing, confidence intervals, and regression analysis, are employed in its application. The utilisation of inferential analysis aids researchers in formulating generalisations and evaluating the statistical significance of discovered correlations or disparities within the data (Lewis et al., 2003).

Correlation analysis is a statistical technique that investigates the magnitude and direction of the association between two or more variables. The measurement of connection is conducted by the utilisation of correlation coefficients, such as Pearson's correlation coefficient. Additionally, this analysis aims to ascertain the statistical significance of the observed link. Correlation analysis enables researchers to discern trends and establish relationships between data.

Regression analysis is a statistical technique used to examine the association between a dependent variable and one or more independent variables. This methodology aids in the anticipation and elucidation of the influence exerted by independent factors upon the dependent variable. According to Constantine (2012), regression analysis offers valuable insights into causal linkages, facilitates the process of forecasting, and aids in creating accurate forecasts.

Experimental design is a methodical approach that entails the deliberate modification of variables and the subsequent evaluation of their effects on the outcome (Fraenkel et al., 2012). This tool enables researchers to establish causal linkages. Statistical methodologies such as analysis of variance (ANOVA) and t-tests are employed to assess the disparity between group averages and ascertain the statistical significance of these differences.

The present study used a quantitative analysis methodology, namely correlation analysis, to synthesise data, draw conclusions, explore associations, establish causal linkages, predict outcomes, and identify patterns or trends. The aim is to provide support for decision-making based on empirical evidence (Lewis et al., 2003).

Regression analysis was employed to evaluate the relationship between independent variables and dependent variables, with the aim of forecasting and elucidating their impact. This perspective was endorsed by Constantine (2012). Regression analysis is a statistical method used to evaluate the association between a dependent variable and one or more independent variables. This methodology aids in the anticipation and elucidation of the influence exerted by independent factors on the dependent variable. According to Constantine (2012), regression analysis offers valuable insights

into cause-and-effect relationships, facilitates the process of forecasting, and aids in creating accurate forecasts.

4.6.1.1 Preliminary analysis

The preliminary analysis is of utmost importance in this study's data processing method. The subsequent phases were adhered to.

The process of data cleaning involved a comprehensive examination of the dataset to detect and rectify any instances of missing values or inaccuracies. Eliminate or rectify any erroneous or unreliable data points to enhance the quality of the data.

The process of data exploration involved the utilisation of descriptive statistics and data visualisation techniques to discern patterns, trends, and noteworthy discoveries that might provide valuable insights for subsequent research.

The examination of variable relationships facilitated the exploration of potential linkages and correlations between variables. Utilise scatter plots, correlation matrices, or alternative methodologies to evaluate the magnitude and orientation of associations.

The initial research objectives were derived from the research problem statement, drawing upon the insights obtained from the preliminary study. This aids in directing the researcher's future analysis and investigation.

Moreover, the assumption of normality was employed in the data analysis, which is of special significance when verifying the supposed normal distribution. There exist two distinct categories for evaluating normalcy, namely the graphical technique and the statistical method. The graphical method encompasses various techniques such as the histogram, stem-and-leaf plot, box plot, normal distribution plot, and detrended normal plot (Tabachnick and Fidell, 2007; Field, 2009; Ghasemi and Zahediasl, 2012). The statistical methods employed in this study encompass the Kolmogorov-Smirnov (K-S) test, the Shapiro-Wilk test, as well as measures of skewness and kurtosis (Ghasemi & Zahediasl, 2012).

Through the process of doing preliminary analysis, the researcher acquired a comprehensive overview of the information, enabling them to discern potential

difficulties and derive valuable insights that will inform subsequent study. The initial analysis serves as the basis for this study, enabling the application of sophisticated statistical techniques, objectives testing, and the subsequent interpretation of data.

4.6.1.2 Assessing the assumption of normality

The evaluation of the assumption of normality holds significance in the realm of data analysis, especially when employing parametric statistical tests that rely on the assumption of a normal distribution. There are various methodologies that can be utilised.

The process of visually examining an object or system. The utilisation of histograms, box plots, or Q-Q plots for data visualisation enables an initial evaluation of normalcy. A distribution that is symmetrical and bell-shaped is indicative of normalcy.

Statistical methods, such as the Shapiro-Wilk or Kolmogorov-Smirnov tests, can be employed to evaluate the normality of a distribution. (Yap & Sim, 2011). The assumption of normality is met if the p-value exceeds a predefined significance level, such as 0.05.

The application of mathematical transformations, such as logarithmic or square root transformations, can be utilised to normalise data that is skewed or non-normal. This normalisation process renders the data more appropriate for parametric analysis.

Non-parametric tests, such as the Mann-Whitney U test or Kruskal-Wallis test, can be employed when the assumption of normality cannot be satisfied. These tests do not necessitate the fulfilment of normal distribution assumptions.

The evaluation of the assumption of normalcy is crucial in determining the suitability of parametric tests, improving the validity of statistical conclusions, and aiding researchers in making precise interpretations of the data.

4.6.1.3 Reliability and validity of data

(Bougie and Sekaran, 2020; Pallant, 2020) cite that... The reliability of a scale refers to its ability to minimise bias and errors, therefore ensuring uniform measurement across all elements within the instrument. To clarify, the dependability of a measure refers to its ability to assess the intended idea consistently and accurately, thereby

contributing to the determination of its validity (Bougie and Sekaran, 2020; De Vaus, 2013). The dependability of a scale is often assessed using two commonly utilised indicators: stability of measures, also known as test-retest reliability, and internal consistency.

The stability of measures refers to the inherent ability of a measurement to maintain its consistency and constancy during a given period. This exemplifies its exceptional quality since the notion may be consistently quantified irrespective of the timing of measurement. Test-retest reliability and parallel-form reliability are two measures used to assess the stability of a test or measurement (Bougie and Sekaran, 2020). The test-retest reliability of a scale is established by administering a questionnaire on two distinct occasions and thereafter computing the correlation between the two acquired scores (Pallant, 2020; Bougie and Sekaran, 2020). A scale that exhibits strong test-retest correlations is considered to possess greater reliability. Parallel-form reliability refers to the degree of correlation between responses obtained from two sets of measurements that are designed to assess the same construct (Bougie & Sekaran, 2020).

The second discernible facet of dependability pertains to the internal consistency of measurements. The measure's internal consistency reflects the degree of homogeneity among the items that make up the construct-tapping measure (Bougie & Sekaran, 2020). To clarify, the term "hanging together" pertains to the extent to which the items of a scale assess a consistent underlying attribute (Pallant, 2020; Bougie and Sekaran, 2020). The most often used metrics of internal consistency include Cronbach's alpha coefficient (Rungtusanatham et al., 2003; Stangor, 2006; Nunnally, 1978), interitem consistency, and slit-half reliability tests (DeVellis, 2016).

Furthermore, an assessment was conducted to determine the reliabilities of the inter-item correlations. The inter-item correlation technique is utilised to assess the reliability of a singular construct (DeVellis, 2016). The study investigates the extent of association between the scores of a single item and the scores of all other items that assess the same underlying concept (PHAM, 2020). Cronbach's coefficient alpha (Cronbach, 1946) and the Kuder-Richardson formulae (Kuder and Richardson, 1937) are widely utilised measures for assessing interitem consistency reliability in the

context of multipoint-scaled items. According to Robinson et al. (2013), there is a positive relationship between the coefficients and the quality of the measurement apparatus. The measure of split-half dependability in an instrument is indicative of the degree of correlation between its two parts. According to Matsunaga (2008), it is possible for split-half reliabilities to surpass Cronbach's alpha, but only under specific circumstances. This occurs when the measure assesses many underlying response dimensions and certain other conditions are satisfied.

The study included confirmatory factor analyses to assess the convergent and discriminant validity, as well as the composite reliability of the measurement scales. The validity of a scale refers to the degree to which it accurately assesses the construct it is designed to evaluate (Bell et al., 2018). Various techniques of analysing the validity of a concept's measure are distinguished by writers, reflecting the diverse approaches to testing measurement validity (De Vaus, 2014). There are three types of testing validity, including face or content validity, criterion validity, and construct validity (Pallant, 2013; Bell et al., 2018; Bougie and Sekaran, 2020).

4.6.1.4 Addressing bias

The two most common methods of addressing data analysis bias are the common methods bias and non-response bias as discussed below.

Common method bias (CMB)*:* Common method bias is a methodological concern that may arise in research, wherein the variability in responses is erroneously attributed to the measuring method employed, rather than the components under investigation (Conway & Lance, 2010). Measurement instrument-related systematic error can occur in a study, resulting in misleading relationships across variables. This arises due to the interrelatedness of the measurement instruments utilised, leading to erroneous outcomes.

Common method bias is a potential issue that can emerge from multiple origins, including the utilisation of self-report questionnaires, reliance on the same data source or context, adoption of the same technique of data collection, and the close temporal proximity of measurements (Conway and Lance, 2010). The presence of

distortion in the relationships between variables can lead to correlations that are either inflated or attenuated, as well as parameter estimates that are biassed.

The existence of common technique bias presents a potential challenge to the credibility and consistency of study outcomes. The potential consequences include compromising the precision of findings and constraining the applicability of outcomes. The presence of common method bias has the potential to result in the misinterpretation of associations, leading researchers to draw inaccurate inferences or arrive at flawed conclusions (Conway and Lance, 2010).

To uphold the rigour and validity of research findings, it is crucial to acknowledge and address the presence of common technique bias. Researchers can improve the precision of their findings and offer more dependable understandings of the phenomena being studied by implementing suitable methodological approaches.

Non-response bias*:* non-response in research methodology is a term used to describe the circumstance in which persons or units that have been selected for a study either choose not to participate or provide partial responses (Berg, 2005).

To begin with, the phenomenon of non-response has the potential to introduce selection bias, wherein individuals who choose not to respond to a survey exhibit systematic differences in their attributes compared to those who do respond. This phenomenon has the potential to result in a skewed portrayal of the target group, which may ultimately compromise the external validity of the research. The degree of selection bias is contingent upon the factors that are linked to non-response and the level of impact they have on the variables under investigation (Edwards, 2002).

Additionally, the absence of response has the potential to diminish the statistical power of a research investigation. The study's potential for effectively detecting tiny effects or correlations may be compromised due to the limited sample size. The factor may impose constraints on the capacity to formulate comprehensive deductions and establish dependable inferences on the entire population (Berg, 2005).

Furthermore, the lack of response can have a significant effect on the representativeness of the sample, especially in surveys or studies that strive for wide-ranging generalizability. If specific cohorts consistently decline to engage, their viewpoints and encounters may be inadequately represented, resulting in a partial comprehension of the topic under investigation (Berg, 2005).

To address the issue of non-response, researchers might employ efficient sampling methods that aim to optimise response rates by utilising incentives or implementing follow-up procedures. These tactics serve to minimise the potential consequences associated with non-response. In general, the issue of non-response presents difficulties in terms of the credibility, applicability, and statistical strength of study results (Scheaf et al., 2023). To improve the dependability and relevance of the findings, efforts were made to resolve non-response concerns during this investigation.

4.6.1.5 Descriptive statistics

Descriptive statistics facilitate the acquisition of a full comprehension of the data, the identification of trends, and the effective communication of the findings in a succinct and coherent manner (Sprinthall, 2007; Pallant, 2016).

Pallant (2013) elucidated that the concept of normal distribution entails a symmetrical bell-shaped curve characterised by its peak frequency (Bryman & Cramer, 2011, p. 113). Various methods exist for assessing normalcy, including the examination of skewness and kurtosis values, as well as the utilisation of the explore option inside the descriptive statistic menu in SPSS.

4.6.1.6 The mode, mean, and standard deviation

Descriptive statistics include many measures of central tendency, such as the mean, median, and mode, which serve to provide insights into the typical or average value of the dataset. Mishra et al. (2019) emphasised that metrics of variability, including range, standard deviation, and variance, serve to characterise the extent or dispersion of data. Additional descriptive techniques encompass graphical representations, such as histograms and bar charts, as well as summary statistics. These techniques offer valuable insights into the distribution, form, and fundamental

characteristics of the dataset. The previous sections of this chapter covered the assessments of reliability and validity for normalcy assessment. The preceding sections have outlined the data screening procedures employed in this study. The significance of the assessment results was emphasised as a crucial determinant in selecting the appropriate statistical analyses for this study.

4.6.1.7 Inferential statistics

The objective of the statistical analysis was to derive conclusions on the link between the research construct and to make generalisations based on the findings. The findings were augmented by the utilisation of inferential statistics in this study. According to Hainmueller (2014), the utilisation of inferential statistics allows researchers to make predictions about future events or behaviours by leveraging the links that have been established within the collected data. The capacity to foresee future outcomes is highly advantageous across a range of disciplines, encompassing finance, marketing, and the social sciences.

Inferential statistics encompasses a range of techniques that enable the estimation of population parameters that are not directly observable. This research enables the researcher to develop a comprehensive comprehension of the variables and elucidate the interconnections among the research constructs. According to Hainmueller (2014), inferential statistics plays a crucial role in enabling researchers to identify and comprehend the associations between different variables.

4.6.1.8 Correlation analysis

Through the process of data analysis, the researcher successfully ascertained the magnitude and orientation of the relationships, so facilitating a more profound understanding of the phenomena being investigated. Correlation analysis is an essential statistical methodology employed to assess the magnitude and orientation of associations between variables. Correlation analysis enables researchers to ascertain and measure the extent of the relationship between variables (Nathans et al., 2012). This aids in ascertaining the nature of the link between variables, whether it is positive, negative, or lacks statistical significance. The acquisition of this

information is crucial for comprehending the underlying patterns and interrelationships within the dataset.

Correlation analysis offers valuable insights regarding the predicting capabilities of variables. Researchers can assess the degree to which changes in one variable can be utilised to forecast changes in another by analysing the magnitude of correlation coefficients (Maletic, 2013). This facilitates the prediction and strategic decision-making procedures.

Correlation analysis enables researchers to examine and evaluate theories pertaining to the associations between variables. Through the utilisation of correlation coefficients and the implementation of significance tests, researchers can ascertain whether the discovered relationships possess statistical significance or have transpired randomly. The utilisation of correlation analysis allows for the examination of the composition and characteristics of the dataset (Lleras, C., 2005). According to Nakagawa and Cuthill (2007), the utilisation of statistical diagnostics aids researchers in the identification of potential outliers, influential observations, or nonlinear correlations that may necessitate additional investigation or data transformation.

Correlation analysis plays a crucial role in facilitating decision-making processes by elucidating the associations between factors that have the potential to impact outcomes. This resource offers empirically supported knowledge to help the development of policies, marketing tactics, financial choices, and other domains that rely on a comprehensive comprehension of interconnections.

Correlation analysis is a valuable tool utilised by researchers to identify and measure associations between variables, hence improving predicting accuracy, facilitating hypothesis testing, informing decision-making processes, and fostering a more comprehensive comprehension of the data. According to Nakagawa and Cuthill (2007), the utilisation of this instrument is highly advantageous across several disciplines such as social sciences, economics, healthcare, and business.

4.6.1.9 Regression analysis of the research construct

Various forms of correlation analysis are frequently employed to assess the association between variables. The Pearson correlation coefficient is a statistical measure that quantifies the linear relationship between two variables. The Pearson correlation coefficient is employed as a metric to assess the magnitude and direction of a linear association between two variables that are continuous in nature. The scale of correlation coefficients spans from -1 to +1, with -1 denoting a complete negative correlation, +1 indicating a complete positive correlation, and 0 signifying the absence of a linear relationship (Schober et al., 2018).

Spearman's rank-order correlation is a statistical measure used to evaluate the magnitude and direction of the association between variables. It is a non-parametric method, meaning it does not assume any specific distribution for the data. According to Chavan and Kulkarni (2017), it is deemed suitable to employ ordinal or ranked scales for measuring variables, or when the assumption of normalcy is compromised.

Kendall's Correlation: Kendall's tau is a non-parametric statistic commonly employed to assess the magnitude and direction of the association between variables. The method is appropriate for analysing ordinal data and evaluates the level of agreement or disagreement in the ordering of variables.

The utilisation of correlation analysis techniques allows researchers to quantitatively assess the magnitude and orientation of associations between variables, irrespective of their linearity or monotonicity, and without consideration to the nature of the variables under investigation. According to Ekström (2011), associations have a significant role in shedding light on the characteristics of linkages and contribute to the comprehension of interconnections within datasets. The selection of a correlation analysis technique is contingent upon the characteristics of the variables under investigation and the research inquiry being pursued.

The study conducted by Maletic (2013) utilised Pearson's Correlation Coefficient to ascertain the linear relationship between ICT and integration practises and

organisational performance. Spearman's Rank-Order correlation was employed to evaluate the magnitude and direction of the association between the variables under investigation. Additionally, Kendall's tau is employed as a non-parametric statistic in this research to assess the level of agreement or disagreement in the ordering of variables.

The purpose of correlation is to forecast a dependent variable based on one or more predictor variables by utilising a linear equation to analyse observed data (Maletic, 2013).

4.6.1.10 Major types of multiple regressions

The role of research ethics is of paramount importance in any scientific endeavour. While it is true that researchers in operations and supply chain management generally avoid conducting studies that endanger the lives of participants, it is crucial to acknowledge and address ethical concerns when gathering primary data. Multiple regression is a statistical method employed to investigate the association between a dependent variable and two or more independent variables (Uyanık & Güler, 2013). Multiple regression is a widely utilised statistical technique in data analysis, encompassing various significant forms.

Linear regression is widely regarded as the prevailing form of multiple regression analysis. The assumption made is that there exists a linear relationship between the dependent variable and the independent variables. The objective is to identify the optimal line or plane that minimises the discrepancy between the observed and predicted values (Uyanık and Güler, 2013).

This study employs linear regression and standard regression techniques to examine the impact of information and communication technology (ICT) and integration practise. The aim is to observe and forecast the link between these variables, while also minimising any potential negative effects.

4.6.1.11 Factor analysis

Factor analysis is a statistical methodology employed to discern and comprehend the latent factors or constructs that elucidate the interrelationships seen among a collection of variables (Bandalos and Finney, 2018). The primary aim of factor analysis is to decrease the dimensionality of the data and identify significant factors that encapsulate the shared variance across the variables.

Factor analysis is a statistical technique that entails the conversion of a given collection of observed variables into a reduced set of latent components. The components encompass the common variance among the variables and offer a more succinct depiction of the data (Yong & Pearce, 2013). Factor analysis was employed as a methodological approach to reveal the latent structure and inherent connections among the variables under investigation, so offering valuable insights into the fundamental constructs and dimensions being assessed. Factor analysis is a widely utilised technique with diverse applications across various disciplines, including psychology, social sciences, marketing, and economics (Yong & Pearce, 2013).

Factor analysis is a frequently employed statistical technique in the process of constructing and verifying measurement scales (Tella, 2011). Factor analysis is a valuable tool in the identification of the fundamental dimensions or factors that make up a construct. Additionally, it aids in the process of item selection and refinement, which is crucial for the development of scales that are both reliable and valid. Factor analysis is a statistical technique that aids in the reduction of dimensionality in extensive datasets by identifying the fundamental latent components that account for the observed variability. This approach has the potential to streamline data interpretation and enhance the feasibility of subsequent analysis. Factor analysis is utilised in this study to evaluate the construct validity by analysing the degree to which the observed variables correspond with the postulated hypothesis.

4.6.1.11.1 EFA

The statistical method known as Exploratory Factor Analysis (EFA) is employed to reveal the latent components or constructs that exist within a given set of observable data (Yang, 2005). The primary objective of this study is to ascertain the arrangement and connections between variables, so enabling researchers to comprehend the shared components that lead to the observed correlations.

According to Mvududu and Sink (2013), the main objective of Exploratory Factor Analysis (EFA) is to decrease the dimensionality of a dataset by consolidating correlated variables into a more limited set of factors. The utilisation of data analysis aids in comprehending the fundamental framework of intricate datasets and offers valuable perspectives into the underlying constructions being assessed.

Construct validity of measurement instruments can be assessed through EFA by examining the extent to which the observed variables align with the hypothesized factor structure. Tavakol and Wetzel, (2020) asserted that EFA provides evidence for the underlying dimensions of the constructs being measured.

4.6.1.11.2 CFA

Confirmatory factor analysis is a structural equation modelling technique commonly employed in quantitative data analysis. The utilisation of this statistical approach is mostly focused on assessing the congruity between a measure variable and several constructs, owing to its multivariate nature (Hair et al., 2010). The research commenced by establishing the model specification, which was subsequently refined and retested to facilitate the analysis of Confirmatory Factor Analysis (CFA). Finally, the parameters are estimated. Multiple metrics are utilised to evaluate the degree to which the data aligns with the theoretical framework.

4.7 Summary of the Research Process

The researchers assessed internal consistency reliability to ascertain whether the questionnaire adequately meets the study requirements as identified by Tabackhink and Fidell (2007). The research technique of this study encompassed four distinct phases. The initial phase entails doing a comprehensive literature review on the process of ICT adoption, practises related to ICT integration, and the collective

influence of these factors on supply chain performance. The objective of this review is to analyse the existing literature on the framework for performance measurement and to understand the rationale behind the use of performance measurement indicators in the supply chain industry. The analysis encompasses an examination of the fundamental components of supply chain key performance indicators (KPIs), which serve as quantifiable metrics that focus on both operational and strategic aspects of performance.

The subsequent stage involves elaborating on the findings of the initial phase, so allowing the researcher to structure the information obtained from the literature study and formulate interview inquiries. The industrial interviews involved consultation with five specialists in the supply chain field. The objective of this interview was to assess the role of the National Information Technology Development Agency (NITDA) as a government agency in facilitating the achievement of a digital economy in Nigeria. Additionally, it aimed to examine the effects and extent of information and communication technology (ICT) adoption and integration practises within the industry. Furthermore, the interview sought to evaluate the key performance metrics and challenges associated with performance management, along with other relevant matters. The participants of the interview were also extended an invitation to express any supplementary viewpoints pertaining to the discourse.

The interview material was transcribed and afterwards underwent thematic analysis, following the approach outlined by Braun and Clarke (2006), to identify commonalities and variations in the perceptions of the interviewees. The statistics constituted the basis for the proposed extension of performance measures. The performance measures in this technique were subsequently revised to incorporate supplementary measures derived from the interview's findings. The self-administered questionnaire was constructed based on the established set of performance metrics and additional insights obtained through interviews. The technique was employed to achieve the triangulation of data. The purpose of this study was to verify the validity of a set of performance measures by assessing their level of significance across the industry. Furthermore, the primary objective of this

study was to examine the causal relationship between choice performance indicators, organisational strategies, and organisational performance.

The data analysis technique involved the utilisation of IBM SPSS and AMOS 28 version software. The purpose of this study was to collect quantitative data and examine the construct relationship as presented in the conceptual framework, as well as assess the causal link between variables.

Figure 4.4 Summary of the research process

4.8 Conclusion

This chapter provides a description of the technique utilised in the present investigation. Furthermore, the research examines the conceptual underpinnings that inform the approaches utilised. The use of pragmatism as a theoretical framework had a profound influence on the methodologies utilised, as it advocated for the integration of mixed-method research and prioritised a pragmatic approach to addressing research inquiries.

The chapter also, explores the underlying justification for employing exploratory interviews and questionnaires as means to address the study inquiries. The objective of the interviews was to get the perspectives of supply chain specialists regarding concerns related to the measurement of supply chain performance. The results were utilised to enhance a suggested collection of performance indicators for the sector, which were obtained from an extensive examination of the existing body of research. Furthermore, the subsequent step of the study was the integration of the interview findings into a questionnaire survey.

The previous part focused on the three main components of the questionnaire, namely its design, administration, and validation. The concluding section of the paper presents a concise overview of the research methodology employed, aiming to offer a full depiction of the research process. The subsequent section presents a discourse on the analysis and findings derived from the industry interviews.

Chapter five: Empirical Case Study Analysis

5.1 Introduction

This research methodology is suitable for individual researchers since it facilitates a comprehensive analysis of various features or settings. Case studies can be undertaken either prior to or after the administration of a survey. The post-survey case study commonly aims to uncover significant matters that merit more examination. According to Yin (2009), case study research proves advantageous in addressing numerous inquiries pertaining to the mechanisms and rationales behind social phenomena. This study design employs many procedures, such as interviews, observations, and other suitable approaches, to gather data to address the research objectives (Bell and Waters, 2018). The selection of this research was predicated on the assumption that there exist common attributes shared by all businesses and individuals. Therefore, a case study is undertaken to ascertain these features, such as scrutinising diverse interaction processes inside an organisation or assessing the impact of process implementation on organisational operations. The examination of a singular occurrence may impede the researcher's ability to verify facts, which is among the drawbacks of this approach. The utilisation of this methodology has the potential to lead to biassed reporting, hence distorting the interpretation of the results. Furthermore, a significant issue that arises is to the lack of reliability in generalisations, as highlighted by Bell and Waters (2014).

5.2 Population Sample

Simple random sampling was used to select companies involved in different activities alone the Nigeria Information and Communication Technology Development Agency (NITDA) sector. The NITDA databased was used as a sampling frame to draw firms. The senior managers of the companies were the most suitable to answer the questions posed in the survey because they possess a greater understanding of their companies' operations and capable to access data relevant on how they manage ICT issues and performances indicators of their supply chain. Table 5.1 shows the sample profile involving number of employees, annual turnover, and business sectors of the companies. The sample comprises of 51 firms in the NITDA.

Prior to data collection, the questionnaire was pretested by two academic experts in the Institute of Logistics and Operations Management, University of Central Lancashire. These experts review the questionnaire for structure, readability, ambiguity, and completeness (Neuman, 2014). Based on their feedback, minor changes were made to the final survey questionnaire. The piloted testing was conducted using mailed postal and web survey approaches as suggested by (Dillman et al. 2014).

In accordance with the adapted methodology of Dillman et al. (2014), physical copies of the questionnaire were dispatched by postal mail to recipients whose addresses were sourced from the NITDA database. The research package included a questionnaire, a cover letter, and a participant's information sheet. The information sheet provided an overview of the research objectives and instructions for completing the questionnaire. Additionally, a stamped and addressed envelope was included to enable the return of the completed questionnaire. According to Frankfort-Nachmias and Nachmias (2007), a follow-up email and telephone reminder were sent to individuals who did not answer to the questionnaire two weeks after it was initially issued. However, out of the 120 questionnaires that were distributed via mail, a total of 51 questions were deemed suitable for research. This is a response rate of 36 percent, which is considered legitimate for conducting preliminary analysis.

5.2.1 Interview questions

The format utilised for gathering primary data from the ICT industry involved the use of unstructured, open-ended questions. These questions were devised and administered to obtain relevant information. A semi-structured interview refers to an interview format where a predetermined set of questions is prepared beforehand to act as a framework for the interview process (Blaikie, 2007). The formulation of these questions has been derived from an extensive examination of the pertinent scholarly works. The interview was conducted with a foundation in the pertinent literature pertaining to supply chain research, with a specific emphasis on the intersection of information and communication technology (ICT) and supply chain integration practises.

An initial interview was carried out utilising unstructured, open-ended inquiries with scholars and industry executives affiliated with the Nigeria Information and Communication Technology Development Agency (NITDA). This level provided a fundamental comprehension of supply chain integration practises and the ongoing information and communication technology (ICT) initiatives within the industry.

5.2.2 Interview processes

The researchers performed telephone interviews. Initially, the participants were contacted over electronic mail and were requested to partake in the interview process. The email included an additional introduction letter that provided details regarding the research. The submission of this letter is necessary for the individuals to make an informed decision regarding their attendance at the interview. Participants were obligated to complete the consent form as a condition for granting their consent. Consequently, a consensus was achieved with the involved parties regarding the specific date and time for the telephonic interview. The interviews were done during the period from March to July 2015, based on the participants' availability. The duration of each interview ranged from 60 to 90 minutes. Following the interview, a comprehensive transcription was electronically sent to the interviewees for their perusal. All inquiries seeking clarification after the interview were transmitted electronically through email. Yin (1994) presents a set of principles for the implementation of case study interviews, which were adhered to during the execution of industrial interviews.

Yin (1994) delineated a repertoire of requisite competencies for the researcher when undertaking interviews. The ability to generate and analyse relevant inquiries • The ability to engage in active listening and remain open-minded • The capability to be adaptable and receptive to new situations, perceiving them as potential opportunities rather than challenges • Possessing a comprehensive understanding of the subjects being examined. The data obtained from the interviews was gathered using two distinct methodologies.

5.2.3 Recorded responses

The initial segment of the interview was performed remotely using an online platform, specifically Skype. The participants were provided with a unique annonymouse and coded

participation ID in the form of a link, which served as their access point for the scheduled interview. The responses that were carefully captured annonimousely transcribed into textual format having careful ethical consideration and afterwards utilised as pertinent and dependable material for the development of the questionnaire.

5.2.4 Written responses

The written emails containing responses were collected and subsequently deliberated upon by experts from the department of business and entrepreneurship. These experts provided their professional insights on how to effectively transform the content into relevant questions for the research questionnaire.

5.3 Participant demographics

5.3.1 Participant I

Participant I is the manager and head of the ICT deployment unit in the Nigeria Information and Communication Technology Development Agency (NITDA). He is an ICT engineer and part of the pioneer workers since the establishment of the agency for the last 11 years. His responsibilities include data base maintenance and data sharing within the ministry of information and communication as well as data monitoring, and control between the agency as government representative and service providers. He holds postgraduate honours in IT management and a professional member IAAA for over 8years.

5.3.2 Participant II

Is an employee with MTN Nigeria a national of south Africa, with vast knowledge and experience in ICT deployment and service provider. He has 15 years working experience working with MTN from south Africa and was transferred to Nigeria to serve in the capacity of senior supervisor MTN virtual services and product subscription management. Prior to this position he was working in south Africa head office as MTN router operator and maintenance engineer. The position he held for 6years before his redeployment to work with MTN Nigeria branch.

5.3.3 Participant III

Participant III had 19 years working and vast experience in the IT industry. He engages in the sale service and logistics operations of IT procurement services within and outside Nigeria. He was an employee of Galibson computer software and accessories that specialises in the sale, service, maintenance, import and expert logistics company for 7years. He resigned and established a private company that engages in ICT adoption and deployment services (multi-link co. ltd) a registered company which he operates as the Chief executive and Director for 12years.

5.3.4 Participant IV

Participant IV had been engaging in the academic teaching and learning circle of ICT for over 22years. He rose from graduate assistant in the department of mathematics and computing to the administrative responsibilities of heading the ICT unit within the institution. The responsibilities that include ICT deployment and installation within the institution, Seminar conference participation on IT and ICT related themes as well as provision of IT workshop training for both university staff and student on ICT adoption and deployment practices. He is a member of ICT professional bodies both with and outside Nigeria.

5.3.5 Participant V

A practitioner with 7years experience in the printing and design company, who engages in the use of computerised design for fabrics production. Engineer specialises in the use and application of computer technologies such as the CAD for design of materials fabrics, shapes, and fashion for different needs and uses. Versatile in the application of CAM to design and recommend colour mixing for different fabrics manufacturing for both local content consumption and international distribution. Currently, he is acting in the capacity of deputy Director design and manufacturing unit of the company.

