



Smart logistics diffusion strategies amongst supply chain
networks in emerging markets: a case of Nigeria's
micro/SMEs 3PLs

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The candidate confirms that this work is his own, except where study which has formed part of jointly-authored publication has been included. The contributions of the researcher and the other authors have been explicitly indicated below. The scholar confirms appropriate acknowledgment has been given to the works of others.

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PhD publications

Several aspects of the PhD thesis have been published in the following peer-reviewed international journal and conferences:

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Abstract

This study investigates the mechanism influencing Information and Communication Technology (ICT) diffusion in the Nigerian transport/logistics industry, necessitated by the need to improve logistics performance in the region. The study involved a mixed-method approach, divided into four phases: scoping study; questionnaire survey; multiple case studies; and focus group discussion/in-depth expert interviews. The approach was required to respond to the following specific objectives of the study, including to (i) unpack diverse ranges of both internal and external factors influencing ICT diffusion in the industry. (ii) Empirically capture the causal interrelationships of the relevant factors influencing ICT diffusion in the industry, using evidence from the activities of the local small and medium third-party logistics operators (