Participant	Position	Company/organisation	Gender	working experience	Sector
I	Manager	NITDA	M	10	Government (NITDA)
II	Employee	MTN	M	12	ICT Service provider
III	Director	Computer/electronics	M	15	ICT deployment engineer
IV	Director	Data base maintenance	M	12	ICT teaching/learning
V	Employee	Printing/publishing	M	**9**	Software and design engineer

Table 5.1 Summary of Participants Demography

5.4 Interview questions for this study

5.4.1 ICT experts and service providers

5.4.1.1 What is the level of ICT technology adoption and usage in your organisation

A - Emerging

B - Applying,

C - Infusing,

D - Transforming

Level of ICT in your organisation	Participant I	Participant II	Participant III	Participant IV	Participant V
ICT application in your organisation?	Transforming	Infusing	Infusing	applying	Emerging
ICT implementation and customers engagement	Transforming	Applying	Applying	Applying	Applying
Main ICT elements used by your organization.	Transforming	infusing	Applying	Applying	applying

Industry wide ICT implementation and benefits.	Transforming	Infusing	Infusing	Infusing	Infusing

Table 5.2 Summary of levels of ICT implementation

5.4.1.2 Motivations for ICT implementation; the drivers for the implementation of ICT technology in your organisation?

"The drivers of ICT (Information and Communication Technology) in our company depends partly on the company's need for increased efficiency and productivity, improved communication and collaboration, as well as cost savings through automation and streamlined processes, competitive advantages gained from technological advancements, access to real-time data for better decision-making, recent tactical decisions, emphasises flexibility in operations, enhanced customer experiences, and compliance with industry regulations". *Respondent II*

"From the industry perspective, our company was motivated by factors such as technological advancements, changing market dynamics, evolving customer expectations, and the desire to stay ahead in a digital landscape. Very important also for our company to remain competitive and thrive in today's interconnected world". Respondent I

Describe the role of government on ICT and integration practice in supply chain industry

Respondent I

The government plays a significant role in influencing ICT (Information and Communication Technology) and integration practices in organizations. Here's a description of the Nigerian government's role in promoting and regulating ICT and integration practices:

*5.4.1.3 **Government Policy and Regulation***

"Our organisation as governments establishment develops policies and regulations that govern the use of ICT within organizations. These policies encompass areas such as data protection, privacy, cybersecurity, intellectual property rights, and digital accessibility. They set the framework for organizations to adopt and integrate ICT responsibly and securely". Respondent I&II

5.4.1.4 ***ICT Infrastructure Development***

Governments often invest in the development of ICT infrastructure, such as broadband networks and data centres. By providing a healthy and reliable ICT infrastructure, governments create an enabling environment for organizations to adopt and integrate ICT effectively.

5.4.1.5 ***Standardization and Interoperability***

"I can confirm that NITDA play a crucial role in promoting standardization and interoperability in ICT sector. We establish standards and frameworks that ensure compatibility and seamless integration of ICT systems and applications". Respondent I

These standards facilitate information exchange, data sharing, and interoperability between different organizations and sectors (Gordon and Catalini, 2018).

5.4.1.6 ***Digital Skills and Education***

Nigerian governments realise the effects of education and skills acquisition invest in initiatives to promote digital skills and education among the population. They develop programs to train and upskill individuals in ICT-related fields.

"By enhancing digital literacy and skills, governments enable organizations to have a workforce that is competent in using and integrating ICT effectively". Respondent III

5.4.1.7 ***Funding and Grants***

"Occasionally Governments through the ministry of communication provide funding and grants to support our organizations in adopting and integrating ICT". Respondent II

These funds can also be allocated for research and development projects, ICT infrastructure investments, digital transformation initiatives, and capacity-building programs. Government funding encourages organizations to invest in ICT and integration practices.

5.4.1.8 ***Collaboration and Partnerships***

"We (NITDA) as governments agents, initiates IT development policies purposely to foster collaboration and partnerships between organizations, research institutions, and ICT industry players". Respondent I

By creating platforms for knowledge sharing and collaboration, governments promote the exchange of best practices, innovation, and the adoption of emerging technologies. This

collaboration drives integration practices and the development of ICT solutions tailored to organizational needs.

5.4.1.9 ***E-Government Initiatives***

"Governments themselves serve as examples of ICT adoption and integration through e-government initiatives". Respondent III

"*They implement digital services and platforms to enhance service delivery to citizens and businesses. These initiatives encourage organizations to follow suit and adopt similar practices, leading to increased efficiency, transparency, and improved interactions with the government*". *respondent IV*

5.4.1.10 ***Promoting Digital Transformation***

"*Governments actively promote digital transformation across various sectors, including healthcare, education, finance, and transportation*". *Respondent V*

"We know they provide incentives and support for organizations to embrace digital technologies and integrate ICT into their operations". Respondent IV

Governments may introduce policies that encourage the use of digital tools, electronic transactions, and online services to streamline processes and improve productivity.

The government plays a multifaceted role in ICT and integration practices in organizations. Through policy development, infrastructure investment, standardization, skills development, funding, collaboration, and regulation, governments create an environment conducive to the adoption and integration of ICT (Juma and Yee-Cheong, 2005). They ensure the responsible use of ICT, protect data, promote interoperability, and drive digital transformation across sectors, ultimately supporting organizations in leveraging ICT to enhance their operations and competitiveness.

5.4.1.11 At what state of ICT adoption is your organisation?

Most of the case study organisations in this study are operating at various levels of ICT adoption stages. NITDA as governmental agency and custodian of ICT deployment policy was able to position in the full implementation stage of ICT. This development enhances its achievement to deliver on the government mandate of achieving digital economy policy standard set come 2030. The take up saw NITDA registering and encouraging many business organisations to take advantage of the digitalisation government policy (Adeyanju, (2021). With the intended full take up of the policy come 2030, IT software subscription and application in business organisation become significantly on the increase. Business organisations small, medium, or large are seen to be operating at various IT implementation stages as summarised below.

Organization/companies	Pilot	Impartial,	Full implementation
NITDA			✓
MTN			✓
University			✓
Cement company		✓	
Electronic and computer accessories			✓
Textile factory			✓
Furniture factory		✓	
Food and beverages	✓		
Oil and gas company		✓	
Plastic company		✓	
Transportation	✓		

Table 5.3 Summary of levels of ICT implementation

5.4.1.12 Who has the ultimate responsibility for ICT adoption in your organisation?

Respondent I&II

"*The responsibility for ICT (Information and Communication Technology) adoption in our organization is typically shared among various stakeholders, with specific roles and responsibilities assigned to each*".

The personnel and departments that play a crucial role in the implementation of ICT adoption in this example are as follows:

The senior management team, consisting of the CEO, CIO (Chief Information Officer), and other executives, plays a pivotal role in facilitating the implementation of information and communication technology (ICT) (Peppard, 2010).

"I think it is the traditional responsibility of the senior management in any formal organisation to set the vision, strategic objectives, and allocate resources necessary for implementing and leveraging ICT within the organization". *Respondent III*

IT Department: The IT department, led by the IT manager, is responsible for overseeing the overall ICT adoption process. They handle the technical aspects, such as infrastructure, hardware, software selection, implementation, maintenance, and security.

"*One of the advantages we had was how project managers coordinate and manage the implementation of ICT initiatives. They develop project plans, allocate resources, monitor progress, and ensure timely completion within budget. They work closely with IT professionals, business units, and stakeholders to deliver successful implementation of the ICT project*". *Respondent V*

The adoption process of ICT solutions in the daily job of employees also entails a corresponding duty on their part. According to Ndou (2004), individuals demonstrate active engagement in training programmes, offer constructive comments, and readily adopt new technology to optimise the advantages they offer. Nevertheless, the achievement of successful information and communication technology (ICT) adoption necessitates the collaboration and coordination of various stakeholders. It is imperative to implement efficient communication channels, training

initiatives, and change management techniques to facilitate a seamless transition and optimise the advantages of ICT within the organisational context. The references cited in the text include Schaefer et al. (2021) and Ndou (2004).

5.4.1.13 What are the ICT and supply chain integration practice adopted in your organisation.

Respondent III

"To achieving improved company performance our company resort to adopt enabling technologies like; Computer-Aided Design (CAD) Computer-Aided Manufacturing (CAM), Internet, Electronic Data Interchange (EDI) in the textile design and manufacturing control".
Respondent III

On the other hand, "*we internally integrated the functions of the units with the technologies, strategically aiming to establish stronger cooperation among the various units within the company and other operation functions in order to work together in a cooperative manner to arrive at acceptable outcomes*". *Respondent IV*

5.4.1.14 Decision to adopt ICT: What factors played a major role in adopting ICT in your organisation?

"*I think increasing availability of cloud-based services, software-as-a-service (SaaS) solutions, and affordable technology options plays key role in ICT adoption and more accessible for smaller organizations like ours. As these technologies provided us with cost-effective alternatives and allow our businesses to integrate ICT solutions based on specific needs of our company. the available ICT options and technologies to determine the most suitable ones for their specific needs". This involves evaluating different software, hardware, and network infrastructure options and considering factors such as compatibility, scalability, security, and cost".*
Respondent IV

Organization must make decisions regarding the implementation process. This includes setting objectives, assigning responsibilities to internal or external teams, and planning for training and change management to ensure smooth adoption and integration of ICT into existing workflows.

"*Our decision focused on, both financial and human, for ICT adoption. This involves budgeting for hardware and software purchases, maintenance costs, and ongoing technical support, as well as identifying and acquiring the necessary talent or expertise to manage and operate the ICT systems*". *Respondent III*

"*Our organisation was curious to emphasis and consider the potential risks and challenges associated with ICT adoption, such as data security threats, system integration issues, or resistance to change. However, as a timely response we develop strategies to mitigate these risks and address any potential obstacles throughout the adoption process". Respondent IV*

Overall, the major decisions in adopting ICT in the organization revolve around defining objectives, evaluating technology options, planning implementation, allocating resources, and managing risks and challenges (Allaoui et al., 2019; Hwang and Min, 2015).

5.4.1.15 What are the obstacles to ICT adoption in your organisation?

Firstly, limited infrastructure poses a significant challenge. Insufficient internet connectivity, inadequate power supply, and lack of reliable telecommunications networks hinder the effective implementation of the ICT systems and services.

"From my experience, over the years companies operating within the emerging economies face budget constraints and limited financial resources, making it challenging to invest in expensive hardware, software licenses, and infrastructure upgrades required for ICT adoption". Respondent V

"*In developing economies, I know about many critical factors that are obstacle to ICT adoption in organisation, these include shortage of skilled ICT professionals, lack of qualified personnel proficient in ICT implementation and management can impede the successful adoption and utilization of ICT solutions, Cultural factors, and resistance to change from both management and employees as well as fear of job loss also hinder ICT adoption. Traditional work practices, lack of awareness or understanding of the benefits of ICT, and resistance to technological advancements slow down the adoption process*". *Respondent V*

Lastly, challenges related to cybersecurity and data privacy. Inadequate measures to protect sensitive information, lack of cybersecurity infrastructure, and limited awareness of

cybersecurity practices in a way undermine trust and confidence in ICT systems, consequently, hampering the adoption efforts Ani, (Li and Liu, 2021).

5.4.1.16 To what extent and how do the size of your organisation affect decision to adopt ICT?

"Our establishment being it large as well part of government ministry having the responsibility to digitalise the Nigerian economy. We have more resources, financial capabilities, and dedicated IT departments, making it relatively easier to adopt and implement ICT solutions. Because of size and capability, we can invest in hardware, software, and infrastructure upgrades necessary for ICT adoption. Additionally, the establishment (NITDA) have a greater need for efficient data management, communication, and coordination across multiple departments and locations, making ICT adoption a strategic priority". Respondent I

On the other hand, smaller organizations may face more challenges in adopting ICT.

Another challenge pointed out by a respondent is "*limited financial resources, lack of dedicated IT staff, and competing priorities make ICT adoption more difficult because of the Small size of our businesses, this has created great concerns about the initial costs and return on investment associated with our ICT implementation plans". Respondent IV*

5.4.1.17 What benefits does your organisation derive from the implementation of ICT?

Respondent II

"*Regardless of size, benefits of ICT adoption include improved communication, data management, scalability, and competitive advantages offered by ICT solutions. W can witness operational improvement, leading to customer satisfaction because of improved communication that eliminate unnecessary delays in order placement and order fulfilment due to automated services available 24/7"*

Ultimately, the decision to adopt ICT should align with the organization's strategic objectives and future growth plans. Virtual enterprises require high level of communication systems to eliminate non-value adding activities in the supply chain (Gunasekaran et al., 2004). This could help to address human related errors in exchanging information and controlling various operations functions.

5.4.1.18 How does ICT impact the performance metrics:

Respondents I

ICT (Information and Communication Technology) has a significant impact on various performance metrics within an organization, including cost, delivery, quality, responsiveness, flexibility, and customer satisfaction. Here's a detailed exploration of how ICT influences each of these metrics:

Cost:

In our company ICT has help reduce costs in several ways:

"*Process Automation: ICT enables automation of manual and repetitive tasks, eliminating the need for extensive human intervention. This reduces labour costs and improves operational efficiency. Supply Chain Optimization: Integrating ICT systems with supply chain processes enables better inventory management, demand forecasting, and production planning. This optimization helps minimize inventory carrying costs and reduces supply chain disruptions*".

Respondent II

c) Cloud Computing: Cloud-based ICT solutions eliminate the need for organizations to invest in expensive hardware and software infrastructure. By leveraging cloud services, organizations can access scalable resources and pay for what they use, leading to cost savings (Attaran and Woods, 2018; Attaran, 2017). Finally, ICT tools enable virtual meetings, conferences, and collaboration, reducing travel expenses and associated costs. Remote work options supported by ICT can also lower overhead costs for office spaces.

Delivery:

ICT plays a crucial role in improving delivery performance. "*An IT project was initiated in our company for real time Tracking and Monitoring which greatly reduce package loss in transist"*:

Respondent II

ICT systems allow organizations to track shipments, monitor logistics operations, and provide real-time updates to customers ie. blockchain technologies. This enhances visibility into the supply chain, enabling better coordination and ensuring timely delivery (Chang et al., 2019).

Supply Chain Integration: Integrating ICT systems across different stages of the supply chain facilitates seamless information flow, reducing lead times and enhancing coordination between suppliers, manufacturers, and distributors.

"*ICT and Integrative capacity enable us effectively estimates our demand and maintain updated inventory management" Respondent V*

Predictive Analytics: By leveraging ICT tools for data analysis, organizations can gain insights into demand patterns, identify potential bottlenecks, and proactively address supply chain issues. This helps optimize delivery schedules and improve on-time delivery performance.

Respondents IV

Quality:

"*With the adoption of automated procedure, our performance has improved with regards to product inspection and production testing procedures that is fast and more reliable compared to the manual approach*" *Respondent III*

Quality Control Systems: ICT enables the implementation of quality control systems, including automated testing and inspection processes. This ensures consistency, accuracy, and adherence to quality standards. Real-time Data Monitoring: ICT systems can capture and analyse real-time data from various sources, enabling organizations to identify quality issues promptly. Early detection allows for timely corrective actions, minimizing defects and improving overall product or service quality (Colledani et al., 2014).

responsiveness:

"*The adoption and utilisation of the ICT tools such as email, instant messaging, and customer relationship management (CRM) systems enable our organizations to respond to customer inquiries and issues in a timely manner*". *Respondent V*

Quick and efficient communication enhances customer satisfaction and builds trust (Rehman and Coughlan, 2011).

ICT enables organizations to collect and analyse customer feedback through various channels. This feedback can be used to identify areas for improvement, address customer concerns, and enhance responsiveness to their needs (Swift, 2001).

Respondent V

Flexibility:

"With ICT tools, our employees can work remotely and collaborate virtually, providing flexibility in work arrangements. This allows our organizations to adapt to changing circumstances, such as emergencies, travel restrictions, or the need for flexible work schedules. Scalable Infrastructure": Respondent III

Cloud-based ICT solutions offer scalability, allowing organizations to quickly adjust their IT infrastructure based on changing business needs. This flexibility helps organizations accommodate growth or fluctuations in demand without significant upfront investments. Real-time Data Access: ICT systems provide employees with real-time access to information and data from various sources, enabling quick decision-making and rapid response to changing market conditions (Yang et al., 2013).

5.4.1.19 How does ICT and supply chain integration impact the following performance metrics

Customer satisfaction

Profitability

Respondents II & III

Customer Satisfaction:

ICT tools, such as email, live chat, social media, and customer relationship management (CRM) systems, facilitate efficient and personalized communication with customers. Organizations can address customer queries, provide support, and gather feedback in a timely manner, leading to improved customer satisfaction. Enhanced Service Delivery:

"ICT enables our organizations to streamline and automate various customer-facing processes. Self-service portals, online ordering systems, and chatbots provide customers with convenient and efficient ways to interact with the organization, leading to quicker service delivery and increased satisfaction. Personalization and Customization: The systems also allow our organizations to collect and analyse customer data to gain insights into their preferences, behaviours, and needs. With this information, organizations can personalize their offerings, tailor marketing messages, and provide targeted recommendations, enhancing the overall customer experience". Respondent III

ICT platforms enable customers to provide feedback, reviews, and ratings about products and services. Organizations can monitor and respond to this feedback promptly, demonstrating their commitment to customer satisfaction and making improvements based on customer insights (Burnett and Lisk,2021).

Profitability:

"*The adoption of ICT enables our organizations to automate repetitive and manual tasks, leading to improved operational efficiency. This automation reduces costs, minimizes errors, and frees up resources, allowing organizations to focus on higher-value activities, increase productivity, and optimize resource allocation, ultimately improving profitability. Our existing ICT systems provide our organizations with access to large volumes of data and advanced analytics capabilities. By leveraging these tools, our organizations can extract valuable insights, identify trends, make informed decisions, and optimize business strategies*". *Respondent III*

Data-driven decision-making enhances operational efficiency, reduces risks, and leads to improved profitability (Berry and Parasuraman, 2004).

Supply Chain Optimization: Integrative ICT capabilities allow organizations to integrate their supply chain processes, enabling better coordination, demand forecasting, and inventory management. This optimization minimizes costs associated with inventory carrying, reduces lead times, and improves supply chain efficiency, positively impacting profitability.

"With the adoption of digital marketing platforms, we are able to effectively manage our relationship with customers (CRM)" Respondent III

e-commerce solutions, enable organizations to reach a wider audience, target specific customer segments, and optimize marketing campaigns. These tools facilitate effective customer engagement, lead generation, and conversion, ultimately driving sales and increasing profitability (Goodman 2019).

ICT significantly impacts both customer satisfaction and profitability. By leveraging ICT tools and capabilities, organizations can enhance communication, personalize experiences, streamline

processes, drive efficiency, leverage data insights, optimize the supply chain, and improve marketing and sales efforts (Min et al., 2005). These factors collectively contribute to increased customer satisfaction and improved profitability, making ICT an essential driver of success in today's digital era.

5.4.1.20 How does integration practice mediate the relationship between ICT and supply chain performance?

Respondent 1

Integrative practices mediate the effect of inter-organisational ICT on performance outcomes in an organisation. That is, organisational ICT drive more supply chain integration, which in turn increase supply chain performance.

"I think the external environment, such as market changes, government policies and provisions have effects on the relationship between ICT adoption, the kind of integration we practice, and supply chain performance". Respondent I

Unforeseen events or changes in market conditions can disrupt supply chain operations and impact performance, regardless of the level of ICT integration. Flexibility and adaptability are essential to mitigate the negative effects of external factors and maintain supply chain performance (Chunsheng et al., 2020).

The proficiency of employees in using ICT tools and systems can impact integration efforts and supply chain performance.

"*Adequate training and skill development programs we engage our employees aid them employees to effectively utilize the changes to enhance integration platforms. It is my understanding that if employees lack the necessary skills or training, the potential benefits of ICT may not be fully realized, limiting the impact on supply chain performance". Respondents I*

The introduction of new ICT systems and integration practices requires effective change management. Resistance to change or inadequate change management strategies can impede successful integration and hinder supply chain performance. Clear communication, stakeholder engagement, and training programs are necessary to manage the transition effectively and

ensure that all parties involved embrace the changes brought about by ICT (McCarthy and Eastman, 2021).

5.4.1.21 How does ICT moderate the relationship between integration practices and supply chain performance?

ICT facilitates communication and collaboration across geographically dispersed supply chain partners. "*ICT can regulate the interaction between integration practice and performance outcome through various communication channels like email, video conferencing, and collaborative software, stakeholders can as well easily interact and exchange information irrespective of their physical locations. This fosters better coordination and cooperation, enabling faster problem-solving, efficient order processing, and streamlined decision-making processes. As a result, the integration practices within the supply chain are strengthened, leading to improved supply chain performance*". *Respondent II*

ICT enables efficient and effective information flow among supply chain partners. With the help of advanced technologies such as enterprise resource planning (ERP) systems, electronic data interchange (EDI), and cloud computing, relevant data can be shared in real-time (Yusuf et al., 2004). This real-time information sharing allows supply chain partners to have better visibility into demand patterns, inventory levels, production schedules, and logistics activities. This, in turn, facilitates better decision-making, reduces information asymmetry, and improves overall supply chain responsiveness.

5.4.1.22 What are the combined effects of ICT and Integration practice on your organisational performance?

Respondent I

Using technologies such as Enterprise Resource Planning (ERP) systems, Electronic Data Interchange (EDI), and supply chain management software, organizations can achieve real-time visibility and coordination throughout their supply chains (Varma and Khan, 2014). This leads to improved responsiveness, reduced lead times, and enhanced overall supply chain efficiency.

Integration practices, on the other hand, involve the alignment and synchronization of various supply chain processes and activities. This includes integrating functions such as procurement,

production, logistics, and customer service to create a unified and efficient supply chain network. Integration practices can involve the implementation of cross-functional teams, strategic partnerships, and shared information systems (Varma and Khan, 2014).

"*our organizations achieve several benefits When ICT and integration practices are combined. Firstly, there is improved inventory management and reduced stockouts through enhanced demand forecasting, supply planning, and inventory optimization. Also, information sharing applications enable our organization to make more accurate and timely decisions regarding inventory levels and replenishment*". *Respondent II*

"*Secondly, the integration of processes and systems enables us better coordination between suppliers, manufacturers, and customers. This leads to smoother order processing, reduced errors, and improved customer satisfaction through timely deliveries and enhanced communication*". *Respondent III*

"*Thirdly, the combined effects of ICT and integration practices enable our company to respond quickly to facilitate decision-making, allowing respective departments to adapt to the strategies and operations standard set*".

ICT enables organizations to automate manual processes, reduce paperwork, and improve overall operational efficiency. Swink and Schoenherr, (2015) supported that, integration practices can eliminate redundancies and optimize resource allocation, leading to cost reductions and improved profitability.

The combined effects of ICT and integration practices in supply chains can result in enhanced coordination, responsiveness, and cost efficiency. Similarly, Li et al., (2006) proposed that, organizations that effectively leverage these capabilities can achieve a competitive advantage and improve their overall supply chain performance.

5.5 Importance of performance measurement in the supply chain industry

Performance measurement plays a vital role in the supply chain industry, ensuring its efficiency and effectiveness. The study aims to systematically evaluating key performance indicators (KPIs), within the industry so that organizations can identify areas of improvement, make informed

decisions, and enhance overall supply chain performance. There is attendant uniformity in the collective responses that performance measurement can enables organizations to monitor and evaluate their supply chain processes, such as managing cost, order fulfilment, inventory management, and logistics. And to also be able to identify obstacles, inefficiencies, and areas of waste, thereby optimizing operations and reducing costs.

"I think performance measurement provides our company with insights into realistic goals and targets, and how we track progress, and implement continuous improvement initiatives. It fosters a culture of accountability and encourages our employees to strive for higher performance levels". (participant II)

"Performance measurement is crucial in the supply chain industry as it enables organizations to optimize processes, and to make informed decisions". (Participant I)

"For sustainable improvement, Performance measurement is ultimately needed to improved customer satisfaction and competitive advantage". (Participant I)

Performance measures provides insights into efficiency, effectiveness, and customer satisfaction, enabling informed decision-making and strategic planning (Atkinson and Wells, 1997). By measuring performance indicators such as cost, delivery, inventory accuracy, and cost-effectiveness, organisations can establish a culture of continuous improvement, accountability, and rational decision-making, leading to enhanced supply chain performance, customer satisfaction, and business success (Zairi, 2012).

"The two categories of performance measurement should be in focus organisational performance measure and industry performance measure". (participant III)

"Many companies that I know of are trying to estimate the industries performance as a general guide and direction for their organisational focus on the performance of their organisation". (participant IV)

Information and Communication Technology (ICT) plays a significant role in facilitating performance measurement in the supply chain industry. By leveraging advanced technologies and digital systems, ICT provides organizations automation capabilities, and enhanced visibility

across the supply chain, enabling efficient and effective performance measurement (Yusuf et al., 2014).

"But impliedly, our believe is that, if the industry is improving, they as well have every chance of improving on their organisational performance". (Participant V)

Organizational measurement of supply chain performance involves assessing and evaluating key areas to evaluate the effectiveness and efficiency of supply chain operations.

"Most of the organisations wish to optimise their operational processes to enhance performance. In the area of inventory turnover, order fulfilment cycle, speed of operation and delivery we adopt ICT software to achi". (Participant V)

"*I think to successfully achieve the organisational performance measure, we need to evaluate the strength and weaknesses of our organisation and other areas of improvement so we can sustain our strength and improve on our areas of weaknesses". (Participants 1& IV)*

This type of measurement provides organizations with valuable insights into performance trends, enables benchmarking against industry standards, and supports the identification of best practices. Regularly measuring supply chain performance, will avail organizations with sustainable improved operation that will continue to enhance their operations, meet customer expectations, and achieve strategic performance.

"ICT implementation enables us improved efficiency and productivity by automating the manual processes, which helps in reducing errors, and streamlining workflows. This leads to time savings and cost reductions, allowing employees to focus on value-added tasks. In our company, the management supports automation and digitization by procuring latest technology that will aid in reducing manual intervention and improving supply chain efficiency. This automation leads to increased accuracy, reduced cycle times, and improved productivity within the supply chain. By eliminating manual errors and bottlenecks", *Respondent II*

ICT ensures smoother integration practices, enabling a more seamless and efficient supply chain. Increased visibility and transparency are witnessed across the production and distribution channels, thus allowing the organization to track and monitor inventory, logistics, and production

processes in real-time. This leads to improved supply chain management, reduced lead times, and enhanced overall operational efficiency (Dutta et al., 2020).

How do ICT and integrative capabilities impact on Employees collaboration?

Enhanced Communication: "*it's a known fact that in our company r ICT tools such as email, instant messaging, video conferencing, helps our employees to communicate and collaborate*". *Respondents III*

ICT technologies facilitate real-time communication, quick information sharing, and seamless collaboration, breaking down barriers of time and distance (Attaran, 2004).

Improved Access to Information: Integrative capabilities provided by ICT systems allow employees to access and share information more efficiently. Centralized databases, cloud storage, and knowledge-sharing platforms enable employees to retrieve and exchange relevant data and documents, enhancing collaboration by fostering a culture of knowledge sharing and informed decision-making (Attaran, M., 2004).

Collaboration Tools and Platforms: *"the indicators for collaboration among our employees though ICT solutions are the teamwork and cooperation reflected in the areas of shared calendars, document collaboration tools, and virtual workspaces these our enable employees to work together, contribute to shared goals, and track progress in real-time, enhancing collaboration and productivity". Respondents III*

Flexibility and Remote Work: *integrative capabilities are important because I think they enables flexible work arrangements, including remote work. With the right ICT infrastructure and integrative capabilities, employees can collaborate effectively even when working from different locations*. *Respondents I*

This flexibility promotes collaboration by accommodating diverse schedules and enabling employees to collaborate across time zones (Tang, J.C., Zhao, C., Cao, X. and Inkpen, K., 2011).

Integrative capabilities provided by ICT systems facilitate cross-functional collaboration by breaking down departmental idleness.

Employees from different departments can access shared information, collaborate on projects, and contribute their expertise, leading to improved innovation, problem-solving, and overall organizational performance (Tang, J.C., Zhao, C., Cao, X. and Inkpen, K., 2011).

"Our employees can leverage on ICT and integrative capabilities to enjoy enhanced communication channels, improved access to information, and flexible work arrangements". Respondent IV

These factors contribute to fostering a collaborative culture within the organization, enabling employees to work together effectively, share knowledge, and achieve shared objectives (Yang, C. and Chen, L.C., 2007).

How do ICT and integrative capabilities impact on Supplier collaboration?

Respondents V

Efficient Communication: "*just like the impact of ICT tools such as email, video conferencing, and collaborative on employees, considering the nature and size od the countries population, ICT implementation also enables our organizations to communicate with our teaming suppliers in a fast and effective manner. Real-time communication facilitates timely discussions, issue resolution, subscription of data and decision-making on flatforms fostering collaboration and reducing communication barriers". Respondent III*

"For quality assurance and as service providers our integrative capabilities provided by ICT systems is design to allow for organizations to share relevant information with our customers. This includes real-time updates on product varieties, Improved visibility, and transparency, out ICT services enable suppliers to align their operations with the organization's needs, resulting in better coordination, reduced lead times, and improved information efficiency throughout the supply chain". Respondent II

Collaborative Planning and Forecasting ICT solutions offer platforms that enable organizations and suppliers to collaborate on planning and forecasting activities. By sharing data, insights, and market trends, both parties can align their strategies, optimize inventory levels, and identify

potential risks. Collaborative planning enhances supplier collaboration by fostering a proactive approach and enabling joint decision-making.

Supplier Performance Management: ICT systems support supplier performance management by providing tools to monitor and evaluate supplier performance metrics.

"*Our company can track key performance indicators (KPIs), such as on-time delivery, quality, and responsiveness. Integrative capabilities enable us to provide feedback to our suppliers, address performance issues, and drive continuous improvement, thereby strengthening collaboration". Resident IV*

Streamlined Procurement and Supply Chain Processes: ICT facilitates e-procurement systems, automation, and supply chain integration. These capabilities streamline procurement processes, from requisition to payment, and enable seamless collaboration between organizations and suppliers. Automated processes reduce manual errors, enhance efficiency, and create a more streamlined and collaborative supplier ecosystem.

"*We have an automated payment system that operate and entertain customers 24/7this help us to achieve collaborative planning with our customers, I see that as technology blessing "Respondent III*

Finally, ICT and integrative capabilities play a crucial role in supplier collaboration. They facilitate efficient communication, enhance visibility and transparency, enable collaborative planning and forecasting, support supplier performance management, and streamline procurement and supply chain processes. By leveraging these capabilities, organizations can strengthen their relationships with suppliers, improve supply chain efficiency, and achieve mutual benefits through effective collaboration (Simatupang and SridharaN., 2005).

5.6 Importance of measuring team performance

Measuring team performance establishes clear expectations and holds team members accountable for their individual and collective contributions (Atkinson et.al, 1997). It ensures that team members are aligned with organizational goals, enabling them to work towards common objectives. Regularly measuring team performance, organizations can identify targeted training

needs, and development initiatives to enhance team members' skills, knowledge, and performance levels (Nevis ET AL., 1995).

"By comparing actual team performance with standards organisational performance set will help organisations evaluate the level of performance and commitment of teams towards achieving organisational goals". (Participant II)

"A very important practice is for the organisations to always evaluate team performance periodically based on organisational level of objective achieved. Management by objective approach". (Participant V)

Team performance measurement helps organizations allocate resources effectively, which enables management to identify high-performing teams that may require additional support, recognition, or rewards, also highlights underperforming teams that may need additional guidance or re-evaluation of resources. Accurate and reliable data gathered using IT application can support management make informed decisions regarding team structure, task allocation, and strategic planning (Chenhall and Langfield-Smit., 1998). Which can provide insights into team dynamics, collaboration, and areas where intervention or restructuring may be necessary.

Measuring team performance fosters a culture of continuous improvement, that encourages teams to identify and implement process enhancements, innovative practices, and efficiency, driving overall team and organizational success. Team performance evaluation is vital for accountability, goal alignment, performance improvement, resource allocation, decision-making, Productivity, and attainment of organisation objectives more effectively (Latham and Yukl., 1975).

5.6.1 Strategic performance

Strategic supply chain performance refers to the long-term goals and initiatives aimed at optimizing the overall supply chain to achieve a competitive advantage (Gunasekaran et al., 2008). It involves aligning supply chain activities with the organization's strategic objectives, such as cost reduction, customer satisfaction, or market expansion. Strategic supply chain performance focuses on areas such as supply chain network design, supplier relationship

management, technology adoption, risk mitigation, and sustainability practices. Negri et al., (2021) added that strategic alignment and automation of the supply chain, can improve longterm decision efficiency, responsiveness, and resilience, leading to increased profitability, market share, and customer loyalty in the long run.

5.6.2 Operational performance

Operational supply chain performance refers to the day-to-day execution and management of activities within the supply chain. It involves the efficient handling of tasks such as order processing, inventory control, warehouse operations, transportation execution, and supplier coordination. The focus is on meeting immediate customer demands, ensuring on-time delivery, minimizing errors, and maintaining smooth operational flow. Operational performance directly impacts customer satisfaction, cost control, and overall supply chain efficiency. Key metrics for operational supply chain performance include order cycle time, fill rate, order accuracy, and on-time delivery (Hausman, 2004). Effective operational performance ensures that the supply chain functions smoothly, delivering products or services in a timely and cost-effective manner (Tang, 2006).

5.6.3 Tactical performance

Tactical supply chain performance refers to the medium-term planning and execution of specific initiatives aimed at optimizing operational efficiency and effectiveness within the supply chain Simatupang and Sridharan, 2002). It involves activities such as demand forecasting, inventory management, production scheduling, transportation planning, and supplier management. Tactical decisions are focused on achieving cost savings, improving customer service, and enhancing process efficiency. By effectively managing tactical supply chain performance, organizations can ensure timely order fulfilment, minimize inventory costs, optimize transportation routes, and maintain smooth operations. Tactical performance measures enable organizations to monitor and adjust their strategies to meet short- to medium-term goals and objectives while maintaining overall supply chain alignment with the organization's strategic direction (Bendoly et al., (2007).

5.7 Determining factors for the choice of performance measures in supply chain

The choice of performance measures in the supply chain depends on several factors, including the organization's strategic goals, industry characteristics, customer requirements, and operational priorities (Chan, 2003). Performance measures should align with the organization's strategic goals and priorities. For example, if cost reduction is a primary objective, measures such as total landed cost, cost per unit, or supplier price variance may be chosen.

"Performance measures should reflect customer requirements and satisfaction. Measures like on-time delivery, order fill rate, or customer complaints provide insights into customer-centric performance".

"Industry-specific benchmarks and best practices influence the choice of performance measures".

"Organizations may adopt measures widely accepted in their industry to facilitate benchmarking and performance comparison".

"Measures should reflect operational efficiency and effectiveness. For instance, inventory turnover, order cycle time, or production cycle time can indicate process efficiency and optimization".

The choice of performance measures also depends on the complexity of the supply chain. Measures may vary for global supply chains, multi-tier supplier networks, or organizations with complex logistics requirements. Organizations consider the availability and reliability of data needed to calculate and track performance measures (Kumar et al., 2013). Measures should be based on accurate and accessible data sources. It is important to strike a balance between a comprehensive set of performance measures that cover various aspects of the supply chain while ensuring they are meaningful, actionable, and aligned with the organization's specific goals and requirements.

5.7.1 Government support

Government support plays a crucial role in enhancing supply chain performance. Here are some ways governments can provide support. Governments can invest in transportation, logistics,

and digital infrastructure to improve connectivity and facilitate efficient supply chain operations.

"Governments can create supportive policies, regulations, and standards that promote fair trade, supply chain transparency, and sustainability practices".

"Governments can provide financial support, grants, tax incentives, and subsidies to encourage investment in technology adoption, research and development, and supply chain optimization".

"Governments can invest in education and training programs to develop a skilled workforce capable of driving supply chain innovation, optimization, and management".

"Governments can foster collaboration between industry stakeholders, academia, and research institutions to share knowledge, best practices, and jointly address supply chain challenges".

By providing these forms of support, governments can create an enabling environment for supply chain performance improvement, stimulate economic growth, and enhance the competitiveness of businesses in local and global markets.

5.7.2 Transaction safety

ICT and integration play a vital role in ensuring transactional safety within the supply chain. *"By integrating ICT systems, such as electronic data interchange (EDI) and blockchain technology, organizations can enhance the security and reliability of transactions"*.

"These technologies enable real-time tracking and authentication of goods, secure sharing of transactional information, and traceability of products throughout the supply chain".

"This integration reduces the risk of fraud, counterfeiting, and unauthorized access, ensuring the safety and integrity of transactions".

Additionally, ICT integration enables the implementation of robust data encryption, access controls, and authentication mechanisms, further enhancing transactional safety within the supply chain.

5.8 Challenges in managing performance of supply chain

Supply chains often involve multiple stakeholders, global operations, and complex logistics, making it challenging to coordinate and align performance across the entire network (Awad, 2010).

"Limited visibility into real-time data across the supply chain hinders effective performance management and decision-making".

"Fluctuating customer demands and market dynamics pose challenges in forecasting, inventory management, and meeting service level expectations".

Ensuring collaboration and alignment with suppliers, especially in terms of quality, lead times, and reliability, can be challenging. Managing risks such as supply disruptions, geopolitical uncertainties, and changing regulations requires proactive planning and resilience strategies.

"Implementing and integrating advanced technologies into existing systems, and addressing data security concerns, can pose challenges in improving supply chain performance".

Addressing these challenges requires strategic planning, collaboration, effective communication, technology investment, and continuous improvement initiatives to enhance supply chain performance and overcome operational hurdles.

5.8.1 Data validity and accuracy

"Inaccurate and unreliable data can lead to incorrect analyses, flawed decision-making, and suboptimal performance outcomes".

"Challenges related to data validity and accuracy include data collection errors, inconsistencies across systems, data integration issues, and timeliness of data updates".

"Ensuring data accuracy becomes more challenging in complex supply chains involving multiple partners and data sources".

Organizations must invest in robust data governance practices, establish data quality standards, implement validation processes, and leverage technologies such as data analytics and automated

data capture to address these challenges and ensure the availability of accurate and reliable data for effective supply chain performance management.

5.8.2 Organisational coordination

"Challenges in coordinating activities and aligning goals across different departments or functions within an organization can led to inefficiencies, delays, and misalignment in the supply chain".

"Lack of communication, siloed decision-making, and conflicting priorities hinder effective coordination. This can impact important aspects such as demand forecasting, production planning, inventory management, and customer service".

Overcoming this threat requires strong cross-functional collaboration, clear communication channels, shared metrics, and a culture of cooperation to ensure seamless coordination and alignment of efforts across the organization for optimal supply chain performance.

5.8.3 departmental collaboration

Departmental coordination presents a significant challenge in managing supply chain performance. When departments within an organization operate in isolation or fail to communicate and collaborate effectively, it can lead to several detrimental effects on supply chain performance (Simatupang and Sridharan, (2002).

"Departments making decisions without considering the impact on other areas of the supply chain can lead to suboptimal outcomes. Decisions made in isolation may create bottlenecks, delays, or conflicting priorities that hinder overall supply chain efficiency".

"Lack of coordination between departments can result in inefficiencies and redundancies in processes. Handoffs between departments may be unclear or poorly executed, leading to delays, errors, and increased costs".

Insufficient sharing of relevant information across departments can result in inaccurate demand forecasts, inadequate inventory management, and poor responsiveness to customer needs. This lack of transparency can create a ripple effect of inefficiencies throughout the supply chain.

Inconsistent or conflicting information provided to customers due to poor coordination can result in customer dissatisfaction, lost sales, and damaged reputation. Overcoming this challenge requires establishing cross-functional teams, fostering a culture of collaboration and communication, and implementing systems and processes that facilitate information sharing and coordination. Creating shared goals, metrics, and incentives across departments encourages alignment and collaboration, ultimately enhancing supply chain performance.

5.8.4 Quality of service

Maintaining the quality of service poses a significant challenge in managing supply chain performance. Ensuring consistent and high-quality service levels throughout the supply chain requires evaluating and monitoring the performance of suppliers to maintain consistent quality standards and timely deliveries (Yeung, 2008).

"Ensuring reliable and efficient transportation processes to minimize delivery delays and maintain service level agreements".

"Balancing inventory levels to meet customer demands while avoiding stockouts or excess inventory, ensuring product availability and timely order fulfilment".

Implementing standardized processes and quality control measures to ensure consistency in operations and service delivery. By addressing these challenges, organizations can enhance the quality of service throughout the supply chain, leading to improved customer satisfaction, loyalty, and overall supply chain performance.

5.9 Key supply chain performance measures

5.9.1 Cost

Managing cost is a critical performance measure in the supply chain industry. Effective cost management helps organizations achieve profitability, competitiveness, and financial stability (Cooper, 2017). Implementing strategies to identify and reduce costs at various stages of the supply chain, such as procurement, production, transportation, and inventory management.

"Evaluating the total cost associated with a product or service throughout its lifecycle, including acquisition, operation, maintenance, and disposal costs".

"TC analysis helps in making informed decisions, considering the long-term cost implications of supply chain activities".

"Comparing costs with industry standards, competitors, or internal targets to identify areas for improvement. Benchmarking allows organizations to identify inefficiencies, set cost reduction goals, and adopt best practices".

Effective cost management in the supply chain contributes to improved financial performance, enhanced competitiveness, and customer value (Cooper, 2017). However, it is crucial to balance cost management with other performance measures such as quality, service, and sustainability to ensure long-term success and stakeholder satisfaction.

5.9.2 Quality

Quality maintenance is crucial in supply chain organizations to ensure consistent and high-quality products and services (Lin et al., 2005). Implement robust supplier evaluation and management processes to ensure the reliability, quality of materials and components.

"Establish quality control measures throughout the supply chain, including inspections, testing, and certifications, to maintain adherence to quality standards".

"Foster a culture of continuous improvement, encouraging employees to identify and address quality issues proactively and implement corrective actions".

Provide training programs to enhance employees' understanding of quality standards, processes, and techniques to ensure adherence to quality requirements Jalundhwala and Londhe, 2023).

"By prioritizing quality maintenance, supply chain organizations can enhance customer satisfaction, build a strong reputation, mitigate risks, and drive sustainable growth in the marketplace".

5.9.3 Innovation

Innovation measures play a crucial role in driving success and competitiveness in supply chain management (Jean et al., 2012). Measure the adoption and integration of innovative technologies such as Internet of Things (IoT), artificial intelligence (AI), blockchain, and advanced analytics in supply chain processes. This includes tracking the implementation and utilization of technology solutions to improve efficiency, visibility, and decision-making.

"*Measure the implementation of innovative processes and practices that enhance supply chain performance. This can include initiatives such as lean manufacturing, agile supply chain methodologies, and collaborative planning".*

Measure the development and introduction of new or improved products and services that address customer needs and create value (Jean et al., 2012).

"Measure the level of collaboration and partnerships established with suppliers, customers, and other stakeholders to foster innovation. This includes metrics such as the number of strategic collaborations, joint innovation projects, and co-creation initiatives".

Measure the involvement and engagement of employees in driving innovation within the supply chain. "This can be assessed through metrics such as the number of employee-generated ideas, participation in innovation workshops, and successful implementation of employee-driven innovations. Assess the organization's culture and climate for innovation".

supply chain organizations can foster a culture of innovation, drive continuous improvement, and gain a competitive advantage by staying at the forefront of industry trends and advancements (Jean et al., 2012).

5.9.4 Speed

Speed is a critical measure for supply chain performance. It refers to the ability to deliver products or services quickly and meet customer demands efficiently. Key speed-related measures include order cycle time, lead time, delivery speed, and response time to customer inquiries (Swafford et al., 2008).

"Improving speed in the supply chain enhances customer satisfaction, reduces order-to-delivery time, minimizes stockouts, and enables faster response to market changes. It requires efficient coordination, streamlined processes, effective communication, and responsive logistics".

Monitoring and optimizing speed measures help organizations gain a competitive advantage, improve operational efficiency, and meet the dynamic expectations of customers in today's fast-paced business environment (Swafford et al., 2008).

5.9.5 Delivery

Delivery is a fundamental measure in supply chain management, focusing on the timely and accurate delivery of products or services to customers. It encompasses various aspects of the delivery process and customer satisfaction (Dadfar et al., 2013). Measure the ability to fulfil customer orders accurately and completely. This includes tracking the order accuracy rate, picking accuracy, and ensuring that all ordered items are included in the shipment.

By effectively managing and measuring delivery performance, organizations can enhance customer satisfaction, build trust, reduce costs associated with delivery errors or delays, and gain a competitive advantage. Continuously monitoring and improving delivery metrics ensures that the supply chain meets customer expectations and maintains high levels of service.

5.10 Summary

The case study's approach consisted of four major stages. At the beginning an investigation into the history of selected case studies was conducted and a sampling random selection followed up to scale the population size. This is to enable the researcher to have a specific focus on the number of case studies and the participants for valid and reliable responses.

The research is structured to gather data from experts inside the chosen organisations who are intended to participate in the data gathering procedure. The reason for this is because the examination primarily emphasised three key subjects. The study focuses on the adoption and integration practises of Information and Communication Technology (ICT) and the subsequent measurement of performance.

The outcomes of the previous stage were subsequently organised to construct semi-structured interview inquiries. The objective of this interview was to examine the primary factors that drive or hinder the adoption of information and communication technology (ICT) in the sector. Additionally, the interview aimed to explore the practises related to integrating ICT into existing systems and the subsequent impact on performance outcomes.

The researcher's decision to employ a case study approach and semi-structured interviews aimed to provide a comprehensive examination of intricate phenomena and yield significant insights that are specific to the setting. Through the utilisation of these methodologies, the researcher can acquire extensive and intricate data, discover novel insights, and make valuable contributions to the advancement of theory within the respective field of study.

From the case study conducted it was apparently observed that, understanding the government's role, geographical factors, and population structure is crucial for successful implementation of the ICT sector in Nigeria. Government policies and regulations impact industry growth, making knowledge of these essential for strategic planning. Geographical diversity in Nigeria requires tailored infrastructure development to ensure widespread access, while a population's demographics inform service customization. A well-informed approach that addresses these aspects will promote equitable ICT access, boost economic development, and bridge the digital divide in this diverse and populous country.

Chapter Six: Survey by Questionnaire

6.1 Introduction

This chapter presents the findings of a survey conducted using questionnaires. The data was collected by the researcher to investigate the impact of ICT adoption and integration practises on supply chain performance. This objective was outlined in chapter 3, which presented the conceptual framework development. To examine the proposed research objectives, several statistical analyses were performed, including correlations as Correlation analysis can be is relevant in determining the relationship between ICT adoption and supply chain performance, offering quantitative insights. A study by Gunasekaran et al. (2004) highlights the importance of ICT in improving supply chain performance. Using correlation analysis, researchers can quantify the strength and direction of the relationship between variables, such as the adoption of ICT tools and supply chain efficiency. This statistical approach aids in identifying whether increased ICT adoption correlates positively or negatively with enhanced supply chain performance, providing empirical evidence for strategic decision-making and resource allocation in supply chain management. Regression analysis on the otherhand is a vital tool in defining the direction of construct relationships in research. Through this statistical method, study can quantify and understand how changes in one variable predict changes in another. For instance, in studying the impact of ICT adoption on organisational performance, regression analysis provides a coefficient that signifies the direction and strength of the relationship (Hair et al., 2017). A positive

coefficient indicates a positive relationship, while a negative one signifies a negative association. This quantitative approach allows researchers to elucidate the precise direction of the construct relationship, offering valuable insights for informed decision-making in various research domains. Consistent with the research undertaken by Zhang et al. (2016), a correlation analysis was conducted to evaluate the associations between the adoption of information and communication technology (ICT), integrative practises, and supply chain performance. The study additionally examines the connections between firm-level factors and industry features, and their influence on key performance indicators (KPIs) including cost, speed, flexibility, quality, reliability, and financial metrics pertaining to supply chain performance using factor analysis such as Exploratory factor analysis EFA and confirmatory factor analysis CFA Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) are crucial in analyzing the interrelationship among research variables. EFA identifies latent factors and patterns within observed variables, aiding in variable reduction and theory development. CFA, as endorsed by Kline (2015), validates pre-specified factor structures, confirming or refining theoretical models. Together, EFA and CFA enhance the understanding of complex relationships between variables, ensuring measurement validity and providing a robust foundation for sound research conclusions in various disciplines. In summary, correlation analysis enables researchers to evaluate the magnitude and direction of correlations between variables under investigation. Wang and Ahmed (2004) employed factor analysis to determine the presence of potential interrelationships among groupings of variables. Additionally, it was employed to determine whether the indications exhibit a tendency to cluster together, forming one or multiple groups of indicators. These sets of indications are sometimes referred to as factors or components.

There are two main issues in this research; the first is that businesses employed information and communication technology (ICT) to improves employee engagement, customer interaction, and enhances supply chain visibility of their projects. These will enhance customer and employee satisfaction, increase profitability and grow return on investment. The second aspect of the research was that the effect of ICT adoption on supply chain performance might be increased when combined with supply chain integration practices. While adopting ICT might be copied but developing customer and/or supplier relationships cannot be bought and will therefore improve the performance of supply chains. Here the research argued that implementing ICT, interacting with customers and suppliers, and engaging with employees in a stimulating interaction with the product/services will lead to customer satisfactions. As a result, customers will buy more products, and sale/supplier performance will increase. For businesses who show little interest in adopting ICT, and who do not approach suppliers and customers proactively, and who are less engaging in employee integrations, customer satisfaction will be lower, and will buy fewer products thereby decrease supply chain performance. In short, the research looked at the mediating impact of supply chain integration practices in the relationship between ICT adoption and supply chain performance. As such, a survey design was adopted to undertake the study to gain more insights of the subjects. The survey was also performed to determine the extent of ICT adoption and integrative practices in a dynamic environment. Survey method was the right research methodology, as it examines practitioners' opinions on emerging concepts and practices of information technology (Dubey et al., 2020). Survey research being a deductive research method, as opposed to the inductive method, was deemed suitable to test the interrelationships among adoption of ICT, supply chain integration practices and performance. The survey is

extensive, as ICT adoption is rarely being subjected to empirical research. So, the insufficient research on the adoption of ICT and the related practice of integration necessitates combining the case study and survey methods to lessen the limitations of a method, as well as gain further insight through the in-depth study of limited cases.

Though prior studies on the adoption of ICT (Zhang et al., 2011; Zhang et al., 2016) and supply chain integration practices (Yusuf et al., 2004; Flynn et al., 2010; Kim, 2013; Prajogo and Olhager 2012; Gimenez et al., 2012) have been carried out, to date there is no research that have been carried out to assess the combined effects of ICT adoption and supply chain integration on performance of supply chains in Nigeria. This research is exploratory in nature as it attempts to explore the impact of ICT adoption and integration practices on the performance of supply chains in the dynamic emerging business environment.

The survey data was designed to provide the basis for defining and achieving the research objectives. To reduce error and enhance validity of results, procedures of survey design, administration and data analyses were followed (Bell et al., 2022; Nachmias and Nachmias, 1992).

6.2 Pilot-test of the questionnaire

A pilot study is the mini versions of a full-scale study called 'feasibility study' (Van Teijlinge and Hundley, 2001; Polit et al., 2001, p. 467). It might be the pre-testing of an instrument (Baker, 1994). It helps in planning and modification of the main research project. It gives advance warning about where the main research project could fail. That is, it shows difficulties associated with the

questionnaire wording and clarity as well as the survey administrative processes (Forza, 2002). This research conducted pilot studies to:

- Develop and test adequacy of the research instruments,
- Assess the feasibility of a full-scale survey,
- Design research protocol,
- Assess if the research protocol is realistic and workable,
- Establish if the sampling frame and technique are effective,
- Assess the success of proposed recruitment approaches,
- Collect preliminary data,
- Asses the proposed data analysis techniques to uncover potential problems,
- Develop a research question and strategy, among other.

Prior to the commencement of the survey, questionnaire has been submitted to three types of participants: ICT deployment practitioners, industry experts and other professional supply chain managers as suggested by (Forza, 2002). The role of the colleagues is to test if the questionnaire accomplishes the study objectives, while the role of industry experts is to prevent the inclusion of some obvious questions that might reveal avoidable ignorance of the researcher in some specific area. And target respondents provide feedback on everything that can affect answering by and the answer of the targeted respondents. According to Forza (2002), the best approach to pre-test a questionnaire is to proceed in two phases. In the first phase the researcher fills in the questionnaire with a group of potential respondents or when visiting potential respondents. Here the respondents fill the questionnaire as if they were

part of the planned survey. The researcher should be present, observing how respondents fill in the questionnaire and record their feedback. Subsequently the researcher determines from the respondent and recording the feedback. The researcher asks whether:

- the instructions were clear.
- the questions were clear.
- there were problems in understanding what kind of answers were expected, or in providing answers to the questions posed.
- the planned administration procedure would be effective.

In the second phase, the researcher carries out a small pre-test to test the contact-administration protocol, to gather data to perform an exploratory assessment of measurement quality, and to obtain information to define better the adequacy of measures in relation to the sample. In this phase, the researcher performed a preliminary analysis of the data to investigate if:

- the answers to certain questions are too concentrated due to the choice of scale.
- the content of answers differs from what was expected.
- the context modifies the appropriateness of questions (such as a question can be meaningful for individual operations but not for supply networks or might be appropriate for large companies but not for small and medium size enterprises).

In this research project, the feed back from potential respondents, provided clarity, flow and practical insight on how to formulate questions that will generate valid data. These respondents were also asked to write comments and observation they have on the questionnaire. Results from this pre-test indicated average of 15 minutes to complete the questionnaire. Comments

expressed on the questionnaire in terms of clarity of instructions from the pre-test were discussed with the supervisors and appropriate changes were included into the final questionnaire. Finally, thirty questionnaires were sent out by mail to members of Nigeria IT industry Networks. Twenty-five filled questionnaires were returned with detailed comments and suggestions which helped towards improving the contents and format of the final questionnaire for final administration.

Generally, the result of pretest indicates that the survey instrument was perceived:

- Clear, legible and the items comprehensively measure the issues.
- The questionnaire took about 15 minutes to answer.
- The instructions on how to complete the questionnaire were clearly understood.

6.2.1 Questionnaire administration and response rate

Of the total of one thousand, four hundred (1,400) questionnaires emailed to the respondents' organisations, 303 companies completed and returned the questionnaire (see Appendix 1), accounted for a response rate of 21.6%. This response rate is representative of studies on operations and supply chains. An earlier empirical survey of organisations Ahmed et al (1996) achieved a response rate of 6.5%. Of the 303 questionnaires returned, 238 were completed with the answers being logical. The 238 questionnaires including the 51 used in pilot study were deemed as valid and usable for the study while 65 questionnaires were excluded from further analysis. Although poorly completed questionnaires still provide some data, researchers often exclude such questionnaires to reduce the incidence of missing data in statistical analysis as well as improve the reliability of results (Hair et al., 2006; Tabachnick and Fidell, 2007; Gill and

Johnson, 2002). Table 6.1 reports the sample, response, and usable percentage rates per business sector under studied. From the spread of the response among the business sectors it can be inferred that there is no bias in the demographic composition of responses.

After looking at the spread of responses among the business sectors the next section will give an account of the statistical analysis carried out on the data. The analysis forms the basis for data testing and validation carried out towards achieving the research objectives.

Table 6.1 Analysis of response rates across business sectors

Business sectors	Sample	Rate (%)	Response	Rate (%)	Usable	Rate (%)
IT products and services	150	10.7	48	3.4	32	2.3
Manufacturing	65	4.6	20	1.4	20	1.4
Financial services	160	11.4	13	0.9	13	0.9
Healthcare	80	5.7	23	1.6	18	1.3
Energy and utilities	125	8.9	32	2.3	27	1.9
Consulting and professional services	180	12.9	48	3.5	38	2.7
Transport and logistics	40	2.9	5	0.4	5	0.4
Retails	210	15.0	30	2.1	21	1.5
Telecoms	240	17.1	50	3.6	40	2.8
Government	40	2.9	2	0.1	2	0.1
Other supporting activities	110	7.9	32	2.3	22	1.6
Total	1400	100	303	21.6	238	16.9

6.3 Statistical results

The survey responses were input into Statistical Package for the Social Sciences (SPSS version 28 for windows) to performed statistical analysis of the collected data. The SPSS software allows quantitative data to be managed and analysed, which include frequency, means, standard

deviation, correlation, regression, and exploratory factor analysis of the collected data. It also allows thorough statistical comparative analysis of the data between the various classifications of the research theme to test for association or differences among organisations under study.

6.3.1 Assessing normality

- Prior to conducting inferential statistical analysis, it is important to evaluate the attributes of the data to ascertain the normal distribution of variables. The term "normal" is employed to characterise a distribution that exhibits a symmetrical, bell-shaped curve, wherein the highest frequency of scores is concentrated in the central region, while the frequencies diminish towards the extremes (Pallant, 2020). The assessment of normality can be conducted by obtaining the values of skewness and kurtosis. Additional procedures commonly employed in statistical analysis include the utilisation of a histogram, a normal Q-Q plot, a Detrended normal Q-Q plot, a boxplot, and a Test of normality (Pallant, 2020). In addition, there are several statistical methods that can be utilised to assess normalcy, such as:
- Kolmogrov – Smirnov (K-S) statistics with a Lilliefors significance level and the Shapiro-Wilk statistic.

  The Kolmogorov-Smirnov (K-S) statistic measures the maximum vertical distance between the empirical distribution function of a dataset and the cumulative distribution function of a reference distribution. Lilliefors modified the K-S test to adjust for small sample sizes by introducing specific critical values for significance levels. This adaptation, known as the Lilliefors test, improves the accuracy of hypothesis testing for normality. Conversely, the Shapiro-Wilk statistic calculates the correlation between observed data and expected

normal values. Although both tests assess the normality of data, they differ in their statistical approaches. The K-S test evaluates the maximum discrepancy between empirical and theoretical distributions, while the Shapiro-Wilk test emphasizes the correlation between observed and expected values. Researchers often choose between these tests based on sample size and distribution characteristics. (Citations may include: Conover, W.J. "Practical Nonparametric Statistics". 1999. and Shapiro, S.S. and Wilk, M.B. "An analysis of variance test for normality (complete samples)" 1965.

- Skewness and Kurtosis

Skewness significance level assesses the departure of a dataset's skewness from that of a normal distribution. It measures the asymmetry of the distribution's tail towards higher or lower values. Kurtosis, on the other hand, quantifies the peakedness or flatness of a distribution relative to the normal distribution. A significant skewness indicates a non-normal distribution, potentially affecting statistical inferences. For kurtosis, values higher than three indicate a leptokurtic distribution with heavier tails, while values lower than three suggest platykurtosis, indicating lighter tails. Both skewness and kurtosis are crucial for understanding the shape of a distribution and can guide appropriate statistical analyses. (References: Joanes, D.N., and Gill, C.A. "Comparing measures of sample skewness and kurtosis". 1998. and Westfall, P.H. and Henning, K.S. "Understanding Advanced Statistical Methods". 2013.)

In this work, the tests employed to assess normality included the normal probability plots, Shapiro-Wilks test, and the K-S (Lilliefors) test. The SPSS tool offers additional strategies through the explore option within the descriptive statistics menu. The distribution of scores for total intra- and inter-firm ICT, total SC integration practises, and total supply chain performance

characteristics was evaluated by the researcher. The explored analysis technique was utilised to conduct assessments of normalcy for each construct. Figures 6.2 – 6.5 depict various graphical representations, including histogram, stem-and-leaf plots, as well as normal and detrended plots. These plots are based on a sample of data that follows a normal distribution, specifically pertaining to the practises of internal integration, supplier integration, and customer integration. Histogram is a statistical chart that is used to assess the distribution of a dataset. In this regard, Figure 6.2 shows the histogram of internal integration practice, supplier, and customer integration practices. In this tables, scores appear to be reasonably normally distributed.

Normality test of Supply chain performance Histogram

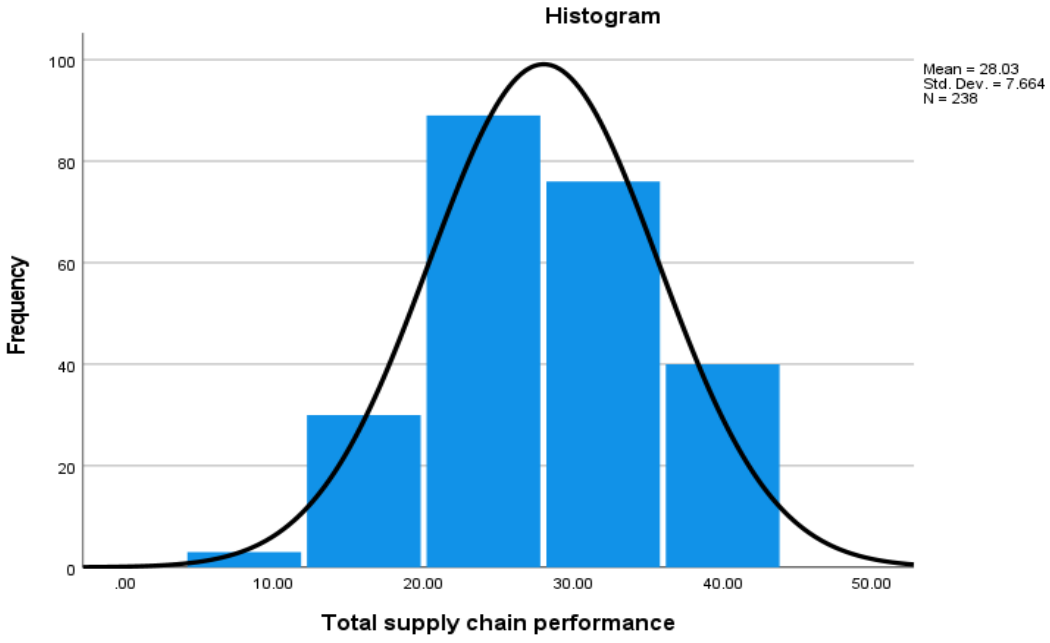


Figure 6.1 Histogram plot of supply chain performance

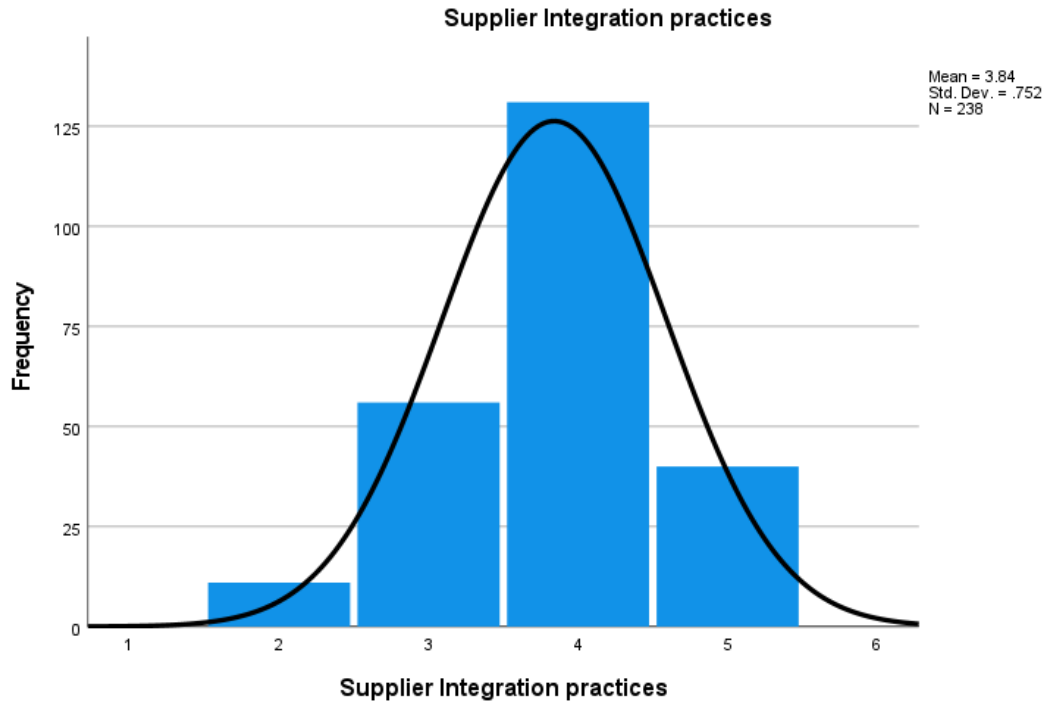


Figure 6.2 Histogram plot of supplier integration practices

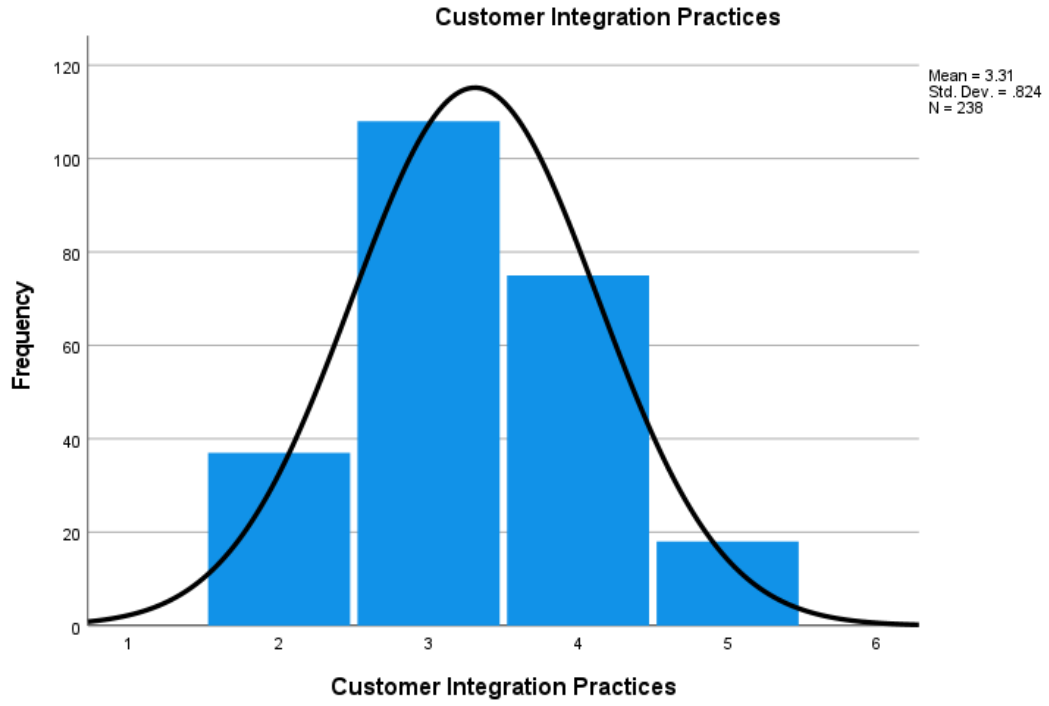


Figure 6.2c Histogram plot of Customer integration practice

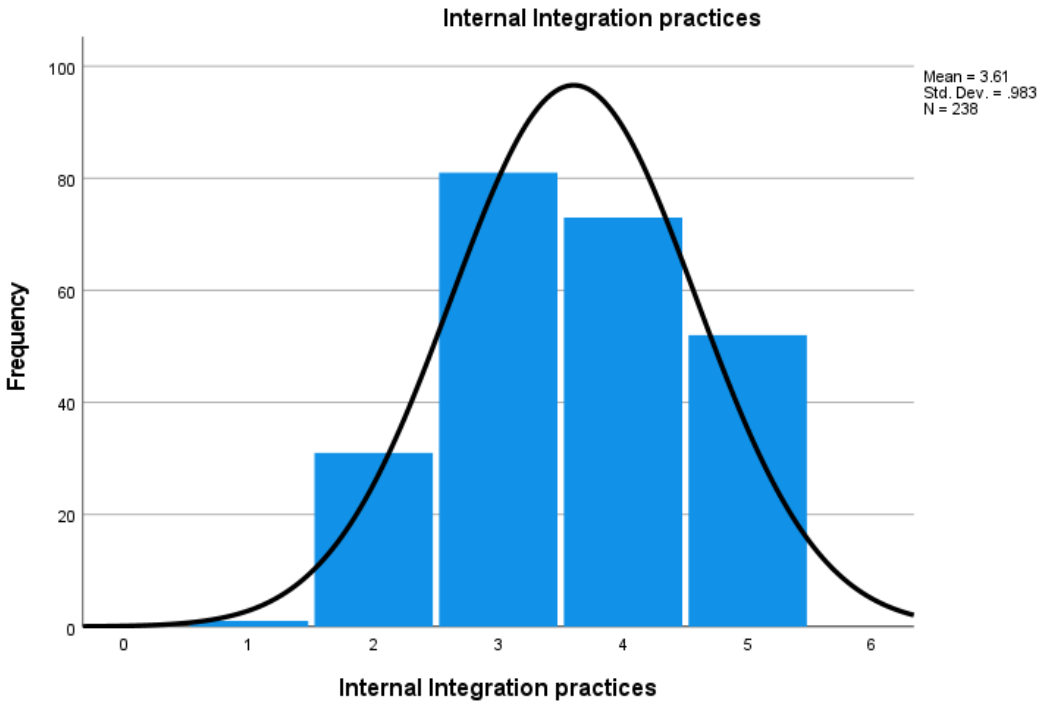


Figure 6.2d Histogram plot of Internal integration practices

This is supported by the inspection of the normal probability plots called normal Q-Q plot, as display in figure 6.3. in these plots, the observed value for each score is plotted against the expected value from the normal distribution. A reasonably straight line suggests a normal distribution (see table 6.3 for details).

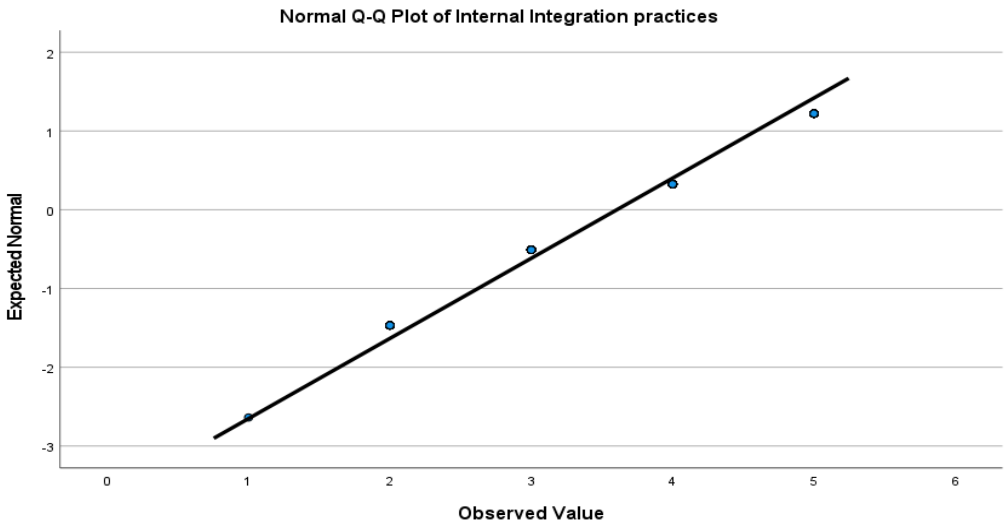


Figure 6.3a Normal Q-Q Plot of Internal integration practices

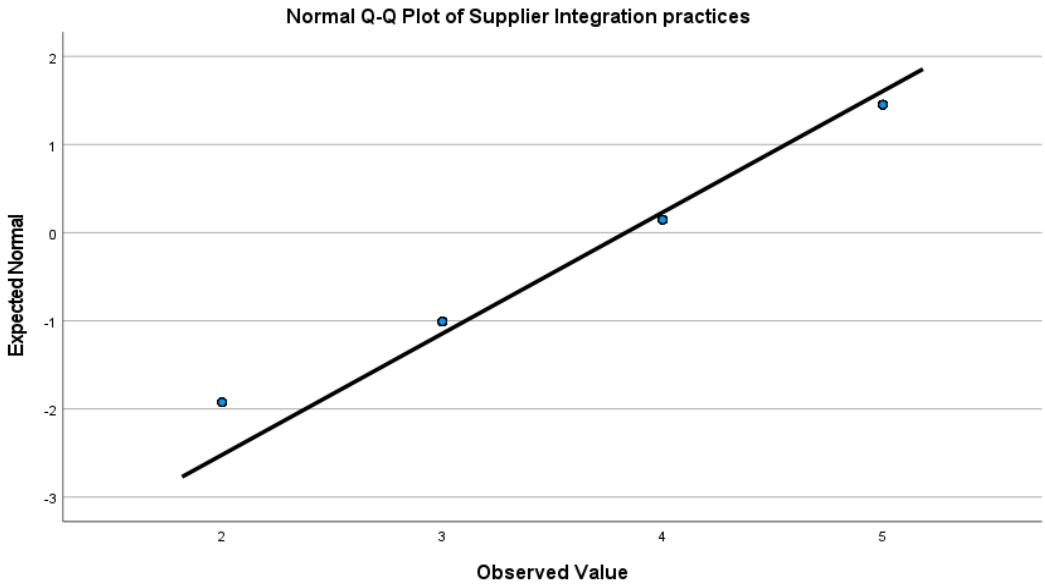


Figure 6.3b Normal Q-Q Plot of Supplier integration practices

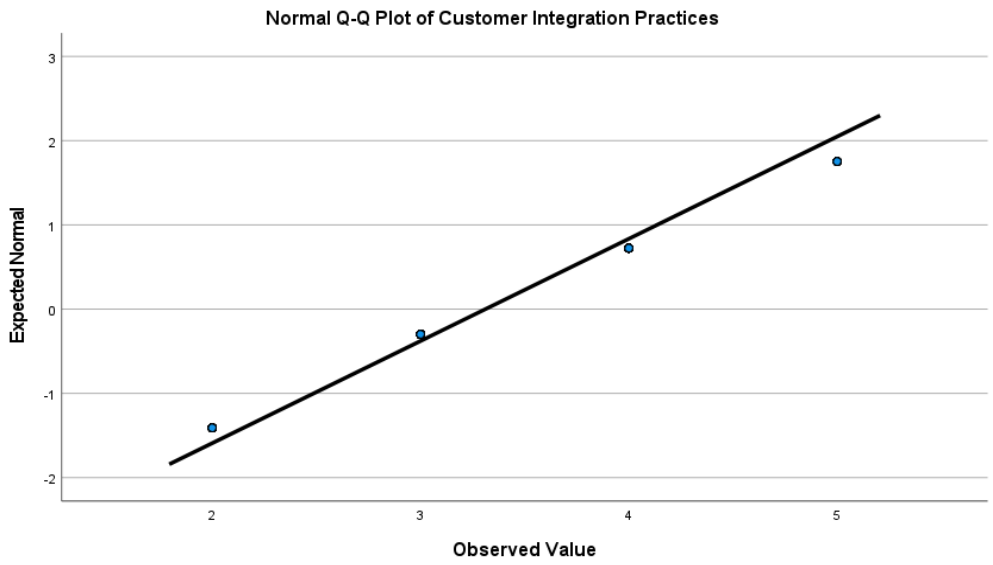


Figure 6.3c Normal Q-Q Plot of Customer integration practices

Table 6.3c show the detrended normal Q-Q plots of internal integration practices, supplier, and customer integration practices. These tables show the actual deviation of the dataset from the straight line. If the scores are from a normal distribution, then there should be no real clustering of the points, with most collecting around the zero line (Pallant, 2020; Coakes et al., 2006).

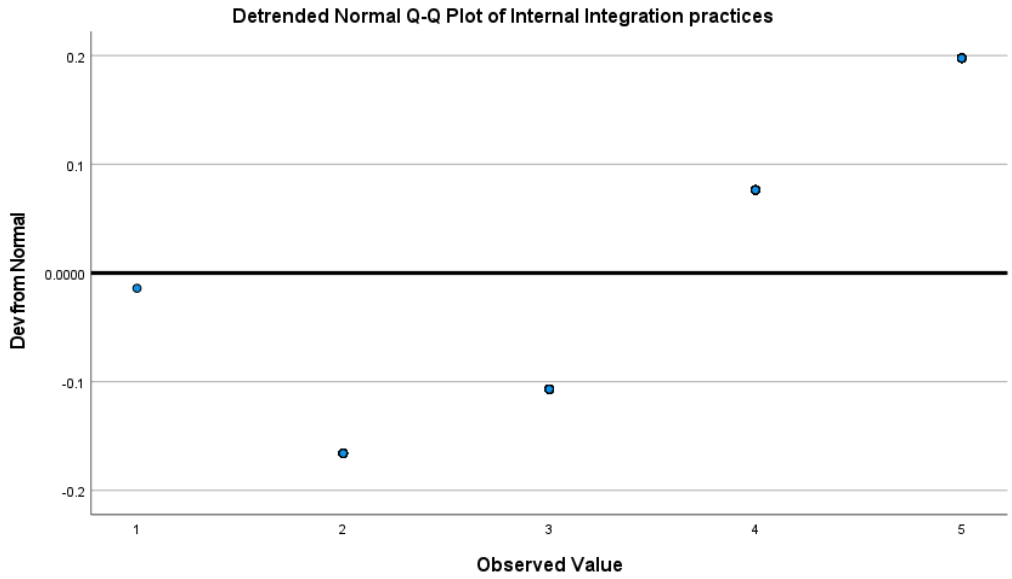


Figure 6.4a Detrended Normal Q-Q plot of Internal integration practices

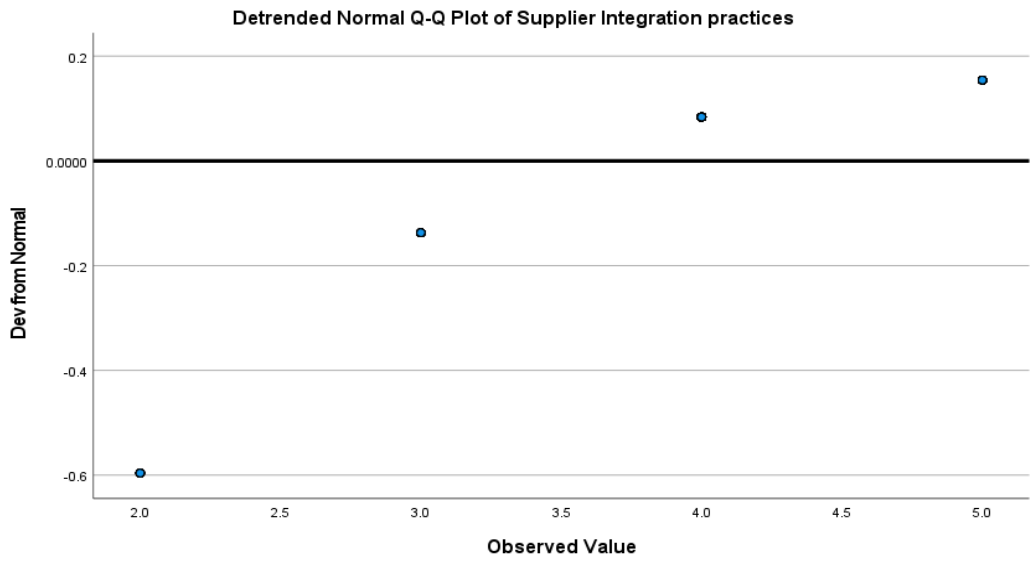


Figure 6.4b Detrended Normal Q-Q plot of Supplier integration practices

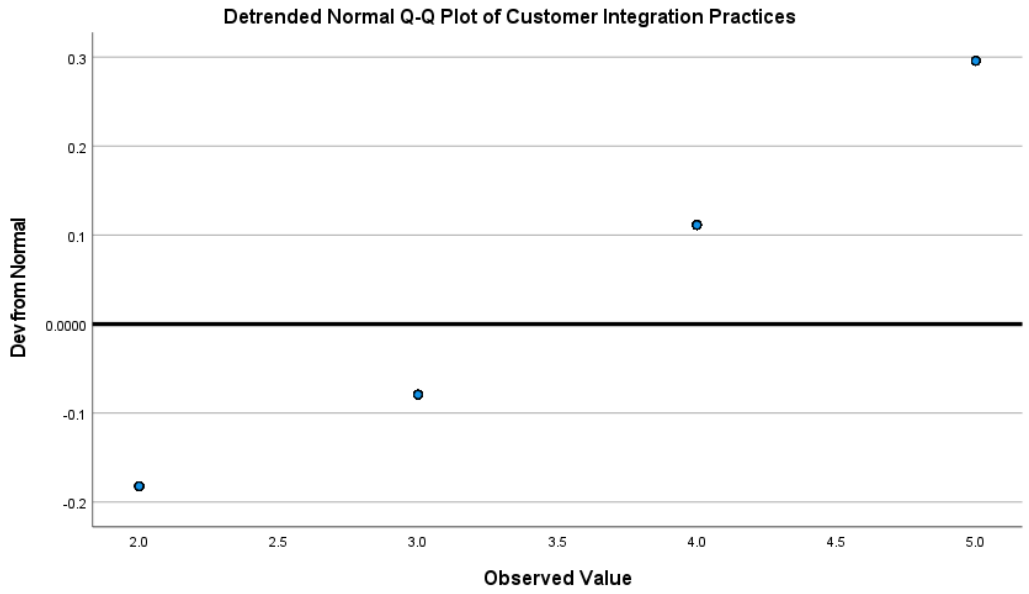


Figure 6.4c Detrended Normal Q-Q plot of Customer integration practices

Figure 6.5 shows the boxplots of some of the variables studied. These variables are Internal integration practices, supplier, and customer integration practices. The rectangle represents 50% of the case repsenting the smallest and largest values. The boxplots of the variables show that the supplier and customer integration practices are normally distributed about the mean, while internal integration practices, though one variable is outside the lower quartiles, is also normally distributed about the mean. Hence the variable is normally distributed based on the observation that a variable is an outlier if it lies at box lengths from the upper or lower quartiles.

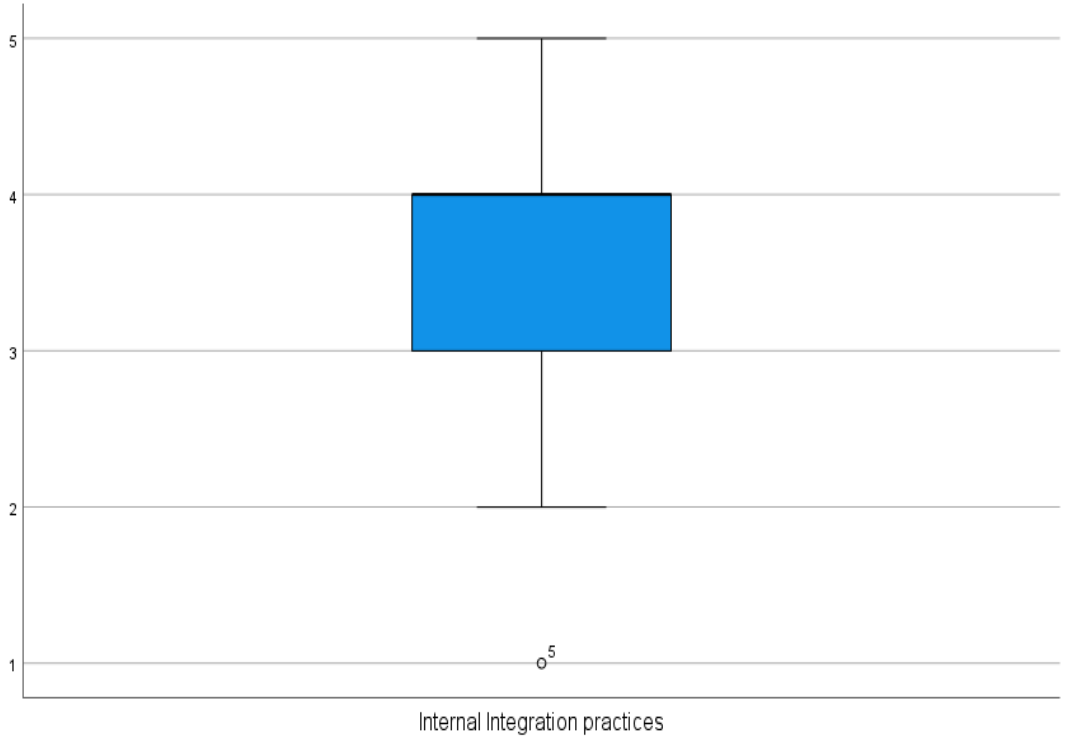


Figure 6.5a Boxplot of Internal integration practices

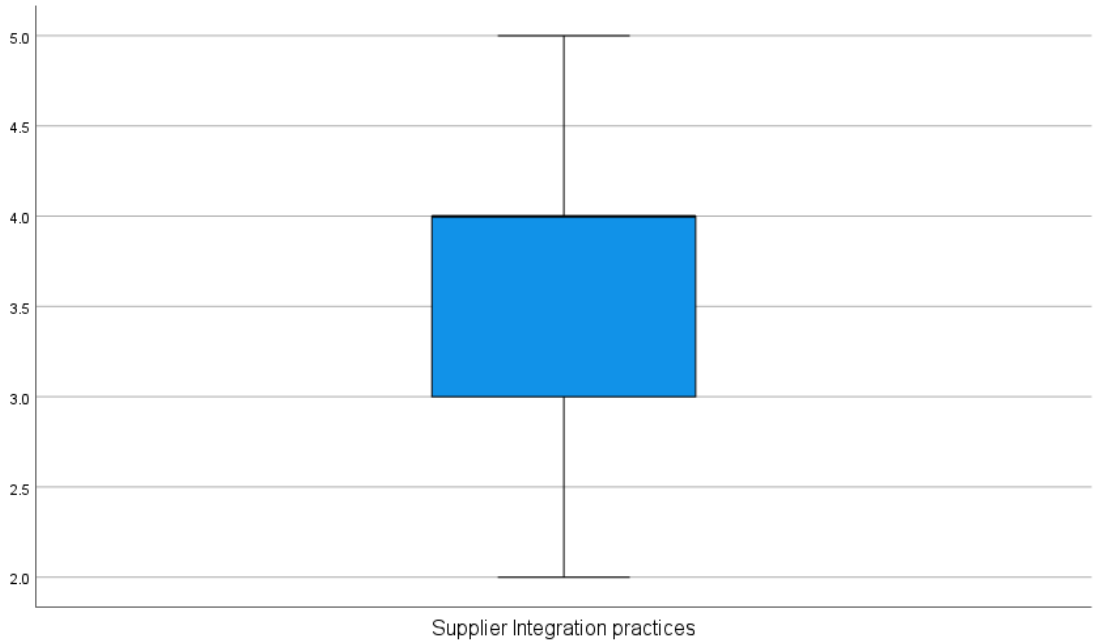


Figure 6.5b Boxplot of Supplier integration practices

Figure 6.5c Boxplot of Customer integration practices

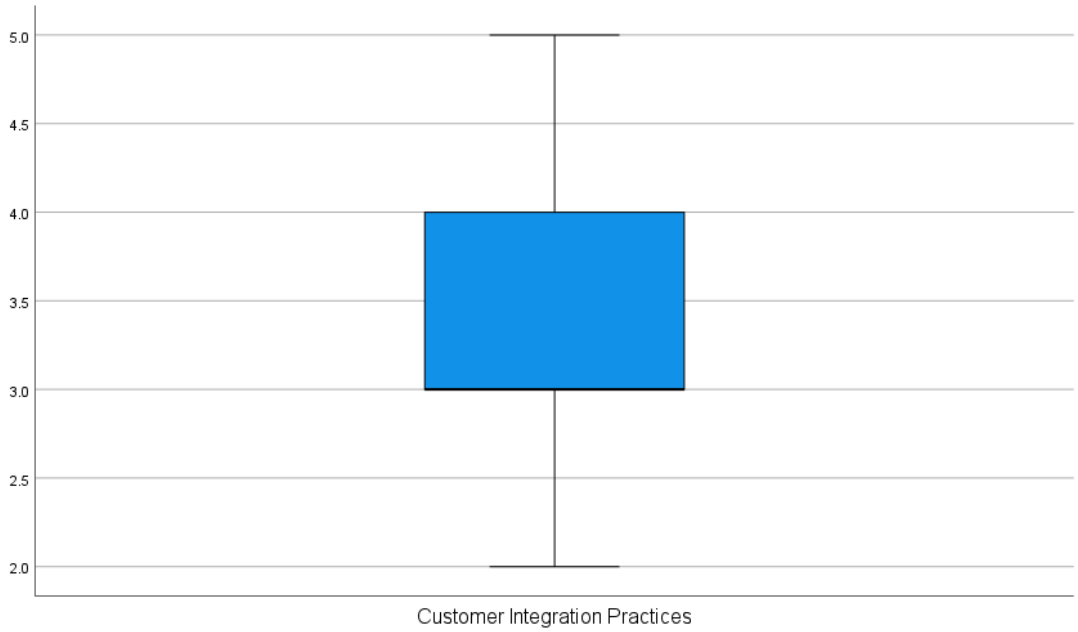


Table 6.2 shows the Kolmogorov-Smirnov (KS) statistics with Lilliefors significance test statistics computed for ICT adoption, supply chain integration practices and performance measures. KS assesses the normality of the distribution of datasets. As well, the Shapiro Wilks statistics was also computed. Coakes et al. (2006) and Pallant (2020) maintained that a non-significant result (Sig. value of more than 0.05) indicates normality. In this research, the Sig. value of .200**, suggests no violation of the assumption of normality. Hence, the statement that there is no significant difference between the distribution of the data from which the statistics in Table 6.2 were computed and normal distribution cannot be rejected. In short, the tests of normality presented in Table 6.2 and Figures 6.1 - 6.5 demonstrates that the data set satisfies the requirement for normal distribution from the study.

Table 6.2: Test of normality for the ICT, integration practices, and supply chain performance

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Intra-organisational ICT	.183	6	.200*	.960	6	.820
Inter-organisational ICT	.254	6	.200*	.866	6	.212
Supply chain integration practice	.198	12	.200*	.894	12	.134
Supply chain performance	.263	8	.109	.827	8	.056

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

6.3.2 Non-response bias analysis

There are other approaches available to address the possible issue of non-response bias. One approach, as documented by Lambert and Harrington (1990), entails condensing the first questionnaire and distributing it to the individuals who did not reply, with the expectation that they will complete it. Upon receipt of the outcome of their response, a one-way analysis of

variance (ANOVA) is conducted to examine the variance between participants who completed the full questionnaire and those who completed the shortened questionnaire. The present study did not employ this strategy due to the absence of assurance over the responsiveness of this group to the research, as they had declined participation in the initial study. The second method entails examining the potential presence of non-response bias in the data, which involves doing a statistical test to determine if there are significant changes in the replies between the early and late waves of returned surveys. The most recent batch of surveys obtained accurately represented the population of those who did not reply. Subsequently, t-tests were conducted on the data collected from the two waves, and the outcome of the t-test is presented in Table 6.4. The t-test analysis revealed that there were no statistically significant differences seen among the survey questions that were examined. Hence, the findings presented in Table 6.4 indicate that the study was not significantly affected by non-response bias.

Research that fulfils the criterion of non-response bias by ensuring representation of all surveyed organisations has the potential to be extrapolated to many research contexts outside the original study. This suggests that if the same research instrument is delivered to a different sample from the same population, it is expected to yield consistent results (Wisner, 2003). Within the field of organisational research, there exists a contentious discussion on the nature of data that is generated because of conducted study. The debate around the data format revolves around subjective perceptual data and objective data. Dess and Robinson Jr. (2002) and Ward et al (1994) conducted an empirical assessment of two data forms and discovered a significant correlation between subjective perceptions of relative improvement in organisational performance and objective measures of absolute changes in business performance during the same timeframe.

Therefore, the findings of this study suggest that the perceptions of senior management on the performance of their firms, as judged subjectively and comparatively, align with the actual performance of their organisations. In situations where objective data is unattainable or lacking, perceptual subjective data presents a feasible alternative. Hence, the utilisation of perceptual data in this work was motivated, at least in part, by the challenges associated with obtaining direct access to the phenomenon under investigation. Given the respondents' awareness of potential participation from their competitors, they exhibited reluctance in disclosing objective operational data, despite being assured that the information would solely serve academic purposes and strict confidentiality would be upheld throughout its utilisation.

6.3.3 Reliability and validity analysis

The significance of evaluating the efficacy of a research instrument is underscored by Forza (2002), as it emphasises that the absence of reliability and validity assessments hinders the ability to address the impact of measurement errors on the measurement of theoretical relationships.

6.3.3.1 Reliability

The assessment of internal consistency reliability was conducted to ascertain if the questionnaire aligns with the research requirements, as recommended by Tabachnick and Fidell (2007). Internal consistency refers to the extent to which the items inside a scale are interrelated (Pallant, 2013). The concept of indicators pertains to the extent to which various items effectively assess identical concerns (Bryman & Cramer, 2011). One of the most employed measures for assessing internal consistency is the Cronbach's alpha coefficient (Rungtusanatham et al., 2003). According to DeVellis (2016), it is recommended that a reliable scale should exhibit a Cronbach's alpha

coefficient over 0.7. However, Flynn et al. (2010) and Lau (1999) have put up the argument that alpha levels as low as 0.60 can be deemed acceptable.

The results (table 6.3) show the total scale of the Cronbach's alpha coefficient was (0.89), suggesting very good internal consistency reliability. While the Cronbach's alpha coefficient for all the sub-variables of the study was greater than (0.7). From the analysis, the Cronbach's alpha coefficient for intra-ICT was (0.994). Other's variables such as inter- ICT was (0.988); supplier integration practices were (0.986); and supply chain performance had (0.983) respectively see table 6.3.

Table 6.3: Reliability test of intra-/inter-organisational ICT, supply chain integration practices, and supply chain performance

Practices and Measures	Cronbach's Alpha
The entire questionnaire	0.888
Intra-organisational ICT	0.994
Inter-organisational ICT	0.988
Internal integration practices	0.974
Customer integration practices	0.981
Supply chain integration practices	0.986
Supply chain performance	0.983

6.3.3.2 Validity

The concept of scale validity refers to the extent to which a given scale accurately measures the construct it is intended to assess (Pallant, 2020). The validity of a scale cannot be determined by a single indicator. The process of validating a scale include the collection of empirical facts pertaining to its utilisation. This implies that consistent outcomes would need to be observed

upon replicating the research procedures. Therefore, it is imperative for a scale to possess both internal and external validity. Additional forms of validity include content validity, criteria validity, and construct validity (Streiner & Norman, 2015; Kline, 2005). This study employed many metrics to evaluate the effects of information and communication technology (ICT) adoption and supply chain integration practises on the performance of supply chains. To enhance the credibility of the scale, a comprehensive study of the pertinent literature was undertaken. Subsequently, a conceptual framework was established, and the research construct relationship formulated. Furthermore, the questionnaire incorporated many control items. Prior to data analysis, the questionnaires that had been filled out were thoroughly assessed for both consistency and completeness. According to O'Leary-Kelly and Vokurka (1998), the instrument can be regarded as a sound construction with validity.

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questionnaire incorporated many control items. Prior to data analysis, the questionnaires that had been filled out were thoroughly assessed for both consistency and completeness. According to O'Leary-Kelly and Vokurka (1998), the instrument can be regarded as a sound construction with validity.

Table 6.4 Wave analysis to test external validity for non-response bias of the questionnaire.

	1st Wave	**2nd Wave**	**2 tail sig.**	**df**	**Levene's test**
Experience of respondent	2.99	2.84	.380	227.942	.772
Number of employees	3.14	2.88	.331	235.127	.948
Industry sectors	6.14	5.32	.467	230.197	.531
Environmental dynamism	15.22	15.30	.628	229.252	.236
Intra- ICT	11.74	12.08	.115	235.875	.504
Inter- ICT	20.52	20.49	.238	235.963	.398
Internal integration practices	21.59	21.06	.197	222.620	.672
Customer integration practices	16.41	15.88	.661	224.036	.193
Supplier integration practices	26.66	26.82	.484	226.657	.492
Supply chain performance	19.63	19.88	.094	222.288	.835
Early response = 144.04					
Late response = 142.55					

Table 6.4 displays the results of the wave analysis between the early and late respondents to the survey as a proxy of non-response bias associated with the study's respondents. The characteristics measured in the wave analysis were demographic characteristics, types of ICT, integration practices, environmental dynamism, and supply chain performance. As explained in the Table, the two important tail values are greater than 0.1 for all the attributes measured. The null proposition that there is no significant difference between the mean values of the two waves

of responses is rejected. In addition, the Levene test for variance of measured characteristics between early and late respondents is also stated in Table. Levene's test tests the assumption that there is similarity of variance between two groups. If the Levene test is significant (i.e., significant level of 0.05 or less), it indicates that the two variances differ significantly, but if it is not significant (i.e., significant level greater than 0.05), then there is no significant difference between the two groups, which means that both variances are equal. As such, from Table 6.4 all the characteristics measured rejected the null assumption that there are no significant differences between the mean values of the two response waves. Thus, based on the two-sided significance and the Levene-T test, as illustrated in Table 6.4, a high degree of validity can be attributed to the research scales. The research assumption, that there is no significant difference between non-respondents and those who responded to the survey cannot be rejected (see table 6.4 for detail).

6.4 Descriptive statistics of respondents

In the above-mentioned sections, statistical tests for normality, validity, and reliability were reported as part of data analysis and to determine that the data set satisfies the assumptions for parametric analysis. Here data will be analysed for descriptive statistics. Descriptive statistics have several uses. These include:

- Describe the characteristics of sample discussed in the chapter 4.
- Check variables for any violation of the assumptions underlying the statistical techniques that will use to address research questions.
- Address specific research questions.

Testing of assumptions involves obtaining descriptive statistics on research variables. These descriptive statistics include the mean, standard deviation, skewness, and kurtosis, among others. Table 6.5 show the main constructs and variables respectively. This table also consists of the minimum and maximum, as shown in the responses to the questionnaire (see Appendix for details). The table also display the mean, standard deviation, skewness, and kurtosis scores. From the table, the standard deviations prove there is a measure of dispersion in the constructs measured. Inspecting the skewness and kurtosis, revealed that neither of variables have high values and there is an even spread of positive and negative values within distributed data. The skewness and kurtosis allow to determine the characteristics of the research constructs based on the responses to the survey questionnaire.

Table 6.5 Descriptive statistics of research variables

Research variables		Min	Max	Mean	Std Dev.	Skewness	Kurtosis
Information and communication technology (ICT)	**Intra-ICT**						
	Radio Frequency Identification	1	5	3.31	.843	-.036	-.338
	Enterprise Resources Planning (ERP)	1	5	3.26	.853	.122	-.087
	Electronic Data Interchange (EDI)	1	5	3.26	.852	-.031	-.062
	Material Resources Planning (MRP)	1	5	3.24	.825	.120	-.167
	Computer Aided Design/Manufacturing (CAD/CAM)	1	5	3.23	.790	-.092	-.276
	Advanced Planning and Schedule (APS)	1	5	3.21	.763	.190	-.011
	Inter-ICT						
	We use advanced data analytics software	1	4	3.30	.963	-1.172	.198
	We use additive manufacturing for managing production activities	1	4	3.27	.957	-1.124	.143
	We use cloud computing technologies to share data and information with suppliers	1	4	3.16	.934	-.929	-.055

	We have an internet connect with the customer	1	4	3.16	.921	-.934	.037
	We use electronic mail with the key customer	1	4	3.13	.925	-.874	-.093
	We have an extranet connection with key consumer	1	5	3.13	.842	-.499	-.159
	.193						
Supply chain integration practices	**Internal Integration practices (IIP)**						
	Real-time integration and connection among all internal functions	1	5	3.61	.983	-.081	-.898
	Integrative inventory management	2	5	3.60	.979	-.054	-1.008
	Real-time sharing of the level of inventory	2	5	3.54	.957	.069	-.948
	Enterprise application integration among internal functions	2	5	3.53	.958	.105	-.947
	Real-time sharing of the logistics-related operating data	1	5	3.53	.966	-.013	-.839
	Data integration among internal functions	2	5	3.52	.944	.060	-.899
	Use of cross-functional teams in new product improvement	2	5	3.44	.911	.193	-.752
	Use of cross-functional teams in process improvement	2	5	3.42	.919	.143	-.788
	Supplier Integration Practices (SIP)						
	Long-term procurement relationship with suppliers	1	5	3.86	.793	-.608	.490
	Helping suppliers improve their process to better meet the firms‟ needs	1	5	3.85	.757	-.689	.885
	Suppliers share their production schedule information with the firm	2	5	3.84	.752	-.389	.031
	Sharing inventory levels with suppliers	2	5	3.83	.727	-.528	.408
	Sharing demand forecasts with suppliers	1	5	3.83	.783	-.653	.621
	Establishment of quick ordering systems with suppliers	1	5	3.82	.772	-.620	.625
	Information exchange with suppliers through information networks	2	5	3.81	.742	-.431	.151
	Participation of suppliers in the process of procurement and production	2	5	3.81	.755	-.434	.096

	Involvement of suppliers in the design stage	1	5	3.81	.766	-.621	.652
	Strategic partnership with suppliers	2	5	3.80	.724	-.412	.195
	Suppliers share their production capacity information with the firm	1	5	3.77	.764	-.556	.523
	Sharing production plans information with suppliers	2	5	3.74	.710	-.372	.151
	Customer Integration Practices (CIP)						
	Customer share demand forecast with the firm	1	5	3.47	1.127	-.138	-1.014
	Sharing production plan with customers	1	5	3.45	1.112	-.115	-.962
	Frequency contact with customers	1	5	3.43	1.155	-.197	-.925
	Establishment of quick ordering systems with customers	1	5	3.42	1.162	-.181	-.954
	Sharing of market information with customers	2	5	3.31	.824	.188	-.471
	Communication with customers	2	5	3.30	.796	.161	-.405
	Customers share Point-of-Sales (POS) information with the firm	2	5	3.29	.783	.227	-.296
	Cooperates with customer through information networks	1	5	3.29	.771	.061	-.145
	Sharing available inventory with customers	2	5	3.27	.777	.134	-.392
Supply chain performance (SCP)	Increase in employee engagement	2	5	3.55	.902	-.008	-.771
	Delivery Speed	1	5	3.50	.958	-.085	-.561
	Increase in customer satisfaction	1	5	3.50	.958	-.032	-.563
	Flexibility	1	5	3.49	.936	-.057	-.598
	Improve delivery reliability	2	5	3.47	.794	.364	-.383
	Increase in return on investment	1	5	3.46	.953	-.068	-.555
	Improve product quality	1	5	3.46	.957	-.069	-.577
	Reduction in cost of production	1	5	3.44	.916	.009	-.519
	Increase in net profit	1	5	3.39	.934	.074	-.459
Valid N (listwise) = 238							

The results (table 6.5) show that supply chain performance covers increased employee engagement, delivery speed, increased customer satisfaction, flexibility, as well as delivery reliability, while increased profitability was the least on supply chain performance measures. In the context of ICT adoption, the results also show that the use of radio frequency identification, enterprise resource planning and electronic data interchange has increased, while the least of all the intra_ICT adoption is the use of advanced planning and schedule (APS). In the adoption of inter_ICT, the results indicated that the use of data analytics software, additive manufacturing for managing operations and supply chain activities, and the use of cloud computing technologies to share data and information with suppliers are promoted with the supply chain. While less emphasis is given to an extranet connection with key customers.

Within the supply chain integration, three practices were investigated. These are internal integration practice, supplier, and customer integration practices. Within the internal integration practices, the results (table 6.5) show that internal integration and connection among all internal functions, which ranked (1) is the most important practices in the companies, while the use of cross-functional teams in process improvement (ranked 8) is the least. The importance of supplier integration practices was also studied. The results display in table 6.5 revealed that collaborative relationship with suppliers is highest important, while sharing production plans information with suppliers is considered least important. Within the customer integration practices, the results show that increased share of demand information with the organisations is the most important, whereas sharing inventory information with customer is considered least

important. Nonetheless, these results suggest that all integration practices are considered important by the respondents since the least practices had a mean value above 3.27.

6.5 Demographic characteristics of respondents

Descriptive statistics were used to analyse the distribution of the demographic characteristics of the response to the survey. In Table 6.6 some basic demographic characteristics of the survey respondents are depicted including organisational size by number of employees, company turnovers (in terms of millions of naira), and Designation of respondents, and principal business Sectors of the respondents to the survey. Inspection of the result, show that the survey is representative in terms of firm level, business sector and the designation of respondents. A detailed account of the demographic characteristics of the respondents are given in the following sections.

The respondent's designation to the survey is illustrated in Table 6.6. the results show 14.2% of the respondents are CEOs, Directors, and MDs. A significant challenge with firm-level study is that they have limited time due to tight schedules to complete survey. Even so, as mentioned earlier, the CEO, MD, and Director constitute the least of the respondents. Supply chain managers constitute 43.5% of the respondents, followed by IT specialist with responses of 24%. The feeling in the study is that the key information solicited in the study is held by supply chain managers and IT experts, as they possess better overview of the issues under the study.

The number of employees and the total turnover were used as size of company reported by the survey respondents. The results in Table 6.6 show two indicators of company size and related demographic characteristics of the survey respondents. It can be opined from the table that out of the sample respondents about 39% of firms have fewer 100 employees while about 15% of

firms have more than 300 workers. About 17% have a workforce in the range of 200 to 299 employees.

Table 6.6: Demographic characteristics of respondents

Total number of respondents = 95	Frequency	Percentage (%)
Size by number of employees		
Less than 49	7	3%
50 - 99	93	39%
100 - 199	62	26%
200 - 299	40	17%
Above 300	36	15%
Designation of respondents		
CEO, Director, MD	34	14.2%
Supply chain manager	104	43.5%
IT specialist/consultant	58	24.5%
Others	42	17.8%
Company annual turnover (# million)		
Less than #25	5	2.2
26 - 50	27	11.4
56 - 200	80	33.7
201 - 300	67	28.5
301 - 400	33	14.0
401 and above	24	10.2
Working experience of the respondent		
1 – 5 years	38	16%
6 – 10 years	43	18%
11 – 15 years	83	35%

16 – 20 years	48	20%
21 years above	26	11%
Principal business sectors		
IT products and services	32	13.5
Manufacturing	20	8.5
Financial services	13	5.3
Healthcare	18	7.6
Energy and utilities	27	11.3
Consulting and professional services	38	15.9
Transport and logistics	5	2.1
Retails	21	8.7
Telecoms	40	17.2
Government	2	0.7
Other supporting activities	22	9.2

In addition to the above, the table also shows the profile of the respondents. Out of the 238 respondents, 16% had less than five years of experience, 18% had six to ten years of experience with about 66% (i.e., 35+20+11) having over ten years of experience.

Table 6.6 also shows the percentage of respondent's business sectors. 17.2 percent of the respondents belong to telecoms, 15.9 percent are consultant and professional services, while 0.7% are government agency.

6.6 Inferential statistics

To enhance comprehension of pertinent practises linked to the implementation of Information and Communication Technology (ICT) and the integration of supply chains, an analysis of correlation was conducted to examine and evaluate the connections among the research constructs under scrutiny. This analysis aimed to assess the cumulative effects of these practises

on measures of supply chain performance. Correlation is employed to examine the magnitude of associations between variables being investigated. Additionally, it provides an indication of the direction (positive or negative) and magnitude of the correlation. A positive correlation suggests that there is a simultaneous rise in supply chain performance as the usage of ICT (Information and Communication Technology) increases. A negative correlation suggests that there is an inverse relationship between the level of ICT adoption and organisational performance, meaning that as the former increases, the latter tends to deteriorate. Similarly, a regression analysis was conducted to investigate the predictive capacity of a collection of ICT adoption and supply chain integration practises on the performance metrics of the supply chain. Furthermore, it aids in the establishment of cause-effect linkages among various components and their combinations.

To present the outcomes of the statistical tests in a systematic manner, the findings of the correlation analysis will be reported first, followed by the results of the regression analysis. The analysis encompasses the assessment of the conceptual model through the utilisation of factor analysis. Factor analysis enables the reduction of a substantial number of variables or items on scales into a more concise set of components that are easier to handle. This process is achieved by the identification and synthesis of the fundamental patterns of correlation, with a particular focus on identifying clusters or associations among related elements (Pallant, 2011). The utilisation of this methodology is frequently observed in the process of constructing scales and measures, with the aim of discerning the fundamental framework. The results of factor analysis will subsequently be employed within a structural equation model (SEM).

SEM was used to undertake path analysis of the conceptual model which was presented in Figure 6.6.

6.6.1 Correlation Analysis

Correlation coefficient is a measure of the extent to which research constructs are related. It is expressed by the letter r ranges from -1 to +1 with the value signifying the strength of the relationship while the sign (- or +) indicates the direction of relationship. A value close to -1 or +1 denotes strong positive or negative correlation, which connotes the direct or indirect association

among the constructs. Thus, correlation analysis does not permit the manipulation of the study constructs to enable causal analysis of relationships. Certainly, the presence of correlation does not demonstrate causality, but it indicates a necessary precondition for it. In other words, the lack of relationship reveals that no causality is present, so impeding the need for undertaking regression analysis.

6.6.1.1 The Relationships amongst the key research constructs

To examine the relationship between the use of information and communication technology (ICT), supply chain integration practises, and performance, a bivariate correlation analysis was conducted. This study examines the veracity of the fundamental claim that forms the basis for the use of information and communication technology (ICT) in businesses, as well as its implications for integrated supply chain practises within a changing economic landscape. Indeed, there exists a viewpoint among scholars that the adoption and integration of information and communication technology (ICT) are prominent techniques in the realm of competition, which have the potential to collectively boost the performance of supply chains. To assess the influence of information and communication technology (ICT) adoption and integration practises on supply chain performance, relevant metrics were collected and analysed for any correlations. The study examined the associations between the variables by employing the Pearson product-moment correlation coefficient. As previously mentioned, initial analyses were conducted to verify that there were no violations of the assumptions of normality, linearity, and homoscedasticity (Hair et al., 2009). The research did not reveal any serious issues pertaining to the assumptions. The correlation coefficient of the primary research variables is presented in Table 6.7. The cumulative relationships are among the ICT adoption, integration practices, environmental dynamism, and supply chain performance. From table 6.7, there was a strong positive and significant correlation among the variables. The relationship between level of ICT adoption and supply chain performance was ($r = 0.428$, $p < 0.001$); integration practices and supply chain performance was ($r = 0.609$, $p < 0.001$), and environmental dynamism and supply chain performance was ($r = 0.445$, $p < 0.001$), while the relationship between the level of ICT adoption and supply chain integration practices was ($r = 0.462$, $p < 0.001$) and environmental dynamics and supply chain integration practices was ($r = 0.709$, $p < 0.001$), as well as environmental dynamism and the ICT adoption was

also correlated with ($r = 0.227$, $p < 0.001$). From the results, it could be suggested that high level of dynamic business environment associated with the higher level of integration practices within the supply chain; while increase uncertainty in the supply chain amplify the adoption of information and communication technologies. As option for best practice both the ICT adoption and integration practices are linked with supply chain performance improvement.

Table 6.7: Correlations between main constructs of the research

Correlations

		tED	tICT	tSCIP	tSCP
Total Environmental Dynamism (ED)	Pearson Correlation	1	.227**	.709**	.445**
	Sig. (2-tailed)		<.001	<.001	<.001
	N	238	238	238	238
Total Information and Communication Technology (ICT)	Pearson Correlation	.227**	1	.462**	.428**
	Sig. (2-tailed)	<.001		<.001	<.001
	N	238	238	238	238
Total Supply Chain Integration Practices (SCIP)	Pearson Correlation	.709**	.462**	1	.609**
	Sig. (2-tailed)	<.001	<.001		<.001
	N	238	238	238	238
Total Supply Chain Performance (SCP)	Pearson Correlation	.445**	.428**	.609**	1
	Sig. (2-tailed)	<.001	<.001	<.001	
	N	238	238	238	238

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

6.6.1.2 Assessing the relationship among the factors of each dimension of ICT, supply chain integration practices and performance

The results presented in table 6.8, show that supplier integration practices have the higher correlation with supply chain performance, while intra-ICT adoption have the least association with supply chain performance. It is also evident that there is no significant relationship between intra-ICT adoption and supplier integration practices while in the dynamic environment, organisations focus less on intra-ICT adoption and rather focuses more on inter-ICT adoptio

Table 6.8 Correlation coefficient of individual types of ICT, supply chain integration and their association with performance measures

Sub constructs		tED	Intra- ICT	Inter- ICT	IIP	CIP	SIP	SCP
Environmental dynamism (ED)	Pearson Correlation	1	.087	.266**	.315**	.372**	.849**	.445**
	Sig. (2-tailed)		.182	<.001	<.001	<.001	<.001	<.001
	N	238	238	238	238	238	238	238
Intra- ICT	Pearson Correlation	.087	1	.381**	.280**	.225**	.123	.271**
	Sig. (2-tailed)	.182		<.001	<.001	<.001	.059	<.001
	N	238	238	238	238	238	238	238
Inter- ICT	Pearson Correlation	.266**	.381**	1	.513**	.348**	.276**	.422**
	Sig. (2-tailed)	<.001	<.001		<.001	<.001	<.001	<.001
	N	238	238	238	238	238	238	238
Internal integration practices (IIP)	Pearson Correlation	.315**	.280**	.513**	1	.410**	.349**	.458**
	Sig. (2-tailed)	<.001	<.001	<.001		<.001	<.001	<.001
	N	238	238	238	238	238	238	238
Customer integration practices (CIP)	Pearson Correlation	.372**	.225**	.348**	.410**	1	.474**	.441**
	Sig. (2-tailed)	<.001	<.001	<.001	<.001		<.001	<.001
	N	238	238	238	238	238	238	238
Supplier integration practices (SIP)	Pearson Correlation	.849**	.123	.276**	.349**	.474**	1	.512**
	Sig. (2-tailed)	<.001	.059	<.001	<.001	<.001		<.001
	N	238	238	238	238	238	238	238
Supply chain performance (SCP)	Pearson Correlation	.445**	.271**	.422**	.458**	.441**	.512**	1
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001	
	N	238	238	238	238	238	238	238

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

6.7 Regression and path analysis of the main research constructs

Regression analysis is a statistical method employed to investigate the association between a single dependent variable and multiple independent variables (Pallant, 2020). This approach relies on correlation as its foundation, but it allows for a more advanced analysis of the interconnectedness between a group of variables. The study topics were addressed using regression analysis. This study demonstrates the efficacy of a specific set of supply chain practises in accurately forecasting performance outcomes. The objective of this study is to investigate the extent to which the implementation of information and communication technology (ICT) and the integration of related practises can serve as indicators for the effectiveness of supply chain performance. In essence, regression analysis enables the examination of whether the inclusion of a variable enhances the predictive capacity of the model, in addition to the variables already incorporated within the model.

Tabachnick and Fidell (2013) provided an explication of the many forms of multiple regression analyses, along with an elucidation of the research objectives that necessitate verification. There exist three primary categories of multiple regression analysis, including standard regression, hierarchical regression, and stepwise regression analysis. The primary distinction among these regression analyses lies in the method used to indicate the inclusion of variables inside the regression equation. In the context of normal regression analysis, it is customary to include all independent variables simultaneously in the regression equation. In the conventional regression approach, all the independent variables are simultaneously included in the model. The predictive influence of each independent variable is assessed in relation to the influence of all other factors. This methodology was employed to ascertain the extent to which the adoption of information and communication technology (ICT) and integration practises could account for the variability observed in supply chain performance. Additionally, it provides information regarding the extent to which each independent variable accounted for unique variance in the dependent variable.

In contrast, hierarchical regression involves the sequential inclusion of independent variables into the model according to the researcher's theoretical rationale. In this

study, variables are introduced in a sequential manner, where each individual variable is evaluated based on its contribution to the prediction of the dependent variable, while accounting for the effects of previously controlled variables.

The basic technique of regression analysis involves computing a model of an estimate of the proposed relationship in a sample of data.

In the result of regression analysis, three things are the most important. These are:

- The model summary
- The table of coefficients and
- The table of ANOVA

The fit of the model to the data is evaluated using summary statistics such as β, t, F and R^2. These variables are defined as follows:

β = is the slope of the regression line that approximates the data

t = is the t-test that is done to measure the difference between the variables in the study.

F = F-statistics measures of the ratio between the least squares of the numerator to the least square of the denominator.

R^2 = the proportion of variability which is explained by the regression equation.

Earlier to embark on regression analysis, several assumptions of multiple regression was checked. The analyses conducted did not uncover any significant issues pertaining to the assumptions required for utilising regression analysis. The results of the regression diagnostics indicated the absence of multicollinearity among the variables. The variance inflation factors (VIFs) are calculated for each regression coefficient.

Table 6.9 and 6.10 below reported the results of predictors of model summary and Analysis of variance ANOVA, while Table 6.11 shows the path coefficient for the adoption of ICT and integration practices on supply chain performance. The result of the regression analysis shown as follows: model 1 have R^2 = 0.073, F statistics = 18.658 (0.001), β = 0.271, t = 25.123 (0.001) all being significant at the 10% level

indicates that there is no multicollinearity in the data. The results suggest the absence of multicollinearity as none of the conditions stated by Flynn and Flynn (2004) are satisfied.

As the models in Tables 6.9 and 6.10 shows, there are assumed relationships between the adoption of ICT and integration practices on the performance of supply chains. The model is based on the premise that the level of ICT adoption and integration practices are the exogenous variables, which impact on the performance of supply chains.

Table 6.9 show the regression analysis of ICT adoption, integration practices, and supply chain performance. The first model indicates that the intra-ICT explain (R^2 = 0.073) 7.3 percent of the variance in supply chain performance, while 93 percent of the variance are explained by other variable such as inter-ICT, internal integration practices, customer, and supplier integration practices; the F change is significant at the 1% level. In the way, customer integration practices account for 0.403 percent of variance in supply chain performance. As Table 6.9 shows customer integration practice explains 40.3 percent variation in supply chain performance, and F change is significant at the 5% level.

Table 6.9 Model summary of Predictors of research variables

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.271[a]	.073	.069	3.232	.073	18.658	1	236	<.001
2	.439[b]	.192	.185	3.023	.119	34.645	1	235	<.001
3	.515[c]	.266	.256	2.889	.073	23.310	1	234	<.001
4	.625[d]	.390	.380	2.639	.125	47.574	1	233	<.001
5	.634[e]	.403	.390	2.617	.012	4.842	1	232	.029

a. Predictors: (Constant), Intra- ICT

b. Predictors: (Constant), Intra- ICT, Inter- ICT

c. Predictors: (Constant), Intra- ICT, Inter- ICT, Internal integration practices

d. Predictors: (Constant), Intra- ICT, Inter- ICT, Internal integration practices, Supplier integration practices

e. Predictors: (Constant), Intra- ICT, Inter- ICT, Internal integration practices, Supplier integration practices, Customer integration practices

f. Dependent Variable: Supply chain performance

Table 6.10 ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	194.848	1	194.848	18.658	<.001[b]
	Residual	2464.518	236	10.443		
	Total	2659.366	237			
2	Regression	511.499	2	255.750	27.982	<.001[c]
	Residual	2147.867	235	9.140		
	Total	2659.366	237			
3	Regression	706.077	3	235.359	28.196	<.001[d]
	Residual	1953.288	234	8.347		
	Total	2659.366	237			
4	Regression	1037.276	4	259.319	37.249	<.001[e]
	Residual	1622.089	233	6.962		
	Total	2659.366	237			
5	Regression	1070.438	5	214.088	31.259	<.001[f]
	Residual	1588.927	232	6.849		
	Total	2659.366	237			

a. Dependent Variable: Supply chain performance

b. Predictors: (Constant), Intra- ICT

c. Predictors: (Constant), Intra- ICT, Inter- ICT

d. Predictors: (Constant), Intra- ICT, Inter- ICT, Internal integration practices

e. Predictors: (Constant), Intra- ICT, Inter- ICT, Internal integration practices, Supplier integration practices

f. Predictors: (Constant), Intra- ICT, Inter- ICT, Internal integration practices, Supplier integration practices, Customer integration practices

Table 6.11 reports the detailed regression path analysis between the research constructs. It shows the level of ICT adoption and integration practices pursued in organisations to enhance supply chain performance. As can be seen in table 6.11, inter-ICT adoption has a significant influence on supply chain performance ($\beta = 0.156$, $p < 0.013$) while there is no significant direct effect for intra-ICT ($\beta = 0.089, p > 0.109$). Thus, corroborating finding that organisations should aim for cumulative achievement of competitive performance (Zhang et al., 2016; Flynn and Flynn, 2004) rather than competing on individual measure. Table 6.11 also indicates that internal integration practices, customer and supplier integration practices all have significant impacts on supply chain performance ($\beta = 0.182, p < 0.004$; $\beta = 0.135, p < 0.029$; $\beta = 0.331, p < 0.001$) *respectively.*

Table 6.11 Path coefficients for types of ICT adoption and integration practices

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	16.970	.675		25.123	<.001					
	Intra- ICT	.233	.054	.271	4.320	<.001	.271	.271	.271	1.000	1.000
2	(Constant)	13.520	.862		15.685	<.001					
	Intra- ICT	.111	.055	.129	2.027	.044	.271	.131	.119	.855	1.170
	Inter- ICT	.239	.041	.373	5.886	<.001	.422	.358	.345	.855	1.170
3	(Constant)	10.710	1.009		10.619	<.001					
	Intra- ICT	.084	.052	.097	1.596	.112	.271	.104	.089	.845	1.183
	Inter- ICT	.143	.044	.223	3.265	.001	.422	.209	.183	.676	1.480
	Internal integration practices	.239	.050	.317	4.828	<.001	.458	.301	.270	.729	1.373
4	(Constant)	6.500	1.105		5.883	<.001					
	Intra- ICT	.086	.048	.100	1.800	.073	.271	.117	.092	.845	1.183
	Inter- ICT	.110	.040	.172	2.738	.007	.422	.177	.140	.666	1.501
	Internal integration practices	.158	.047	.210	3.386	<.001	.458	.217	.173	.683	1.465
	Supplier integration practices	.246	.036	.379	6.897	<.001	.512	.412	.353	.865	1.156
5	(Constant)	5.097	1.268		4.020	<.001					
	Intra- ICT	.077	.048	.089	1.610	.109	.271	.105	.082	.838	1.193
	Inter- ICT	.100	.040	.156	2.501	.013	.422	.162	.127	.658	1.519
	Internal integration practices	.138	.047	.182	2.909	.004	.458	.188	.148	.656	1.525
	Supplier integration practices	.214	.038	.331	5.616	<.001	.512	.346	.285	.743	1.346
	Customer integration practices	.186	.084	.135	2.200	.029	.441	.143	.112	.687	1.455

a. Dependent Variable: Supply chain performance

6.8 Exploratory factor analysis

Exploratory factor analysis is used to gather information about the interrelationships among a set of variables. It is used to reduce many related variables to a more manageable number, prior to using them in other analyses (Tabachnick and Fidell, 2013). The 30 items of the ICT, SCI, and SCP were subjected to principal components analysis (PCA) using SPSS Statistics version 28.0.1.1, to extract the suitable factors for this research. Prior to PCA, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of 0.3 and above.

In line with the exploratory factor analysis, Table 6.12 show that the Kaiser-Meyer-Olkin value was 0.862, exceeding the recommended value of 0.6 (Kaiser, 1974), and Bartlett (1954) Test of Sphericity reached statistical significance, supporting the factorability of the correlation matrix. In other words, this measure quantifies the degree of interrelation among the variables and the appropriateness for factor analysis (Hair et al., 2010). The value of KMO is above the minimum of 0.50 for all variables (Tabachnik and Fidell, 2013). These results suggest that the values for all items in this research were above the acceptable value, thus the data set used in this research was appropriate for factor analysis.

Bartlett's test of Sphericity referred to a statistical test for the presence of correlations among the variables. This value provides the statistical significance at which the correlation matrix has significant correlations among at least some of the variables (Hair et al., 2012). From the results, Bartlett's test of Sphericity $\chi 2$ value was 16161.78 ($p < 0.0001$); this value indicated that the correlation between items was sufficiently large for factor analysis.

Table 6.13 shows the result of the pattern matrix. The result revealed the presence of seven factors with eigenvalues exceeding 1, explaining 26.07%, 23.24%, 13.77%, 11.62%, 9.58%, 8.09% and 7.15 of the variance respectively. A further inspection of the scree plot revealed a clear break after the second component. Using Catell (1966) scree test, it was decided to retain two components for further investigation. This was further supported by the results of parallel analysis, which showed two

components with eigenvalue exceeding the corresponding criterion value for a randomly generated data matrix of the same size 30 x 238 respondents).

The seven-component solution explained a total of 91.43% of the variance, with component 1 contributing 26.07% and component 7 contributing 7.15%. To aid in the interpretation of these components, varimax rotation was performed. The rotation solution shown the presence of simple structure (Thurstone, 1947), with each component showing several strong loadings and all variables loading on one component. The interpretation of the six components was consistent with previous research on the ICT and business performance, with positive affect items loading strongly on component 1 affect items loading strongly on component 2, 3 to 7. There were strong correlations amongst the seven factors (r = 0.000). The results of this analysis support the use of the positive affect items and the affect items as separate scales, as suggested by the scale the author Watson et al., 1988). Some cross loading items were removed from the data set for modification.

Table 6.12. KMO and Bartlett's Test

The KMO and Bartlett's test are normally computed using the equation below.

The Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity are used in Exploratory Factor Analysis (EFA) to assess the suitability of the data for factor analysis.

1. **Kaiser-Meyer-Olkin (KMO) Measure:**
   The formula for KMO involves the ratio of the sum of squared correlations between variables (ΣSSC) to the sum of squared correlations plus the sum of squared partial correlations ($\Sigma SSC + \Sigma SSPC$):
   $KMO = \frac{\Sigma SSC}{\Sigma SSC + \Sigma SSPC}$
   KMO values range from 0 to 1, with higher values indicating more suitable data for factor analysis. Generally, a KMO value above 0.7 is considered acceptable.
2. **Bartlett's Test of Sphericity:**
   Bartlett's Test assesses whether the observed variables are correlated in the population. The test statistic (χ^2) is calculated using the formula:
   $\chi^2 = \frac{(N-1-p) \times \Sigma \ln(\det(R))}{1 - \Sigma \ln(\det(R))}$
   where N is the sample size, p is the number of variables, and $\Sigma \ln(\det(R))$ is the sum of the natural logarithms of the determinants of the correlation matrix. The χ^2 statistic is then compared to a critical value based on the degrees of freedom.

In both cases, higher KMO values and a statistically significant Bartlett's Test support the appropriateness of the data for factor analysis.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.862
Bartlett's Test of Sphericity	Approx. Chi-Square	16161.784
	df	561
	Sig.	.000

Table 6.13. Pattern Matrix (Factor loadings for explanatory variables)

Items	Components							Extracted
	1	2	3	4	5	6	7	
	ED	SCP	Inter-ICT	IIP	Intra-ICT	SIP	CIP	Communalities
The rate at which your firm's products/services change	.886							.787
The rate at which your competitors' products/services change	.912							.836
The rate at which your supplier's skills/capabilities change	.907							.826
The rate at which your customer's product/service needs change	.928							.865
we use advanced data analytics software			.970					.943
we use additive manufacturing for managing production activities			.975					.955
we use cloud computing technologies to share data and information with suppliers			.984					.976
We have an internet connect with the customer			.970					.947
We use electronic mail with the key customer			.973					.957
Sharing inventory levels with major suppliers						.971		.959
Sharing production plans information with major suppliers						.981		.980
Sharing demand forecasts with major suppliers						.982		.983
Enterprise Resources Planning (ERP)					.941			.930
Material Resources Planning (MRP)					.956			.954

Electronic Data Interchange (EDI)					.956			.956
Radio Frequency Identification					.929			.883
Real-time integration and connection among all internal functions				.974				.981
Use of cross-functional teams in process improvement				.977				.979
Enterprise application integration among internal functions				.983				.986
Real-time sharing of the level of inventory				.980				.977
Sharing production plan with major customers							.931	.872
Major customer share demand forecast with the firm							.949	.908
Establishment of quick ordering systems with major customers							.916	.845
Sharing of market information with major customers							.950	.907
Sharing available inventory with major customers							.918	.847
Major customers share Point-of-Sales (POS) information with the firm							.930	.869
Delivery Speed		.939						.893
Flexibility		.943						.905
Increase in customer satisfaction		.942						.913
Increase in employee engagement		.921						.876
Increase in products quality		.943						.914
Reduction in the cost of production		.948						.924
Increase in return on investment		.926						.878
increase in net profit		.925						.877
% of variance	26.07 %	23.24 %	13.77 %	11.62%	9.58 %	8.09 %	7.15 %	
Extraction Method: Principal Component Analysis.								
Rotation Method: Varimax with Kaiser Normalization.								
a. Rotation converged in 5 iterations.								

6.9 Confirmatory factor analysis

Confirmatory factor analysis (CFA) is a sophisticated methodology employed to validate predetermined assumptions pertaining to the underlying structure of a collection of variables (Pallant, 2020). The purpose of utilising this method is to evaluate the convergent validity and discriminant validity of the study constructs, as stated by Byrne (2016). Within the framework of the Chartered Financial Analyst (CFA) programme, the evaluation of convergent validity can be conducted through the utilisation of factor loading, average variance extracted (AVE), and composite reliability (CR).

Table 6.14 shows the results of CFA for the ICT adoption, integration practices, environmental dynamism, and supply chain performance. From the results, all factor loadings for the measured items were above the acceptable value of 0.5 and statistically significant with critical ratio or had t-value above 6.00. table 6.14 also display the model fit indexes as followed: CMIN/DF = 3.307; CFI = 0.934; TLI = 0.928; IFI = 0.934; NFI = 0.908; and RMSEA = 0.099 were found to be adequate. The fit indices exceeded the minimum threshold value of 0.9 as suggested by Tabachnick and Fidell (2013), and the standardised item loadings also loaded above 0.70. Garver and Mentzer (1999) suggested that research conducting SEM for evaluating construct validity should concentrate on indices that are independent of sample size. The model indices that were recommended are TLI, CFI, and RMSEA. As a result, with these indices, the measurement model fit was considered acceptable.

Table also confirm the effects of the variable constructs' items on the key performance indicators. Following the rule of thumb, both Cronbach's alpha and composite reliability were all above the acceptable value of 0.7, indicating that the reliability and convergent validity of each construct is acceptable (Fornell and Larcker, 1981). As well, the AVE values, as represented in Table 6.14, were 0.959, 0.949, 0.957, 0.912, and 0.895 for Intra-ICT, inter-ICT, IIP, SIP, and CIP, respectively. The values of AVE for all research constructs were above the acceptable value of 0.5 (see table 6.14 for details).

Table 6.14. Results of confirmatory factor analysis

Items ≠	Scale items	Standardised item loadings	R^2	t-value
Information and communication technology (ICT)				
Intra- ICT	Cronbach's α = 0.994, CR = 0.989, AVE = 0.959			
IntraICT1	Enterprise Resources Planning (ERP)	.959	.920	8.444
IntraICT2	Material Resources Planning (MRP)	.981	.962	5.588
IntraICT3	Electronic Data Interchange (EDI)	.968	.937	7.612
IntraICT4	Radio Frequency Identification	.897	.805	10.055
Inter- ICT	Cronbach's α = 0.988, CR = 0.989, AVE = 0.949			
Inter-ICT1	we use advanced data analytics software	.946	.895	10.158
Inter-ICT2	we use additive manufacturing for managing production activities	.955	.912	9.997
Inter-ICT3	we use cloud computing technologies to share data and information with suppliers	.993	.986	4.683
Inter-ICT4	We have an internet connect with the customer	.972	.945	9.342
Inter-ICT5	We use electronic mail with the key customer	.981	.962	8.491
Supply chain integration (SCI)				
Supplier Integration practices (SIP)	Cronbach's α = 0.986, CR = 0.985, AVE = 0.957			
SIP1	Sharing inventory levels with major suppliers	0.994	.913	9.944
SIP2	Sharing production plans information with major suppliers	0.989	.977	5.258
SIP3	Sharing demand forecasts with major suppliers	0.956	.989	2.881
Customer integration practices (CIP)	Cronbach's α = 0.981, CR = 0.984, AVE = 0.912			

CIP1	Sharing production plan with major customers	.932	.869	9.689
CIP2	Major customer share demand forecast with the firm	.965	.932	8.384
CIP3	Establishment of quick ordering systems with major customers	.927	.859	9.793
CIP4	Sharing of market information with major customers	.974	.949	7.511
CIP5	Sharing available inventory with major customers	.940	.883	9.519
CIP6	Major customers share Point-of-Sales (POS) information with the firm	.949	.900	9.253
Internal integration practices (IIP)	Cronbach's α = 0.974, CR = 0.972, AVE = 0.895			
IIP1	Real-time integration and connection among all internal functions	.985	.970	8.587
IIP2	Use of cross-functional teams in process improvement	.984	.967	8.765
IIP3	Enterprise application integration among internal functions	.992	.984	6.359
IIP4	Real-time sharing of the level of inventory	.986	.973	8.311
Supply chain performance (SCP)	Cronbach's α = 0.983, CR = 0.983, AVE = 0.875			
SCP1	Delivery Speed	.935	.874	9.633
SCP2	Flexibility	.943	.889	9.434
SCP3	Increase in customer satisfaction	.949	.900	9.254
SCP4	Increase in employee engagement	.924	.854	9.834
SCP5	Increase in products quality	.950	.902	9.211
SCP6	Reduction in the cost of production	.954	.910	9.042
SCP7	Increase in return on investment	.923	.852	9.849
SCP8	increase in net profit	.922	.850	9.860

*** all significant to P < 0.000

_a indicates a parameter that was fixed at 1.000

N = 238, Estimation Method = Maximum Likelihood.

Mode fit indexes: CMIN/DF = 3.307; CFI = 0.934; TLI = 0.928; IFI = 0.934; NFI = 0.908; and RMSEA = 0.099

6.10 Structural model of ICT adoption and integration practices

The structural model refers to a theoretical depiction of the interrelationships between proposed constructs, as determined by path estimates (Schreiber et al., 2006). There are multiple fit indexes available, rendering an explanation of these indices unnecessary. Hair et al. (2006) conducted a study which emphasised the need of including evidence of three or four model fit when reporting model fit in research. It is not necessary to in some cases report all the suggested model fit indices due to the overlap that may be observed among the various indices. Therefore, several indices pertaining to the fit of the model will be presented.

Using SPSS-AMOS version 28, the result of the Goodness-of-fit (GOF) for the proposed model were acceptable (see Figure 6.6). The Ration for Chi square/degree of freedom (χ^2 /degree of freedom) value is 3.307; the comparative fit index (CFI) value is 0.934; TLI value = 0.928; IFI value = 0.934; the normal fir index (NFI) has values of 0.908, which all exceeded the recommended minimum of 0.9 (Byrne, 2016). The other fit index assessed include the root mean square error of approximation (RMSEA) with the value of 0.099 at $p < 0.05$ is lower than the threshold of 0.10 (Hair et al., 2014 and Tabachnick and Fidell, 2014).

6.10.1 Assessing direct effects of integration on supply chain performance.

Figure 6.6 show the structural equation model (SEM) of the relationship among the ICT adoption, supply chain integration practices and performance. It is evident from the structural model that there is a positive correlation between the degree of ICT adoption and supply chain performance (Standardised coefficient = 0.338, $p < 0.001$). Similarly, the level of ICT adoption was predicted by the more supply chain integration (Standardised coefficient = 0.605, $p < 0.001$). Besides, increasing supply chain integration practices results in enhancement of supply chain performance (Standardised coefficient = 0.459, $p < 0.001$). Table 6.5 presented the summary of the direct impact of the ICT adoption and supply chain integration practices on performance.

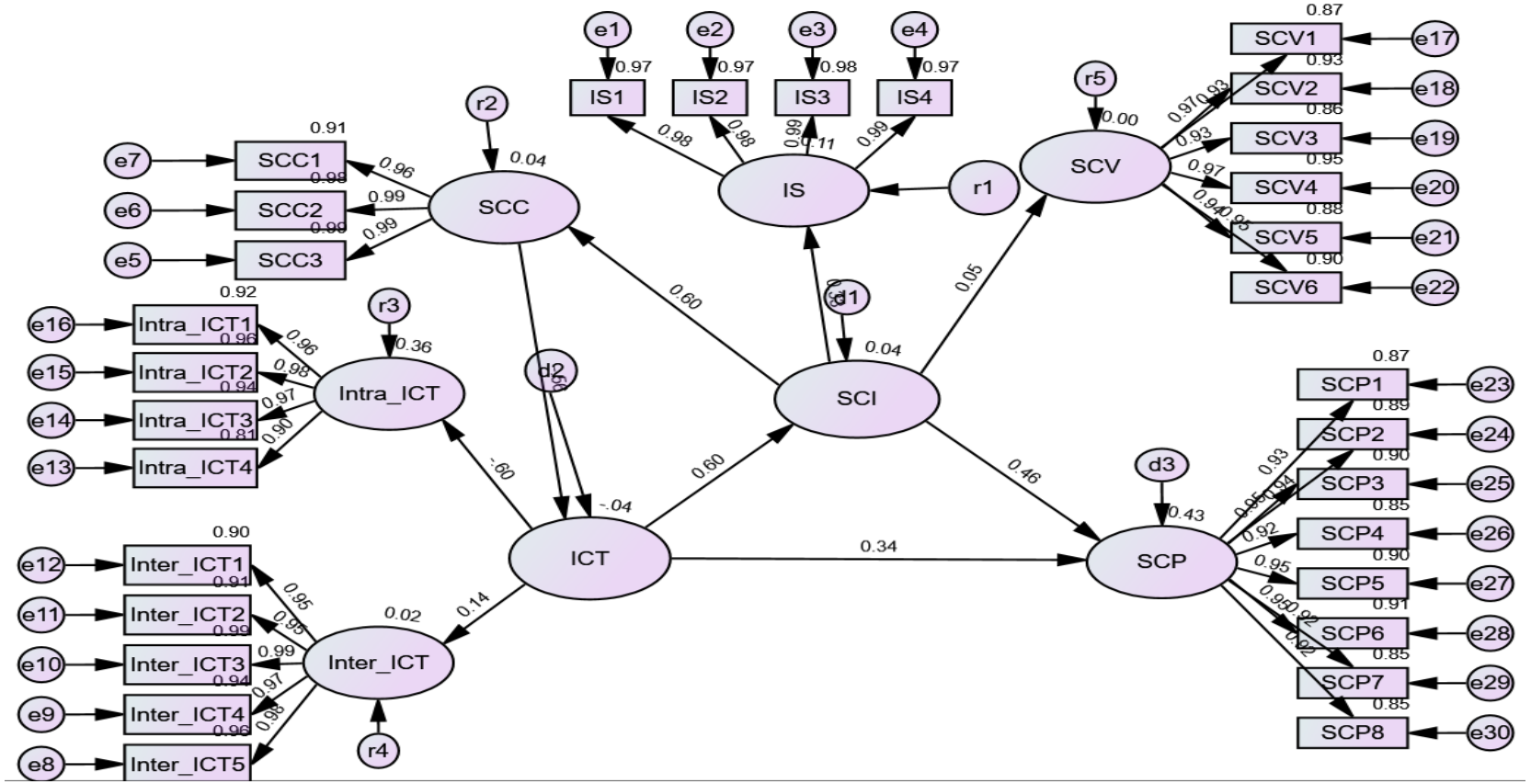

Figure 6.6: Structural Equation Model (SEM) of ICT adoption, integration practices, and supply chain performance

Table 6.15. The significance of relationships identified.

Correlations			Research Objectives	Standard coefficient	t-value
ICT	→	Supply chain performance	R/O 3	0.338	1.150
Supply chain integration	→	ICT→ Supply chain performance	R/O 4	0.605	0.280
ICT → Supply chain integration → supply chain performance			R/O 5	0.614	0.276
*** all significant to P < 0.000					
_a indicates a parameter that was fixed at 1.000					
N = 238, Estimation Method = Maximum Likelihood.					
Mode fit indexes: CMIN/DF = 3.307; CFI = 0.934; TLI = 0.928; IFI = 0.934; NFI = 0.908; and RMSEA = 0.099					

6.10.2 Assessing mediation and moderation effects.

The above objective call for the use of mediated regression analysis. The result of these tests and their interpretation are discussed below. In order to confirm the statement of the research objective that, supply chain integration practices mediates the effect of the degree of ICT adoption on supply chain performance, three regression models were estimated, as suggested by Baron and Kenny (1986): model 1, regressing supply chain integration practices on the adoption of ICT; model 2, regressing supply chain performance on the adoption of ICT; and model 3, regressing supply chain performance on the adoption of ICT, and supply chain integration practices. Several regression coefficients for each equation were estimated and tested. To establish mediation the following conditions were followed:

- The adoption of ICT must affect supply chain performance in model 1,
- The adoption of ICT must be shown to have impact on supply chain integration in model 2, and
- Supply chain integration practices must affect supply chain performance in model 3, while control for the adoption of ICT.

If these conditions all hold in the predicted direction, then the effect of ICT adoption and supply chain integration must be less in model 3 than in model 2. Perfect

mediation holds if the level of ICT adoption has no effect on supply chain performance. In other words, the effect of this variable on supply chain performance is no longer significant when the effect of supply chain integration practices is controlled for (model 3); partial mediation is established if the level of ICT adoption still affects supply chain performance when integration practices is added in the equation (model 3). Table 6.16 represents the results of (Ha3) mediation effect. The findings show that supply chain integration practices help to transmits the effect of the ICT adoption on supply chain performance (0.604 x 0.46 = 0.276 (β = 0.276, p < 0.05)). the P-value here is less than 0.05 showing that supply chain integration practice partially mediates the effect of ICT adoption on supply chain performance.

Table 6.16 Confirmation of the research objectives

	Direct impact	Indirect impact	Total impact	Results
R/O 3: ICT → supply chain performance	0.338	0.000	0.338	Supported
R/O 4: Supply chain integration → {ICT → supply chain performance}	0.604	0.000	0.604	Supported
R/O 5: ICT → supply chain integration → supply chain performance	0.338	0.276	0.614	Supported
*** all significant to P < 0.000				
_a indicates a parameter that was fixed at 1.000				
N = 238, Estimation Method = Maximum Likelihood.				
Mode fit indexes: CMIN/DF = 3.307; CFI = 0.934; TLI = 0.928; IFI = 0.934; NFI = 0.908; and RMSEA = 0.099				

To assess the moderation effect, a two-way between groups analysis was conducted to explore the impact of environmental dynamism in the relationship between the ICT adoption and supply chain performance. From Table 6.17, the moderation effect between the group of environmental dynamism and the ICT adoption as well as supply chain integration practices was statistically significant. The result of (H_{a4i}) is supported, F (1, 229) = 0.441, p < 0.002, proving that there is a significant moderating role of environmental dynamism (ED) in the relationship between the level of ICT adoption and supply chain performance (SCP). In addition, the result of (H_{a4ii}) is also supported, F (1, 229) = 0.364, p < 0.002, showing that ED moderates the impact of supply chain integration practices on supply chain performance.

In figure 6.7, two separate regression lines were plotted. One represents the regression line in the dynamic's context of high environmental dynamism and the other represent regression line for the context of low environmental dynamism. The X-axis represents the degree of ICT adoption and supply chain integration practices respectively, while the Y-axis represents supply chain performance. In both regression lines, there is a positive relationship between the level of ICT adoption and supply chain performance. This is called the main effect. Both regression lines show that with increase adoption of ICT, supply chain performance improves. But an increase in the adoption of ICT results in a much stronger increase in supply chain performance in the high dynamics business environment. While a less adoption of ICT results in lowest supply chain performance in the less dynamic business context. These results mark the present of moderation effect. Here environmental dynamics, as the moderator affects the strength of the relationship between the degree of ICT adoption and supply chain performance such that at different levels of the moderator the strength of the relationship between the ICT adoption and supply chain performance variers.

Table 6.17 **Tests of Between-Subjects Effects** (the moderation effects)

Dependent Variable: Supply chain performance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	746.326[a]	8	93.291	11.167	.281	.001
Intercept	5753.800	1	5753.800	688.757	.750	.001
ICT_1	36.509	1	36.509	4.370	.019	.038
SCIP_2	73.036	1	73.036	8.743	.037	.003
ED_1	165.073	2	82.537	9.880	.079	.001
ICT_1 * SCIP_2	1.230	1	1.230	.147	.001	.702
ICT_1 * ED_1	3.683	1	3.683	.441	**.002**	**.507**
SCIP_2 * ED_1	3.041	1	3.041	.364	**.002**	**.547**
ICT_1 * SCIP_2 * ED_1	3.068	1	3.068	.328	.000	.928
Error	1913.040	229	8.354			
Total	95435.000	238				
Corrected Total	2659.366	237				

a. R Squared = .281 (Adjusted R Squared = .256)

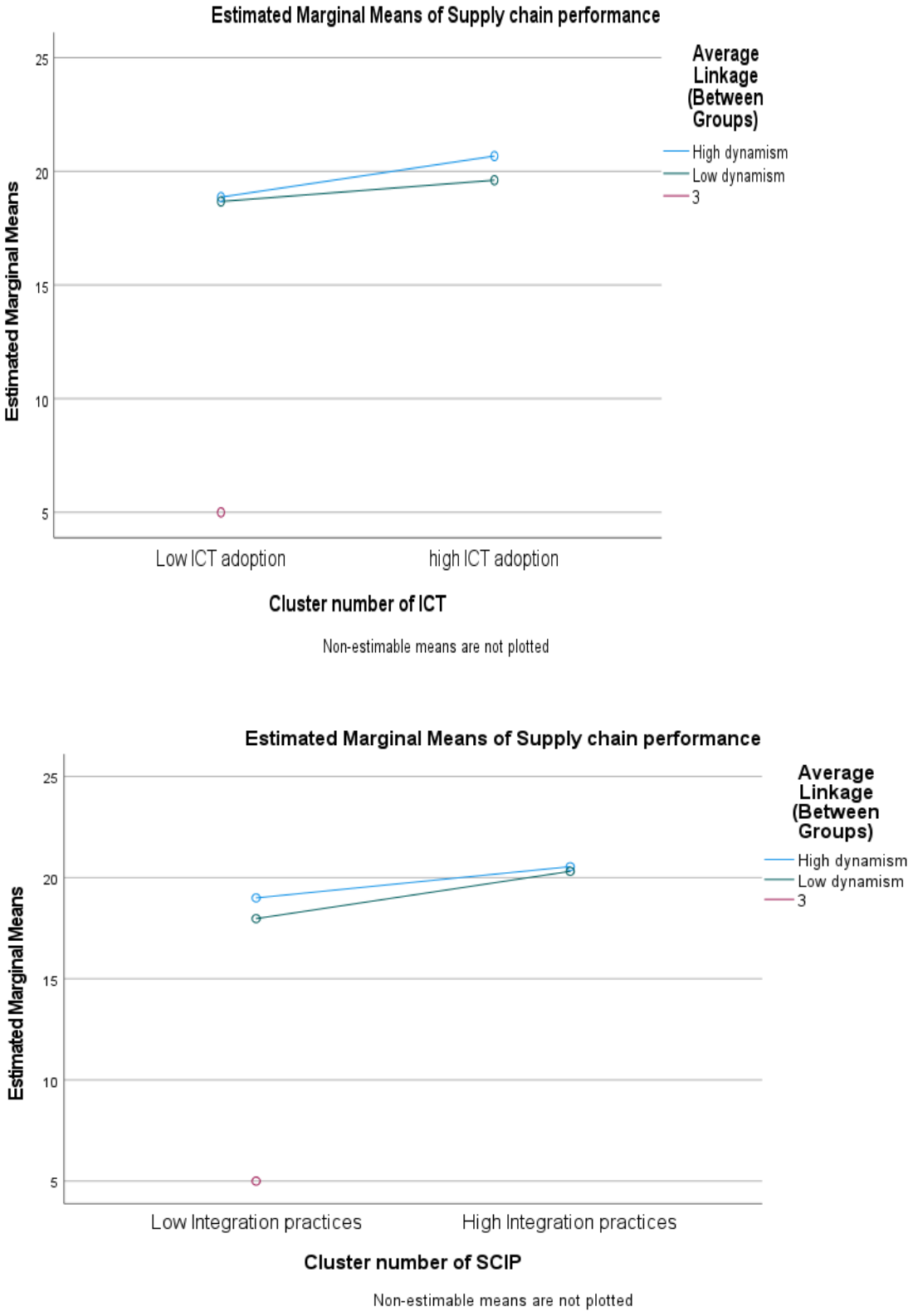

Figure 6.7 Moderation effect of environmental dynamism in the effects of the ICT adoption and supply chain integration practices on supply chain performance

6.11 Summary

This chapter reported the result of data analysis conducted to test and validate the proposed research objectives on the deployment of ICT and integration practices and their impacts on supply chain performance. This survey was administered in the Nigeria IT sector.

The empirical evidence from the survey indicated that improved supply chain performance would be positively correlated with the degree of ICT adoption within the supply chain. Besides, supply chain integration practices assisted to transmits the effect of ICT adoption on supply chain performance. Furthermore, and consistent with extant literature, the results from the empirical study support the relationship between supply chain integration practices and performance enhancement. This suggests that organisations implement integration practices to gain competitive performance. Likewise, employing environmental uncertainty as the critical moderation contingency, the results indicate that the degree of ICT adoption and supply chain integration practices will be enhanced with high environmental dynamism, which in turn, increase the performance of supply chains. These results contribute to the discussion of how the adoption ICT enhanced the performance of enterprises in Nigeria.

Chapter seven: Discussion

7.1 Introduction

The objective of this chapter was to examine the outcomes of the data analysis pertaining to the impact of ICT adoption and integration practises on supply chain performance, as well as to ascertain the degree of influence that these constructs exert on each other. Furthermore, the empirical study aimed to explore the potential association between information and communication technology (ICT), integration practise, and supply chain performance. The research investigated the individual roles and functionalities of each concept, their interdependencies, and the subsequent impact on organisational performance. The study investigated the methodology for assessing the collective impact of information and communication technology (ICT) and integration practises on the performance of supply chains. The primary objective of this study was to make a scholarly contribution by empirically validating the association between direct and indirect notions, as well as examining the influence of internal and external ICT and integration practises on organisational performance.

The development of a conceptual model was informed by existing literature, and the interconnections between the primary constructs were explored through the examination of relevant research objectives. The researchers employed a quantitative methodology to validate the conceptual model, and causal links to clarify the findings of the data analysis.

7.2 An Overview of the Research

Multiple research projects have been conducted to examine the adoption and integration practises of information and communication technology (ICT) in separate instances (Van Wart et al., 2017; Gurzawska et al., 2021). However, despite individual assessments, there has been a lack of comprehensive and cumulative evaluation of these practises in an interdependent manner. Hence, the primary objective of this research is to examine the distinct impacts of information and communication technology (ICT) adoption on supply chain performance. Additionally, this study

seeks to explore the mediating role of integration practises in the relationship between ICT adoption and supply chain performance. Furthermore, it aims to investigate the combined effects of both ICT adoption and integration practises on the overall performance outcomes within the supply chain industry. The current lack of empirical research investigating the collective effects of ICT adoption practise and integration practises on the ability of supply chain organisations to achieve sustainable performance is noteworthy. Previous studies have established correlations between ICT adoption practise and cost and quality efficiency, as well as integration practises and coordination and collaboration towards strategic and operational performance objectives (Esfahbodi et al., 2016; Zhang et al., 2016 The effectiveness of integration practises as a mediator in the relationship between ICT adoption and supply chain performance remains unclear.

According to the studies conducted by Olise et al. (2014) and Liao et al. (2017), the concept of ICT adoption pertains to the systematic incorporation and utilisation of Information and Communication Technology (ICT) tools, systems, and services by individuals, organisations, or societies in their various operations, processes, and day-to-day activities. According to Kamal et al. (2011), the process of ICT adoption encompasses the acquisition, implementation, and integration of ICT solutions with the aim of improving efficiency, communication, and decision-making. In their study, Casalino et al. (2019) differentiates between two key aspects of ICT adoption: its role as a facilitator for enterprises to enhance productivity and competitiveness, and its significance as a resource for strategic, operational, and tactical planning within supply chain organisation. The respective effects were discussed below.

7.2.1 The effect of ICT adoption on supply chain integration

The result show that, ICT has a strong and positive effects on supply chain integration. It was found out that Information and Communication Technology (ICT) enhances effective communication through data sharing, and collaboration among stakeholders. Dubey et al., (2018) pointed out that ICT enables coordination, visibility, and efficiency throughout the supply chain through the adoption of applications such as electronic data interchange and cloud-based systems. Within the emerging economies supply chain companies can leverage on ICT to optimizes

inventory management, reduces lead times, and enhances decision-making (Samad et al., 2022), our analysis also indicated that, through sustainable adoption practice ICT integration can be utilised by Nigeria Supply chain companies and ICT deployment companies to fosters more strong partnerships between suppliers, manufacturers, and distributors within the supply chain industry. In fact, the integration can as well not only improve responsiveness to market demands, reduces operational costs, and increases customer satisfaction, but also, ultimately empowers organizations to adapt to dynamic market conditions, achieve greater supply chain resilience, and gain a competitive edge in the global marketplace.

More Investment in Information and Communication Technology (ICT) and integration practice can transform the supply chain industry in developing economies by leveraging ICT tools and platforms, such as data analytics, and mobile applications (Shaikh et al., 2022), our study corroborate with the study to demonstrate that, Nigerian businesses can improve communication and collaboration among supply chain stakeholders through sustainable ICT adoption that enhance information sharing and sustainable integration practice. According to Fessehaie, J., (2017) ICT-enabled supply chain integration has contributed to better inventory management and fostered stronger partnerships between suppliers and retailers, this is in support of our findings which confirmed that ICT integration in supply chain can enhance coordination and collaboration resulting in reduced operational costs, and increased customer satisfaction.

7.2.2 Effects of ICT adoption on customer integration

The outcome of this study shows that ICT integration have resulted in deeper customer engagement, increased loyalty, and higher satisfaction levels, thus, driving sustainable growth and success for businesses in the digital era. ICT has also facilitated direct communication channels between businesses and customers, such as social media platforms, live chat, and email, enabling faster and more efficient problem resolution and support. While some studies some studies suggested weak and negative effects of ICT on customer integration (Schwertner, K., 2018). Our findings revealed that ICT has a strong positive impact on customer integration resulting in more accessible, convenient, secure, and enhanced buying experience.

Furthermore, customer integration Through customer relationship management (CRM) systems, businesses can gather and analyse customer data, allowing for better understanding of preferences and behaviours. This leads to more targeted marketing efforts, tailored product offerings, and improved customer service.

7.2.3 Effects of ICT adoption on supplier integration

The outcome of this study indicated that Information and Communication Technology (ICT) has profound effects on supplier integration. By using ICT tools like Enterprise Resource Planning (ERP) systems, online portals, and electronic data interchange (EDI), businesses in Nigeria can enhance communication and collaboration with suppliers, enhanced data sharing enable efficient inventory management, and production planning which could lead to optimising supply chain efficiency. According to Ebinger and Omondi, (2020) ICT facilitates transparent and traceable supplier relationships, ensuring compliance with quality and ethical standards. Table 5.7 of our analysis indicates that EDI (Electronic Data Interchange) is crucial in supplier integration as it enables continuous and automated exchange of business documents between partners, the finding is also in line with the studies conducted by Min, (2019); Sarac et al., (2010) who indicated that EDI not only enhances communication, accelerates order processing, reduces errors, and improves supply chain efficiency but also, leads to better collaboration, cost savings, and faster response times in today's globalised markets and this study support our finding which confirms that the impact if ICT integration on supplier include stronger partnerships that leads to cost minimisation, and more competitive advantage.

7.2.4 Effects of ICT adoption on employee integration

According to Gupta et al., (2008) Information and Communication Technology (ICT) has significantly impacted employee integration in the workplace through unified communication and collaboration especially in the emerging economies. (Bingham et al., 2013) added that, ICT promotes a sense of connectivity among employees, regardless of geographical locations or organizational levels facilitated through virtual meetings, social networks, and online collaboration tools to foster a cohesive work environment and enhance team synergy. Our empirical result demonstrated

that MRP applications enables easy access to shared resources and knowledge, accelerating the operational process and promoting a more inclusive work culture. Furthermore, our result also demonstrate that ICT adoption empowers managers to optimize production schedules, inventory levels, and resource allocation, enabling them to make informed and efficient decisions specifically the use of APS enables considering various constraints and uncertainties, providing insights into potential risks and opportunities. With its ability to generate accurate forecasts and scenario simulations, APS can enhance strategic planning and aids in identifying cost-saving measures. Table 5.5 principal component analysis reveals the validity and reliability of ICT implementation for streamlining operations and ensuring timely execution as the finding demonstrate that APS enables managers to respond swiftly to changing market demands, improving overall performance and competitiveness in a dynamic business landscape, this also in line with the study of (Horváth et al., 2019) that APS has revolutionised employee integration by breaking down barriers and enhancing engagement, resulting in improved productivity and organizational cohesion within the internal consistency of managerial strategic planning.

7.2.5 Effects of ICT adoption on supply chain performance

Information and Communication Technology (ICT) has profoundly impacted supply chain performance. By integrating digital systems, ICT enhances visibility and transparency across the supply chain, enabling tracking and monitoring of inventory, orders, and shipments (Barreto et al., 2017). Successful ICT implementation fosters efficient inventory management, reducing stockouts and excess inventory costs. Additionally, Rathore, (2023) reported that ICT enables automation, reduces manual errors and operational costs. This study, however, provides evidence that ICT empowers supply chains to be more agile, responsive, and cost-effective, ultimately enhancing customer satisfaction and competitive advantage.

7.2.6 Effects of ICT adoption on strategic supply chain performance

Strategic supply chain performance refers to the ability of a supply chain to align its operations and processes with the overall strategic goals of the organization. It

involves optimizing the flow of goods, services, and information across the supply chain to achieve a competitive advantage and meet customer demands effectively. Information and Communication Technology (ICT) has modernised strategic supply chain performance, enhancing managerial decision-making by providing access to data, analytics, and collaboration tools (Zhong et al, 2016). Our study demonstrated that the multiple ICT adoption and integration effects can enable managers make informed choices swiftly, based on accurate insights, improving operational efficiency, resource allocation, and long-term planning of their organisational objectives.

According to Popovič et al., (2012) ICT enhances data visibility, allowing businesses to make informed decisions based on timely, valid, and reliable information. In table 5.7, our study reveals that a combination of intra and inter organisational ICT implementation such as Block chain and Radio Frequency Identification (RFID) technologies to track products in real time along the supply chain will promotes better communication and coordination, leading to improved operational efficiency and cost-effectiveness.

It was further suggested that ICT integration presents a strong impact that strategically aids supply chains to be more resilient, adaptable, and customer-centric, driving competitive advantage and long-term success.

7.2.7 Effects of ICT adoption on supply chain operational performance

Supply chain operational performance refers to the efficiency and effectiveness with which a supply chain executes its day-to-day activities (Zhong, R.et. al, 2016). It involves the smooth flow of goods, services, and information to meet customer demands and operational objectives (Horváth et al., 2019) in line with the literature, our study also emphasised that for organisations to have great effects on supply chain operational performance it is essential to undergo a restructuring process through implementation of technologies like RFID and IoT for tracking of inventory and shipments as well as reducing stockouts and improving demand forecasting. Automation and digitalization reduce manual errors, improving overall operational productivity (Ortiz et al., 2023). The integration of ICT in supply chains results in

smoother operations, reduced lead times, and increased cost-effectiveness, ultimately improving both supplier and customer satisfaction.

7.2.8 Effects of ICT adoption on supply chain tactical performance

Supply chain tactical performance refers to the ability of a supply chain to optimise its day-to-day operations and decision-making processes (Yusuf et al 2014); Gunasekaran et al., 2004). It involves efficiently managing inventory, logistics, and supplier relationships to meet short-term objectives and ensure smooth and effective flow of goods and services within the supply chain (Mentzer et al., 2000).

The empirical result reveals that ICT has significant effects on supply chain tactical performance by improving operational efficiency and decision-making, through successful implementation of Advanced technologies, such as RFID, IoT, and cloud computing, real-time tracking and monitoring of inventory and shipments as well as inventory management and reducing lead times will be achieved. These results are in line with prior literature (McLaren et al., 2002), who demonstrated that the implementation of digital platforms promotes better collaboration, communication negotiation and coordination among supply chain partners, fostering better responsiveness leading to improved tactical performance and enhanced competitiveness.

7.2.9 Effects of supply chain integration on strategic supply chain performance

The practices of integrating different supply chain components enhances visibility and transparency and enable better coordination and decision-making (Ahmed et al., 2019). Supply chain organisations concerned with challenges of supply chain integration on strategic supply chain performance such as data standardization, compatibility issues between systems, resistance to change from stakeholders, and the complexity of managing multiple partners, can seize the opportunities of overcoming these hurdles as our study suggested effective communication, collaboration and continuous improvement can be achieved, through integrating compatible systems, engaging employees and suppliers training to overcome resistance to change, while building strong partnerships for better coordination and mutual benefits. The finding was further supported by the studies of Chen et al.,

(2014) that, organisations Integrated systems facilitate collaborative relationships with suppliers and partners ultimately driving strategic objectives and strengthening organization's position in the supply chain industry.

7.2.10 Effects of supply chain integration on operational supply chain performance

The study results also show that supply chain integration significantly impacts operational supply chain performance by connecting different stages and entities, integration enhances visibility and information sharing. The findings oppose the study of (Karanja, 2014) that, data compatibility issues and organisational resistance to change can lead to delays, miscommunications, and inefficiencies, affecting the smooth flow of goods and services within the supply chain. The study further suggested that successful supply integration also fosters better coordination among suppliers and partners, ensuring smooth order fulfilment, minimise errors and communication gaps. The finding was in line with the works of (Parker et al., 2002; Kuk et al., 2004; Smith et al., 2011) that, Supply chain integration positively impacts operational supply chain performance by restructuring processes, enhancing communication, and optimizing resource allocation. The systematic connection between supply chain components leads to improved efficiency, reduced lead times, and better coordination, resulting in higher productivity and customer satisfaction.

7.2.11 Mediating role of supply chain integration in the relationship between ICT adoption and supply chain performance

The mediating role of supply chain integration in the relationship between ICT and supply chain performance refers to how ICT implementation is used to influences supply chain performance (Asamoah et al., 2021). Supply chain visibility and transparency are very critical and one of the reasons for collaborating with suppliers to achieve sustainable performance outcome. As industries are under higher pressure to reduce uncertainties and improve collaboration and coordination of supply chain activities, our study suggested that, Information sharing and network collaboration become fundamental and crucial to ensuring effective communication and coordination of supply chain activities as well as responsible for translating the

indirect benefits of ICT adoption into tangible performance improvements, driving customer confidence, satisfaction and sustainable performance. The above finding is in line with the studies of (Walker et al., 2008; Gereffi et al., 2016), that, the cross functional supply chain Integration practices not only impact within the scope of the supply chain industry, but also with stakeholders such as governments and other private companies, just as closer relations with governments support compliance with current regulations and have an indirect impact on supply chain performance by enhancing collaboration, communication, and data sharing among supply chain partners. The mediating relationship in our result complements the findings that, supply chain integration helps interpret the direct and indirect benefits of ICT adoption into tangible supply chain performance improvements, ultimately driving competitiveness and enhancing customer satisfaction.

7.2.12 Combined role of ICT adoption and supply chain integration practice on supply chain performance

The role of both ICT and supply chain integration practices on supply chain performance is highly influential. Widespread debates in the literature, offer explanations of the positive correlations and effective ICT and integration practices on supply chain performance that, ICT facilitates real-time data exchange, analytics, and communication (Lee et al., 2015; Gunasekaran et al., 2004) while integration practices promote seamless collaboration among supply chain stakeholders (Parker and Anderson, 2002; Kuk, 2004; Smith, 2011). Together, they streamline operations, optimise inventory management, and enhance responsiveness (Asamoah et al., 2021). The result of this study is in line with the previous studies but differs from the findings by investigating and discovering the synergistic effect of these factors combined as they together enhance decision-making, demand forecasting accuracy, and risk management, ultimately boosting supply chain performance. Furthermore, the total impact drives supply chain resilience, providing supply chain management with sustainable disruption options to adapt quickly to market changes and achieve sustained success in a dynamic business landscape.

7.3 Managerial implications of the study

This study provides insights into how organisations can successfully implement ICT adoption and integration, but the successful implementation requires proactive management, effective collaboration, and a focus on data-driven decision-making. The individual effects of the practices provide enabling ground for adapting the practices to achieve successful implementation cannot be unconnected with organisational challenges.

Our study provides paradigms shift as best options for management to aspire for combined impacts of the practices to overcome the challenges and leverage on the individual and cumulative impact for competitive advantages and sustainable performance outcomes. Fig, 5.6 furthermore, the visibility of the supply chain is substantially improved. With real-time tracking of inventory, orders, and shipments, managers gain a comprehensive view of the entire supply chain. This empowers them to make proactive decisions, reduce lead times, and minimize stockouts effectively.

This research also provides insight for regulators and policymakers. The study suggested that policymakers need to focus on the vital role they need to play in ensuring successful implementation of ICT adoption and integration practices. They can create supportive regulatory frameworks that encourage investments in technology and infrastructure. Additionally, policy makers can provide financial incentives and grants to promote technology adoption among supply chain organizations. By fostering collaboration between public and private sectors, policymakers can facilitate knowledge sharing and standardization, leading to more efficient and cost-effective ICT integration. Moreover, they can address data privacy and security concerns through appropriate legislation, inspiring confidence in technology adoption and driving its widespread success in supply chains. Specific production or importation support policies for ICT tools that will enhances communication across and improve both the strategic and operational performance of the supply chain should be initiated. By facilitating unified information sharing and collaboration between suppliers, manufacturers, and distributors, managers can achieve smoother operations and quicker issue resolution, resulting in reduced delays.

Research and development (R&D) should be encouraged to ensure successful implementation of ICT adoption for improving supply chain performance. R&D efforts drive innovation, leading to the development of cutting-edge technologies and solutions tailored to supply chain needs. It ensures continuous improvement, efficiency, and competitive advantage in the dynamic business environment Furthermore, the research shows that a well-defined framework for the adoption of ICT is crucial for managers to develop data driven insight and be able to collect and analyse data, optimize processes, and make informed decisions to drive continuous improvement.

Our result also emphasises the importance of Innovation support which is necessary to provide promising technologies to ensure successful ICT and integration implementation in supply chain organizations, the innovation support should encompass tailored technology solutions, comprehensive training programs, continuous monitoring, and fostering a culture of adaptability and openness to change. The implementation of ICT also fosters increased agility in the supply chain. By leveraging technology, managers can respond promptly to market changes and disruptions, mitigating their impact and enhancing overall responsiveness. ICT adoption and integration practices can yield cost savings as well Improve processes, coordination, and lead to reduced costs in inventory management, transportation, and warehousing. Supply chain organizations that effectively adopt and integrate ICT gain a competitive advantage. Managers can differentiate their services, expand into new markets, and foster stronger partnerships by leveraging technology effectively.

In conclusion, the successful implementation of ICT adoption and integration practices in the supply chain can drive improved efficiency, cost savings, and increased customer satisfaction. To capitalize on these benefits, managers should invest in appropriate technologies, provide workforce training, and instil confidence in automated operations by establishing robust data security measures.

7.4 Theoretical implications

Theoretical implications of ICT adoption and integration practices in the supply chain industry contribute to the advancement of management and operations theories. By studying the impact of technology on supply chain performance, researchers can

refine existing theories or develop new ones to explain the relationships between technology adoption, efficiency, and competitive advantage. Additionally, understanding the role of ICT in enhancing visibility, coordination, and decision-making aids in the development of frameworks and models that guide supply chain optimization. These theoretical insights provide a foundation for informed managerial decisions, leading to improved supply chain performance and sustainable competitive success.

The dependency theory is explicit about the purpose of the firm: satisfying external stakeholders, i.e., customers, investors, and other stakeholders (organisations) that are affected by the supply chain activity. This idea is acknowledged and elaborated on by stakeholder theory. Stakeholder theory suggests that each stakeholder represents different values that the focal firm should try to realise. The aim of stakeholder theory is to satisfy a broad array of stakeholder groups based on their specific demands. Stakeholder orientations result in firm competitiveness because the focus on stakeholder satisfaction allow a firm to develop trusting relationships with their stakeholders, giving these firms the opportunity to deal better with changes in the environment and consequently spur innovation.

For a long time, the resource-based view was the most dominant paradigm in management field. The resource-based view suggests that an organisation's unique resources, its competences to deploy those resources and its capabilities that are derived from bundled resources provide a source for growth and competitive advantage (Ketchen and Hult, 2007). Some researchers argued that possessing and having access to valuable, rare, inimitable, and non-substitutable resources would provide competitive advantage (Barney, 1991; Grant, 1996). But other researchers suggest that value is created when these resources are evaluated, manipulated, and deployed within the context of business environment (Choi et al., 2010). Thus, resources require a purpose to be structured, bundled, and leveraged. Purpose and value are given to an organisation's resources through directing them with an external orientation, i.e., an orientation towards the needs of customers and society.

The resource-based view is in essence internally oriented and implicitly embeds supplier resources and capabilities in the process of structuring, bundling, and

leveraging resources to obtain competitiveness and meet the needs of customers and society. Therefore, other researchers have suggested that rather than internal resources, the firm also needs to deal with its external resources, i.e., its external dependencies to achieve competitive advantage (Hillman et al., 2009; Radhakrishnan et al., 2018; Kim et al., 2020). This ideal is reflected in dependency theory, which looks beyond the boundaries of an individual firm. It argues that firms are not self-contained in fulfilling demands and therefore need to establish effective linkages with suppliers, and other partners to access resources and capabilities required to deliver customer and societal value (Van Weele, 2018). It centres on how some firms become reliant on others for needed inputs such as goods and materials, and how firms can manage such relationships (Pfeffer and Salancik, 1978). The asymmetric interdependence that exists in these inter-firm relationships is critical to reduce environmental uncertainty for some firms (Ketchen and Hult, 2007). Developing effective relationships with the most qualified suppliers seems to be a prerequisite to secure the external resources that are required to create customer value and, hence, foster the firms' competitiveness (Van Weele, 2018). As supply chain members work together, they often become more dependent on each other. Thus, resources dependence theory has a high level of importance in the supply chain context (Ketchen and Hult, 2007).

Another organisational theory relevant to this research is network theory, which explain relationships among linked entities (Thorelli, 1986). Supply chains are in essence, a form of network, thus, network theory has the potential to reveal interesting truths about supply chains (Morgan et al., 2007; McCarter and Northcraft, 2007). Strong and week ties are key concepts with network theory. As the name suggest, strong ties involve firms that are coupled, and loose ties involve firms with more tenuous links (Granovetter, 1973). Each type presents certain advantages to supply chains. strong ties offer greater reliability, while loose ties enhance flexibility. In the traditional supply chains, strong and weak ties are formed without concern for the overall network alignment. In contrast, best value supply chains approach these issues strategically. A combination of strong and weak ties that matches supply chain needs is created to maximise supply chain performance.

In the end, the Porter theory, resource-based view of the firm, the dependence theory, and stakeholder theory each emphasise a different element of how firms may create value through supply chain collaboration. The resource-based view of the firm is more concerned with the management of a firm internal resources and capabilities that may satisfy external stakeholders of the firm. In the resource dependency theory, the firm's dependence on other external parties, such as suppliers, is critical. Finally, the stakeholder theory focuses on the diverse stakeholder perspectives a firm needs to balance, weigh, and respond to. It argues that for achieving competitive advantage, a firm and its supply chain partners should create in parallel customer value, society value and shareholder value. This is what sustainability and sustainable purchasing is all about.

The study is grounded in the resource-based view (RBV) of the firm as the theoretical lens for the interrelations among the adoption of ICT, integration practices and performance outcome of supply chains. The main argument of the RBV is that the firms' resources are the source of competitive advantage (Barney, 1991). These resources can be both assets and capabilities, which reflects on the one hand, tangible technologies, and other things to be used in offering products and service to customers, and on the hand, it refers to repeatable patterns of actions in the use of resources (Sanchez, 1996). Following Wade and Hullan (2004) and Jeffers et al. (2008), this research considers the ICT as such potential assets, which are complemented by supply chain integration capabilities. Having resources is not enough as a source of competitiveness. However, the combination of assets and capabilities into what is labelled a bundle of assets could be a source of supply chain performance. the RBV helps to understand how some companies gain better performance returns than others from the same adoption of ICT.

7.5 The contribution to methodology

Exploratory Factor Analysis (EFA) is a valuable statistical technique to evaluate test scales of ICT adoption and integration practices (Dimitrov, 2014). By subjecting survey responses to EFA, this research was able to identify underlying factors that explain the observed variability in the data. (Mackenzie et al., 2011) EFA helps to assess the dimensionality of the scales and determine if they capture the intended

constructs effectively. Additionally, the use of EFA in this research aids the identification of potential measurement errors, by refining and validating the scales to ensures the reliability and validity of the measurements as well as enhancing the strength and accuracy of research findings related to the ICT adoption and integration practices.

According to Tripathy et al., (2016) Structural Equation Modelling (SEM) offers a valuable methodological contribution to studying ICT adoption and integration practices in the context of supply chains. In line with previous research, this study employs SEM, to analyse the complex relationships among the multiple variables and assess the direct and indirect effects of ICT adoption and integration practices on supply chain performance. According to Alhumaid et al., (2021) SEM allows the integration of latent constructs and observed variables, enabling a comprehensive examination of various factors influencing technology adoption. Through path analysis and model fit assessment, SEM provides a rigorous approach to validate theoretical frameworks, identify critical drivers of successful integration, and offer actionable insights for organizations aiming to optimize their supply chain processes through ICT adoption and integration practice.

Another important aspect of Structural Equation Modelling (SEM) lies in its ability to effectively test interaction effects between variables. Unlike traditional regression models. SEM allows researchers to explore complex interactions among multiple variables simultaneously, offering a more comprehensive understanding of the underlying relationships (Alhumaid et al., 2021). In this study latent constructs and observed variables were used through SEM analysis to capture the interdependencies and interplays among the research factors thus, revealing week interactions that might be missed by simpler methods. Through model estimation and examination of modification indices, SEM enables us to identify significant interaction effects, providing valuable insights into the complexities of the studied phenomenon and contributing to more robust theories and practical applications.

Using a confirmatory approach to test research objectives in ICT adoption and integration practice offers several advantages to this study. Confirmatory factor analysis was used in this study to confirm specific and testable objectives based on

existing theories or prior research. This focused approach increases the precision and clarity of the study, leading to more accurate results and conclusions. Secondly, confirmatory methods, Structural Equation Modelling (SEM), was also applied to evaluate the complex relationships among the variables, allowing for statistical testing of the theoretical models fit. This approach ensures that the research findings are reliable, valid, and generalizable, enhancing the credibility and rigor of the study in the field of ICT adoption and integration.

Another key benefit of SEM techniques is that it can be employed to test significant differences between research variables by comparing alternative models using chi-square difference tests or nested model comparisons. By assessing the fit of competing models, this study applies SEM technique to determine if adding or removing paths significantly impacts the relationships between variables, providing valuable insights into their significance.

7.6 Empirical contribution

This study examines the empirical relationship between ICT adoption, integration practices and supply chain performance in providing concrete evidence of the impact of technology on supply chain efficiency and effectiveness. Through data analysis and statistical methods of Structural Equation Modelling (SEM), the study also established causal links and quantify the effects of ICT adoption on various performance metrics. The empirical evidence can help organizations make informed decisions about technology investments, process improvements, and strategic planning. Furthermore, this research enriches academic literature by contributing to the advancement of supply chain management theories and offering practical insights for businesses aiming to enhance their supply chain performance through ICT integration.

In this respect, one major empirical research contribution to this study of ICT adoption and integration practices on supply chain performance is the identification of specific technology-driven interventions that lead to significant improvements. Through data collection and analysis, the research defines the most effective ICT tools, adoption strategies, and integration implementation approaches that enhance supply chain efficiency, visibility, and responsiveness. This empirical evidence

identified can helps organisations focus their resources on the most impactful areas, resulting in tangible performance outcomes. Additionally, it contributes to the development of best practices and guidelines, guiding other supply chain managers in their technology adoption journey, ultimately driving industry-wide improvements in supply chain performance.

Another empirical contribution of this study, thus, lies in the fact it provides confirmation regarding the role of the development of a conceptual model serves as a valuable empirical contribution to the study of ICT adoption and integration practices. This model provides a visual representation of the relationships between various variables and constructs related to technology adoption in the supply chain. By synthesizing existing literature and empirical findings, the conceptual model offers a coherent framework to guide future research and empirical investigations. It enables researchers to identify key factors, propose objectives, and test the theoretical underpinnings of ICT integration. This conceptual model enhances the understanding of the complex dynamics involved and forms the basis for more focused and data-driven empirical studies in the field.

The empirical findings also demonstrate that sustainable practices are direct sources of sustainable competitiveness, but their performance impacts are improved when facilitated through agile practices. This indicates that incorporation of ICT is a fundamental facilitator for optimising the impact of implementing integration practises on organisational performance. Lastly, the empirical contribution of this study relies on the individual and reliable data collected from a large sample proportion of (303 respondent organisations). The research declares that the empirical significance of a large set of data collected from highly knowledgeable and experienced supply chain professionals working in an emergent and digitally aspirant economy rests on the data's empirical significance.

7.7 Summary of the research discussions

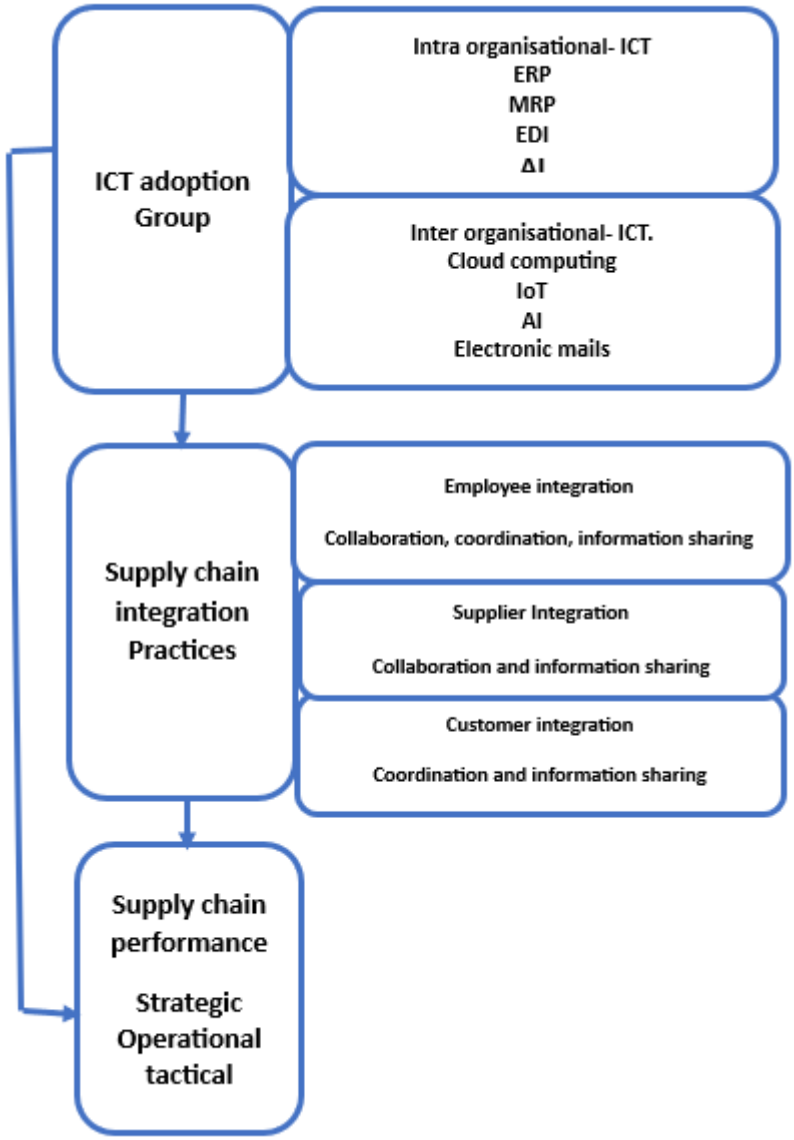

Figure 7. 1 Summarising the discussion of findings.

This chapter discusses the findings of the research and their implications. Beginning with a discussion of various dimensions on the impact of ICT adoption and integration practises on supply chain performance, the chapter then provides background information. Firstly, the study examined the separate effects of ICT adoption and integration practises on strategic and operational supply chain performance. Secondly, the mediating impact of integration practises on the relationship between effects of ICT adoption practises on the performance of supply chain organisations was discussed. Thirdly, the discussion centred on the government and private

company practises and stakeholders that have the greatest influence on specific performance objectives.

From the results, there is strong evidence that there is active support and participation from the Nigerian government and other private companies in the supply chain industrial sector resulting in ICT resource capabilities being fast improving and can overcome the challenges of sustainable ICT and integration implementation practices. The results show that sustainable practices play a key role as a mechanism for the development of both large, small, and medium enterprises within the supply chain sector and across other sectors within the emerging economy.

In addition, the results provide additional support for the proposition that all indicators of integration practises had a strong positive and statistically significant effect on performance outcomes. Visibility and collaboration within the supply chain appeared to be the greatest predictor of operational performance objectives. The research also revealed that the integration capabilities of employees, customers, and suppliers appeared to have the greatest influence on both strategic and operational supply chain performance. Integration of stakeholders had the least impact on performance outcome. This finding raises intriguing concerns concerning the nature and extent to which Nigerian industrial sectors invest in ICT implementation research training and development for management, other employees, and suppliers. This is an essential topic for future study

Chapter Eight: Summary, Conclusion and Recommendation

8.1 Introduction

This chapter summarises the study's main aims, and research methodology adopted to achieve the objectives as presented in chapter eight of the study's findings. In addition, it is essential to restate how the research objectives were achieved and describe the justification for their approval and validation. This chapter also describes the contribution of this study to theory (literature) and practise by individually defining how each of the targeted objectives were addressed. The chapter concludes with a discussion of the study's limitations and recommendations for future research.

8.2 An overview of the study

The main aim of this study is to explore the effects of ICT and supply chain integration on supply chain performance in Nigeria. This is envisaged because there is a lack of empirical study on the roles of various dimensions of ICT and integration on supply chain performance in Nigeria and yet ICT remains central to the government's ambition to develop a digital economy. The government has an Information and Communication Technology Development Agency (ICTDA) as a vehicle to foster diffusion of ICT adoption with the agency under the purview of the Ministry of Information Technology and Digital Economy. In addition, the proposed research will investigate the cumulative effect of inter/intra-organizational ICT and supply chain integration on the overall supply chain performance. The current debates on ICT adoption and integration in supply chain performance revolve around two main aspects. ICT proponents (Alzoubi et al., 2020; Abdullahi et al., 2023) argue that the strategic implementation of Information and Communication Technology (ICT) can significantly enhance supply chain efficiency, visibility, and collaboration, leading to improved overall performance. Conversely, critics Padhy et al., (2011); Liu et al., (2012) express concerns over the potential challenges related to data security, interoperability, and the cost of integrating new technologies. Striking a balance between leveraging ICT's benefits while addressing its associated drawbacks remains a focal point for businesses seeking to optimise their supply chain operations in an increasingly digitalised landscape. This study however, substantiated on the result of immense impact of investment in ICT in supply chain industry especially in emerging economies that are struggling to adopt ICT alongside implementation of sustainable integration practices, the concept of cumulative impact of ICT adoption and

integration practices emerged to enhance higher performance in the supply chain, manufacturing, and other sectors.

The empirical evidence suggests that the effects of ICT adoption and implementation of sustainable integration practise have greater positive effects on the performance of an organisation; however, the extent of its effects on sustainable performance is not well studied.

Therefore, the proposed study aims to determine the impact of integration practise in the relationship between ICT adoption and Sustainable supply chain performance.

This study aims to explore the effects of ICT and supply chain integration on supply chain performance in Nigeria. This is envisaged because there is a lack of empirical study on the roles of various dimensions of ICT and integration on supply chain performance in Nigeria and yet ICT remains central to the government's ambition to develop a digital economy. The government has an Information and Communication Technology Development Agency (NITDA) as a vehicle to foster diffusion of ICT adoption with the agency under the purview of the Ministry of Information Technology and Digital Economy. In addition, the proposed research will investigate the cumulative effect of inter/intra-organizational ICT and supply chain integration on the overall supply chain performance. The research challenges outlined here will be examined and clarified with data drawn from organisations in Nigeria.

A conceptual framework consisting of three concepts were developed namely, ICT adoption, integration practice, and supply chain performance. The outline of the conceptual framework is that the effects of ICT adoption and sustainable integration practice will provide the necessary atmosphere for achieving improved supply chain performance. In this regard, four research objectives were proposed to test the validity of relationships specified in the conceptual framework. A survey by questionnaire was employed to test the impact of ICT adoption and integration practice on the performance of supply chain. A total of 450 questionnaires were administered to ICT government development agency and supply chain organisations across Nigeria. The responding organisations were selected randomly from across a wide range of industries. The analysis, and results of which were used as a basis for making inferences and reaching conclusions. Data collection from the responding organisations was focused on their level of inter ICT, intra ICT adoption and Supplier, customer and employee integration practice and impact on strategi, operation and tactical organisational performance. Data analysis validated the three research objectives and were defined from the perspective of the research conceptual framework. The results from the

data analyses corroborated previous studies that suggested that there is a significant relationship between the main research variables.

8.3 Addressing the research objectives

ICT adoption and integration practice refer to the process of incorporating Information and Communication Technology (ICT) tools, systems, and strategies into an organization's existing operations to enhance productivity and efficiency (Caperna, A., 2012). It involves the implementation of software, hardware, and communication technologies that streamline data management, communication, and decision-making across the entire business ecosystem. Key practices include adopting enterprise resource planning (ERP) systems, cloud computing solutions, Blockchains, and Internet of Things (IoT) devices, RFID, MRP, and APS. Successful integration requires careful planning, employee training, and aligning ICT initiatives with the organization's overall goals, ensuring continuous collaboration among various departments and stakeholders for optimized performance and competitive advantage (Kaplan et al., 2004). Presented below are the research objectives and the answers as provided by the data analysis.

8.3.1 Examining the effects of ICT adoption on supply chain integration practice?

According to (Rogerson et al., 2020) one of the most significant effects of ICT adoption is enhanced visibility throughout the supply chain. The result of this study shows that the adoption of ICT tools, such as real-time tracking systems, supply chain analytics, and data-sharing platforms, provide stakeholders with comprehensive insights into inventory levels, production processes, and shipment status. (Schmidt et al., 2019) added that supply chain transparency enables better decision-making, facilitates faster problem resolution, and fosters collaboration among supply chain partners. These result support the findings of (Alreshidi et al., 2018) who suggested that Communication barriers are broken down using collaboration platforms and cloud-based solutions, allowing timely data exchange and smoother communication among suppliers, manufacturers, distributors, and customers. The major reason for the adoption of ICT is cost savings which are a direct result of ICT integration on supply chain performance outcome (Zailani et al., 2012). The result show that, implementation of automated processes, reduced manual interventions, minimised errors, and contribute to overall cost efficiency in supply chain management. Just as optimised inventory levels and transportation routes further add to cost reduction and resource optimization.

These results corroborate the findings of a great deal of the existing literature in ICT adoption and risk management capabilities. Companies can use data analytics and scenario planning to identify potential supply chain risks and vulnerabilities (de Araújo et al., 2020). The study supported the findings that the foresight empowers businesses to develop contingency strategies, ensuring resilience and preparedness in the face of uncertainties.

Shahid et al., (2018), who suggested that ICT adoption also has a profound impact on customer satisfaction. This study suggested that, through improved data analysis and customer insights, businesses can better understand customer preferences and expectations. The enhanced supply chain integration will, therefore, enables on-time deliveries, personalised services, and improved customer experiences, fostering loyalty and repeat business.

Other researchers stressed that implementing inter and intra ICT solutions are means for engaging supply chain organisations with communities (Power, 2005). Also, Lee et al., (2012) demonstrated that inter organisational ICT adoption fosters increased connectivity and communication channels, enabling meaningful engagement between individuals, organizations, and local stakeholders. Gallaugher et al., (2010) supported that, ICT tools, such as social media platforms and online forums, empower communities to share ideas, voice concerns, and collaborate on initiatives. In turn, community engagement drives ICT adoption, as technology serves as a bridge to connect individuals with relevant information and resources. This research, however, confirms that, mutually reinforcing relationship leads to enhanced civic participation, social cohesion, and the collective pursuit of shared goals, ultimately benefiting both the community and IT compliant organisations. ICT innovation for environmental or Community engagement can open new markets and opportunities for the supply chain companies (Casciani et al., 2022). Implementing intra ICT organisational initiatives can make it easier to recruit and retain good workers, which, in turn, increased employee engagement while sustainability through implementation of Effective intra ICT thrives. (Scholl, 2003).

This study provides strong empirical evidence that the implementation of sustainable ICT adoption practices will lead to improved operational performance and better strategic performance in terms of cost, quality, speed, reliability, flexibility, and long-term innovation objectives.

Empirical literature of other studies reveals that ICT adoption enhances strategic performance by enabling more stakeholder integration, facilitating real-time communication, and automating processes (Ghobakhloo et al., 2021). Our study also

corroborates that, the implementation empowers informed decision-making, enhance process management, and expands market reach, impliedly, effective ICT integration supports agility and competitiveness, resulting in improved strategic outcomes, growth, and adaptability for organizations.

8.3.2 Investigating the effects of integration practice on supply chain performance?

Integration practices such as supplier integration provide stakeholders with improved visibility into supply chain activities (Wang et al., 2020). This study provide evidence that supply chain transparency enables better decision-making, quicker issue identification, and proactive problem-solving, leading to increased operational efficiency. Gambetti et al., (2013) in their study argues that supplier and stakeholders' integration foster continuous communication and collaboration among supply chain partners, reducing communication delays and errors and that ICT integrated organisations benefit smooth exchange of information, enables better coordination, minimizes lead times, and enhances overall responsiveness to market demands.

Customer integration strategies are more agile and capable of adapting to changing market conditions and unforeseen disruptions (Carvalho et al., 2012). The benefit of adaptability and flexibility are well defined in the research literature that, it enhances information sharing and support coordinating efforts to overcome new challenges and leverage new opportunities allowing companies to develop robust contingency plans and minimize the impact of potential disruptions. In line with the above, our result provided that efficient integration practices lead to better customer service by improving order accuracy, and personalized experiences, thus the result of our survey confirm that, satisfied customers are more likely to become loyal and advocate for more services and products thereby positively impacting overall business performance.

According to (Yusuf et al. 2020) increasing availability and falling cost of ICT applications encourage a culture of continuous improvement in Integration and supply chain performance. Our study further confirms that due to falling cost of IT software's, government, and private companies from developing economies can afford technologies, implement targeted objectives, empower individuals, businesses, and communities to enhance communication, streamline processes, and develop new solutions, fostering progress across various sectors and promoting global connectivity. In comparison, previous studies (Huo et al., (2021) confirm that, IT integrated organisations achieve more competitive

advantages by adapting swiftly to market changes, enhancing customer experiences, and optimizing resource allocation while, non-IT organizations might struggle to keep pace with technological advancements and lack the same level of operational optimization.

8.3.3 Exploring the mediation effects of integration practice in the relationship between ICT adoption and supply chain performance?

Integration practices act as a mediator in the relationship between ICT adoption and supply chain performance by facilitating the effective implementation and utilization of Information and Communication Technology (ICT) tools and a necessary condition to enhance overall supply chain efficiency and effectiveness.

That is, integration practices ensure that ICT systems and tools are continuously integrated into the supply chain processes (Boyens et al., 2015). Smooth flow of data and information across different stages of the supply chain, fostering real-time visibility and collaboration are enhanced through successful implementation. Somapa et al., (2011) added that, Integration practices establish standardized communication channels and data-sharing protocols. This allows for efficient sharing of information among supply chain partners, enabling better coordination, faster decision-making, and improved responsiveness to market changes.

The examination of indirect effects confirmed that integration mediate the links between sustainable ICT adoption practices, and operational supply chain performance. These findings show that the implementation of sustainable integration practices simplifies the implementation of sustainable ICT adoption practices. Integration practices help align ICT adoption with specific supply chain functions, streamlining workflows, and eliminating redundancies (Rejeb et al., 2021; Qrunfleh et al., 2015). This optimizes resource allocation, reduces manual interventions, and enhances operational efficiency. Integration enables the collection and analysis of data from various ICT systems, generating valuable performance metrics. These metrics offer insights into supply chain performance, identify areas for improvement, and support data-driven decision-making.

Our findings further confirm that Integration practices promote collaborative environments where stakeholders can share knowledge and best practices. This is in line with the studies of Rao, M., (2012) who proposed that, integration fosters a culture of continuous learning, enabling companies to harness the full potential of ICT tools and leverage collective expertise for supply chain optimization. Gunasekaran et al., (2008) suggested that, through integration, ICT adoption helps create a more agile and adaptable supply chain. Real-time

data and communication enable quick responses to change in demand, supply disruptions, and market trends, enhancing supply chain resilience.

Integration practices facilitate the iterative improvement of ICT tools and supply chain processes and through regular evaluations of ICT adoption effectiveness led to ongoing enhancements, ensuring that the technology continues to align with evolving business needs and industry trends (Gattorna, J. ed., 2017). integration practices serve as a crucial intermediary between ICT adoption and supply chain performance. By optimizing ICT implementation, data exchange, collaboration, and integration practices can empower companies to harness the full potential of technology and drive tangible improvements in supply chain efficiency, visibility, and responsiveness, ultimately leading to enhanced overall supply chain performance.

8.3.4 Examining the extent of combined effects of ICT and integration practice on the performance of supply chain?

The cumulative effects of Information and Communication Technology (ICT) adoption and integration practices on the performance of the supply chain are extensive and transformative. Reported in our research are the key dimensions that highlight the profound impact of ICT and integration on supply chain performance, ICT adoption streamlines supply chain processes, automates repetitive tasks, and reduces manual interventions, leading to improved operational efficiency on one hand and on another, integration practices further optimize workflows, minimising delays and reduce costs throughout the supply chain (Chopra and Sodhi, (2004). Other studies, Mastos et al., (2021) asserted that ICT tools enable real-time tracking, monitoring, and analytics, providing stakeholders with comprehensive visibility into supply chain activities. Guggenberger et al (2020) further argues that integration practices aggregate data from various sources, facilitating seamless data sharing and enhancing overall supply chain transparency.

Other studies (Sundram et al., (2020) added that integration practices facilitate smooth communication and data exchange among supply chain partners. Pirinen, (2016) Further view ICT tools as enablers for continuous collaboration, breaking down communication barriers, and fostering a more cohesive and responsive supply chain ecosystem. Cumulative ICT adoption and integration make the supply chain more agile, adaptable, and enhanced real-time data and analytics which enable quick responses to change in demand, supply disruptions, and market dynamics, enhancing the supply chain's ability to anticipate and meet customer needs.

The combination of ICT and integration practices provides data-driven insights and performance metrics, enabling informed decision-making. Access to accurate and timely information empowers supply chain managers to make strategic choices, leading to optimized resource allocation and improved outcomes (Yusuf et al. 2020). The enhanced efficiency, visibility, and responsiveness achieved through cumulative ICT and integration positively impact customer satisfaction. Meeting delivery timelines, reducing order errors, and providing personalized services result in higher customer loyalty and repeat business. The comprehensive data and analytics enabled by ICT and integration practices strengthen supply chain risk management. Companies can proactively identify potential risks, develop contingency plans, and minimize the impact of disruptions.

Theories supporting ICT integration include the explaining user adoption, Porters five force theory and the Resource-Based View (RBV) emphasizing IT as a strategic asset, and the Diffusion of Innovations theory elucidating technology dissemination. These theories guide organizations in implementing effective ICT integration practices for enhanced productivity and competitiveness this study applies the theories to lay foundation of the argument for confirming the cumulative ICT adoption and integration contributing to sustainable supply chain practices, improving visibility, allowing better environmental monitoring resource optimization, and helping companies achieve their sustainability goals. For this study the RBV and porters five force theory were used to support the justification for the impact of the cumulative effects of ICT adoption and integration practices on supply chain performance to be far-reaching, that together, they empower businesses to create more efficient, agile, and customer-centric supply chains, fostering competitive advantages and sustained success in a dynamic and evolving business landscape.

The study supports the role of direct and indirect effects of ICT and integration capabilities in enhancing the performance outcomes of sustainable supply chain performance outcome. It confirms that integration practice is an effective mediator of ICT effects on supply chain performance. This has significant contribution to the strategic and operational supply chain performance outcome. As several studies on the effects of ICT and integration practice have rarely looked at these practices from the perspectives of combined effects (direct and indirect) impact. This is the first empirical study that established the cumulative effect of ICT adoption and integration practices on the extent to which organisations could translate combined effects of adoption and integration of ICT into higher impact on performance outcome and competitive advantage. Therefore, industries and business organisations struggling to find innovative solutions for improved performance and competitive

advantage, this empirical study recognised combined effects of ICT adoption and integration implementations as substantial extension for higher organisational performance outcomes. So also, our findings hold true for successful supply chain revolution through combined impact of ICT solutions as innovative ways to remain competitive in today's global competitive land scape.

Our findings further concluded that, a combination of supplier, customer and stakeholder Integration practices provides higher impact on supply chain performance by enhancing coordination, visibility, and responsiveness. They together enable real-time data sharing, reducing delays and inefficiencies, equally fostering collaboration among stakeholders, improving demand forecasting, inventory management, and order fulfilment. These effects lead to streamlined operations, reduced costs, and improved supplier and customer satisfaction.

8.4 The Research Recommendations

This study has examined the role of ICT adoption and Integration practices in enhancing the overall and sustainable performance of the Nigerian ICT and supply chain industry. The findings of this study have significant opportunities for further research direction and some limitations as academic traditions, researchers may encounter several limitations that can impact the scope and generalisability of their findings.

Agile and resillient digital technologies like manufacturing resource planning I & II, ERP automation system, artificial intelligence, robotics, industry 4.0, Blockchain, drones, and mobile devices will avail Nigerian supply chain organisations with innovative solutions as game changing options for ICT inclined companies and the overall supply chain industry (Lee et al., 2018). As Nigeria and other African countries are battling with energy crisis the research offers huge potential to enable the creation of new sustainable Green products through ICT adoption practices leading to using low energy and resource input; adapt to customer needs for high quality; personalisation and customisation of low-cost operation; digital supply chain, with connectivity between manufacturers, customers and suppliers, increasing speed and manufacturing efficiency, and enhancing opportunities for network collaboration; greater freedom of product design; delivery of innovative new products; higher performance and more flexible manufacturing systems, delivering better quality and cost performance; and maximising complementary services.

Also, the above attributes are less identified and defined in the context of the literature as related to the emerging economies as such the inadequate availability of related literature

on the context was discovered, defined, and treated as barries which will further enrich the literature on the reasons for declining performance of less ICT integrated companies in the Nigerian supply chain industry. Especially what role can SMEs play in enhancing the sustainability performance of the Nigerians ICT and supply chain industry? How can SMEs' participation in ICT and integration practice projects be improved? What benefit will the industry gain from active inclusion of SMEs in ICT and integration practice? how SMEs are using digital/data analytics technologies as a potential game-changer? What benefits could digital technologies have in enhancing strategic performance? How do supply chain organisations best manage ethical and legal risks arising from technologies implementation? Answering these questions will go along way in enhancing ICT integration in the supply chain digital landscape.

8.5 FUTURE RESEARCH

Future researchers can explore areas on ICT to investigate: "The impact of digital transformation on supply chain resilience, sustainability, and agility in response to evolving market dynamics and disruptions on emerging economies."

The aims of the research will include, investigating the cost/benefit of ICT adoption and digital transformation on supply chain resilience and agility and the objectives of the study should define the key drivers and barriers to ICT adoption and digital business transformation in emerging economies? And answer the questions: How does ICT adoption impact supply chain efficiency and responsiveness? And What are the measurable effects of digital transformation on supply chain resilience and agility?

The methodology proposed should be triangulation to have enough data from the sources due to characteristics of the economy and the population structure under study and to corroborate and strengthen the findings of such study in developed economies. Further research should validate the scope of the research on a wider and non-contextual approach for both economic level and industry types. Besides, it is likely that the results of this study are limited to the Nigerian context where practices like ICT and integration practices, strict regulations, social and environmental problems are perhaps less pronounced and less widespread than many other developed countries. Further research thus can replicate and extend the study in other neighbouring African countries, and some of the developing countries that are often beset described with stronger institutions of SMEs and multinational companies.

8.6 RESEARCH LIMITATIONS

Some key limitations include: The availability and willingness of organisations to participate in research can influence the sample size and representativeness of the study (Zheng et al., 2018). Small sample sizes may not fully capture the diversity of industries, geographical regions, or company sizes involved in ICT adoption, limiting the generalisability of the results. Access to accurate and reliable data on ICT adoption and integration practices can be challenging especially in developing economies (Saberi et al., 2019). Companies might be cautious to share sensitive information or might not have comprehensive records, leading to incomplete or biased data sets.

The fast-paced nature of ICT advancements means that research findings may become outdated quickly (Bruns, 2013). Longitudinal studies and continuous data collection are necessary to track changes in ICT adoption and integration practices over time. While Mohtaramzadeh et al., (2018) further argues that ICT adoption and integration practices can be influenced by various contextual factors, such as organizational culture, leadership, and regulatory environments, our study confirms that, ignoring these factors may lead to oversimplified conclusions about the impact of ICT on supply chains.

Studies relying on self-reported data from companies may suffer from social desirability bias, where organizations tend to present themselves in a more positive light. This can affect the accuracy and reliability of the information gathered. Determining causality between ICT adoption, integration practices, and supply chain performance can be challenging. Other factors outside the study's scope may also influence the outcomes, making it difficult to establish a clear cause-and-effect relationship.

Numerous studies may concentrate on short-term results, overlooking the long-term effects of ICT adoption and integration on supply chain performance (Carter et al., 2008). To ensure the validity and reliability of their findings, researchers should acknowledge and address these limitations. Diverse research methods, multiple data sources, and consideration of various contextual factors can help mitigate these limitations and contribute to a deeper understanding of ICT adoption and integration practises in supply chains.

Although sustainable supply chain practises are a multidimensional construct, we focused only on eight key variables: inter-organisational ICT, intra-organisational ICT, information sharing, supplier integration, customer integration, supply chain collaboration, and supply chain visibility, as well as environmental impacts as moderators, as a source of valuable supply chain capabilities for improved performance outcomes.

Another limitation is that the study was the focus primarily on survey data drawn from ICT integrated organisations in Nigeria. Therefore, the results may not be an accurate reflection of what obtains in the less integrated supply chain companies and more developed economies.

8.7 Conclusions

Conducting study on ICT adoption in Nigeria is critical since each developing country has its own set of issues, policy landscape, and socioeconomic setting. Other countries' research like China, India of Turkey may not represent Nigeria's unique characteristics, such as its large population, different cultures, and complicated governance structures. Localised study is very essential and timely as it sheds light on the country's specific digital divide, infrastructure inadequacies, and regulatory concerns. Critical understanding of these unique differences will permit policymakers to design policies for long-term technological integration, economic growth, and social development. Nigeria's prominence in Africa, as well as its potential as a technological hub, underline the importance of dedicated study to promote the country's effective and equitable adoption of ICT. It is therefore timely and necessary to carry out a study that aimed to determine the impact of ICT adoption and integration practices on the performance of supply chain organisations in Nigeria, investigates the mediating role of integration practice between ICT adoption and supply chain performance outcome and the cumulative effects of both ICT adoption and supply chain integration practise on supply chain performance. The chapter begins with an overview of the study, then discusses how the main research objectives contributed to answering the research questions. Based on the results of a case study and questionnaire survey, this chapter provides answers to specific research queries. This chapter concludes with a discussion of some limitations and potential recommendations for future research

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Appendices

Appendix

Appendix 1 Cover Letter

30/08/2021

Dear Sir/Madam

The effects of ICT and integration practices on supply chain performance in Nigeria

Abdullahi Mohammed, a PhD student attached to the Lancashire School of Business and Enterprise, University of Central Lancashire, Preston, is undertaking a research project to examine the effects of ICT and integration practices on supply chain performance in Nigeria.

We welcome your participation in this innovative research. The project forms a vital linkage between supply chain performance, integration, and ICT implementation. By participating in the research, your organization will be able to assess its operations and supply chain competitiveness against tested variables.

We would very much appropriate your contribution to this important research by completing the enclosed questionnaire. It will take only (15) fifteen minutes to complete this questionnaire as most of the questions require a tick (√). It will be most helpful if you could be as accurate as possible and return your responses within two weeks.

If you find yourself unable to respond to some or all of the questions, we would welcome you passing the questionnaire to someone within your organization whom you think is qualified to make the necessary response.

Information for the study and the results will be used for academic purposes only; you and your organization's names will not be divulged as strict confidentiality is assured, if you are interested, a summary of the findings of the research will be made available to you.

If you have any queries please do contact Abdullahi Mohammed on mobile using 08122878332 or amohammed18@uclan.ac.uk and Prof Yahaya Yusuf on mobile using 07930601186 or email YYusuf@uclan.ac.uk.

Thanking you so much for your time and support.

A.Mohammed

Abdullahi Mohammed

Research Student

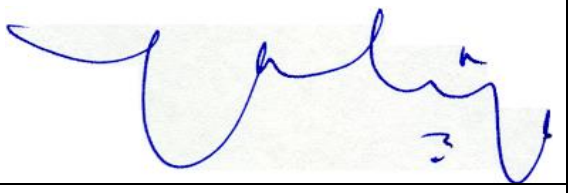
G20773305

Appendix 2

Ethics Declaration

DECLARATION

This declaration needs to be signed by the Principal InvestigatorPI), and the student where it relates to a student project (for research student projects PI is Director of Studies and for Taught or Undergrad project the PI is the Supervisor). Electronic submission of the form is required to EthicsInfo@uclan.ac.uk. Where available insert electronic signature – alternatively, provide an email in lieu from appropriate party.

Please indicate below if you consent to your University Ethics Checklist, Ethics Application and other documentation being shared for training and review purposes. All forms and documents will be anonymised. ☒ Yes ☐ No	
☐ **Signature of Principal Investigator: or** ☒ **Supervisor or Director of Studies**	
Print Name:	**Professor Yahaya Yusuf**
Date:	09/08/2021
Signature of Student Investigator:	
Print Name:	**ABDULLAHI MOHAMMED**
Date:	06/08/2021

Appendix 3; Questionnaire

A survey of the ICT and integration practices on supply chain performance in Nigeria

A. General Information

1. Name of the organisation:
   ……
2. Position of the respondent:
   ……
3. Year of establishment:
   ……..
4. Working experience of the respondent
   1-5years ☐ 6 – 10years ☐ 11 – 15years ☐ 16 – 20years ☐
5. Number of employees
   Less than 49 ☐ 50 – 99 ☐ 100 – 199 ☐ 200 – 299 ☐ above 300 ☐
6. What is the annual sales turnover of your organisation? Please tick.
   Less than #25 million ☐
   #26 – #50 million ☐
   #56 - #200 million ☐
   #201 - #300million ☐
   #301 - #400 million ☐
   #401 and more ☐
7. What is the main business activity of your organisation?

Sectors	**Please tick**
Nigerian Information and Communication Technology Development Agency (ICTDA)	
Cement	
Furniture and fixtures	
Food and beverages	
Textile mill products	
Printing and publishing	
Petroleum refining	
Rubber and plastics products	
Ceramic	
Computer and electronic equipment	
Transportation	
Other supporting industries	

B. The level of Information and communication technology implementation

8. Please indicate to what extent the following technologies used in your company, tick as appropriate.

	Strongly dis-agree. 1	Disagree 2	Neutral 3	Agree 4	Strongly agree. 5
Enterprise Resources Planning (ERP)					
Material Resources Planning (MRP)					
Electronic Data Interchange (EDI)					
Radio Frequency Identification					
Advanced Planning and Schedule (APS)					
Computer Aided Design/Manufacturing (CAD/CAM)					

9. Please indicate to what extent the following technologies used in your company, tick as appropriate.

	Strongly dis-agree. 1	Disagree 2	Neutral 3	Agree 4	Strongly agree. 5
We use electronic mail with the key customer					
We have an internet connect with the customer					
We have an extranet connection with key consumer					
Other please specify ……..					

10. Please indicate the degree to which you agree with each of the following statement, tick as appropriate.

	Strongly disagree. 1	Disagree 2	Neutral 3	Agree 4	Strongly agree. 5
We receive information about changes in the production plans of our key customer					
We receive information about the sales forecasts from our customer					
We receive information about the production plans of our key buyer					
We receive information about stock levels from our key customer					

11. Please indicate the degree to which you agree with each of the following statement, tick as appropriate.

	Strongly disagree. 1	Disagree 2	Neutral 3	Agree 4	Strongly agree. 5
Our members would rather work out a new deal than to hold each other to the original terms					
Our suppliers will be open to modifying their agreement if unexpected events occur					
Our suppliers are jointly responsible for making sure that tasks are complete					
Problems that arise during this relationship are treated as joint rather than individual responsibilities					

12. Please indicate the degree to which you agree with each of the following statement, tick as appropriate.

	Strongly disagree. 1	Disagree 2	Neutral 3	Agree 4	Strongly agree. 5
Business strategy of our company is consistent with customer needs					
The routine of the supplier and operator of our company always fulfil customers needs					
Our company willingly adjust processes to fulfil the different needs of customers					
When suppliers cannot fulfil customers' needs, we initiate necessary changes in processes					

13. Please indicate the degree to which you agree with each of the following statement, tick as appropriate.

	Strongly disagree. 1	Disagree 2	Neutral 3	Agree 4	Strongly agree. 5
The business strategy of our company is consistent with the objectives of stakeholder					
The operator/supplier strategy of our company is consistent with the business strategy					
The employees of our company share the same vision as the stakeholders.					
When suppliers cannot deliver stakeholder objectives, our company initiates necessary changes to processes					

14. Please indicate the degree to which you agree with each of the following statement, tick as appropriate.

	Strongly disagree. 1	Disagree 2	Neutral 3	Agree 4	Strongly agree. 5
The information available to operators and suppliers is relevant to the management of material flow					
The information for the management of material flow by operator and supplier is accurate					
The information for the management of material flow by operator and supplier is available in a timely manner					
The information for the management of material flow by operator and supplier is sufficiently available					
The operators and supplier have sufficient knowledge to use all available information for the management of material flow					

C. Performance measurement

15. Please indicate the degree to which the following organisational performance has improved in your company, tick as appropriate.

	Strongly disagree. 1	Disagree 2	Neutral 3	Agree 4	Strongly agree. 5
Cost/price					
Product quality					
Delivery reliability					

Delivery speed					
Flexibility					
Increase in market share					
Increase in customer satisfaction					
Increase in employee engagement					
Improvement in return on investment					
Increase in net profit					
Increase in revenue targets					

16. Would your company like to participate in the second phase of this research, which involve a case study? Yes ☐ No ☐
17. Please comment on any aspect of ICT, integration practices and supply chain performance in your organisation in the space below:

……
……
……
……
……
……
……
……
……
……

Please return the questionnaire by email to: amohammed18@uclan.ac.uk or mail to:

University of Central Lancashire
School of Business and Enterprise
PR1 2HE PRESTON UK

Appendix 4; Interview questions

ICT experts and service providers

Section 1: Participant demographics

Name: ……

Position: ……

Industry/sector: …….

Gender: ……..

Age: ……..

Years of working experience: ……

Section 2: ICT technology in your organisation

1. How would you define ICT from your own point of view and the use of ICT in your organisation?
2. Please describe the existing ICT technology you implement, and how are customers engaged in this process?
3. Can you provide some of the main ICT elements used by your organisation?
4. Where do you see the major value of ICT implementation in your industry?

Section 3: Motivations for ICT implementation

5. What was the drivers for the implementation of ICT technology in your organisation?
6. How long has your organisation using ICT for?
7. At what state of ICT adoption is your organisation?
    a. Pilot
    b. Impartial, or
    c. Full implementation
8. At what process level is your organisation implementing ICT?
9. How would you describe your sector's awareness of ICT?
10. Who has the ultimate responsibility for ICT adoption in your organisation?
11. Do you believe specific integration outcomes can be derived from the use of ICT? Probing: what are they and how do they work in practice? Examples?
12. Do you believe specific integrative practices can be derived from the use of ICT? Probing: what are they and how do they work in practices? Example?

Section 4: Decision to adopt ICT

13. What factors played a major role in adopting ICT in your organisation?
14. What are the obstacles to ICT adoption in your organisation?
15. To what extent do you think customers and other stakeholders influenced decision to adopt ICT?
16. To what extent and how do the size of your organisation affect decision to adopt ICT?

Section 5: Benefits of the implementation of ICT

17. What benefits does your organisation derive from the implementation of ICT?
18. Do you believe ICT technology solutions can have impacts on building integrative capabilities? If so, how?
19. Do you find a relation between ICT implementation and potential building up of customers' capabilities? If so, explain?
20. From your experience, do you find ICT to have an impact on the following integrative capabilities? If so, how?
    a. Supplier talent
    b. Supplier collaboration
    c. Knowledge and learning
    d. Customer relationship
21. How about the impact of ICT on the following performance metrics:
    a. Cost
    b. Delivery reliability
    c. Quality
    d. Speed of responsiveness
    e. Flexibility
    f. Innovation
    g. Employee engagement
    h. Customer satisfaction
    i. Profitability
    j. Others
22. To what extent and how do ICT and integration practices/characteristics create a short- or long-term competitive benefits? If so, explain?
23. To what extent can ICT incorporate in organisations as integrative resources? How and what role?
24. To what extent and how do customers knowledge exchange facilitate concerted suppliers' action and improved performance outcomes?
25. To what extent and how can knowledge management help your partners bridge shared difference?

Appendix 5

PARTICIPANT'S INFORMATION SHEET

PARTICIPANT'S INFORMATION SHEET

Title of the Project: "The effects of ICT and integration practices on supply chain performance in Nigeria"

About the researcher

Abdullahi Mohammed is currently a Research Student (MPhil/PhD) at the University of Central Lancashire in the School of Management, undertaking research entitled "The effects of ICT and integration practices on supply chain performance in Nigeria**."**.

Invitation to participate in this research

You are being invited to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully. Please do not hesitate to ask questions if there are any areas of the study you are unclear about or if you would need more information. Take time to decide whether you wish to take part.

Aim and objectives of the research

This study aims to explore the effects of ICT and supply chain integration on supply chain performance in Nigeria. This is envisaged since there is a lack of empirical study on the roles of various dimensions of ICT and integration on supply chain performance in Nigeria and yet ICT remains central to the government's ambition to develop a digital economy. The government has an Information and Communication Technology Development Agency (ICTDA) as a vehicle to foster diffusion of ICT adoption with the agency under the purview of the Ministry of Information Technology and Digital Economy. In addition, the proposed research will investigate the cumulative effect of inter/intra-organizational ICT and supply chain integration on the overall supply chain performance. The research challenges outlined here will be examined and clarified with data drawn from organisations in Nigeria.

In specific terms, the main research objectives are to:

i. Review extant literature on inter/intra-organisational ICT and supply chain performance.
ii. Develop an integrated framework of inter/intra-organisational ICT, and their effects on supply chain performance.
iii. Investigate the role of ICT in enhancing supply chain performance through a survey by questionnaire.
iv. Explore the intervening effect of supply chain integration in the relationship between ICT and supply chain performance.
v. Examine the cumulative effects of ICT and supply chain integration on the performance of supply chain.

Why you have been invited to participate in this research?

You have been invited to participate in this research because you have been identified as one of the active participants (stakeholder) who have the responsibilities for the diffusion of information and communication technology (ICT) and integration practice in the ICTDA. Your experience will contribute valuable information to this research.

What will the research involve?

This involves conducting interviews with five selected subject matter experts drawn from senior managers of the ICTDA to explore their views on the diffusion of the ICT, integration practices and performance measurement in the sector. Participants with experience in the ICT will be targeted, to enable in-depth or detailed examinations. The interview will facilitate the collection of detailed information related to the ICT and integration practice and supply chain performance.

The data collected from the participants will be used in the development of a theoretical framework of ICT and integration practices and their effects on supply chain performance. The interview will be recorded and will be used for later analysis.

Do I have to take part?

Your participation is entirely voluntary. If you do wish to participate, you will be given this information sheet to keep and given the opportunity to ask the researcher any questions you have regarding the study. During the study, if there is any aspect that you are unhappy with, you have the right to withdraw at any time, without giving a reason and without any negative consequences. This will include the withdrawal of any data collected from you. All information used will be anonymous.

Can I withdraw my data after my participation?

Yes. Participants may request that their data should not be used even after they have taken part in the interview. However, it will not be possible to withdraw anonymised participant's information after the final analysis has been completed.

What are the possible risks or cost of taking part?

There are no known or anticipated risks to you as a participant or out of pocket costs related with this research.

What are the possible benefits of taking part?

There are no direct benefits to you in this research. However, your participation will provide in-depth information that will enables the researcher to develop an integrated conceptual model. This will contribute to the wider knowledge or development of operations strategy and supply chain management. Most importantly, the research will break new grounds by examining the cumulative effect of ICT, integration practices on supply chain performance.

What happens when the research study stops?

You will not be contacted or required to participate in any further assessments or interviews regarding this study.

Will information about me be kept confidential?

All the information that we collect about you during this research will be kept strictly confidential. All identifying information will be stored on a password protected document on a university network and deleted at end of the study. The data will be kept for 5 years and will then be disposed of via the university's confidential waste service (including handwriting notes and computer printout). The confidentiality of the data collected for the purpose of this research both questionnaire and telephone interview are assured. Only people with a legitimate professional need will see your actual completed questionnaire. The information you provide will be used to write reports such as thesis, Journal, conference paper and may be seen publicly. At no point will you be identified in these reports because the information we give will be numerical and will be information about the group of participants to which you belong, rather than about you personally. The information you provide will be anonymous; that is, your name will not be recorded anywhere, and we will not reveal any personal information about you individually from which you could be identified.

What if there is a problem?

If you have any complaints about the study or how you have been treated in the study, please in the first instance contact the researcher or supervisory team using the details provided. They will do their best to answer your questions. If you do not receive a satisfactory response, concerns should be addressed to the University Officer for Ethics at the OfficerForEthics@uclan.ac.uk. Information provided should

include the study name or description (so that it can be identified), the principal investigator and the substance of the complaint.

What should I do if I want to take part?

All you need to do is indicate your interest to participate to the researcher by mailing amohammed18@uclan.ac.uk. You will then be contracted to agree a time that is convenient for you to be interviewed.

What will happen to the results of the research study?

The information collected will be analysed and validate the results of the statistical analysis and confirm the conceptual model. The findings of the study will be reported in a thesis and submitted to a journal and for conference presentations. None of the data collected will be used for commercial purposes.

Who is organising the research?

The research is being conducted at PhD level in the Lancashire School of Business and Enterprise at University of Central Lancashire.

Who is funding this study?

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Who has reviewed the study?

The University of Central Lancashire Ethics Committee (BAHSS) have reviewed and approved this study.

Thank you for taking the time to read about the study, if you have any questions about this research or interviews, please do not hesitate to contact.

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Appendix 6

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.879
Bartlett's Test of Sphericity	Approx. Chi-Square	13643.840
	df	435
	Sig.	.000

Appendix 7

Communalities

	Initial	Extraction
We collaborate with suppliers to reduce the time to market for the launch of new products/services	1.000	.943
We collaborate with suppliers in the development of new products/services (e.g., early supplier involvement)	1.000	.956
We collaborate with suppliers to increase the level of integration of operations	1.000	.976
Our members would rather work out a new deal than to hold each other to the original terms	1.000	.948
Our suppliers are jointly responsible for making sure that tasks are completed	1.000	.957
We use advanced data analysis software	1.000	.959
We use additive manufacturing for managing production activities	1.000	.981
We use cloud computing technologies to share data and information with supply chain	1.000	.983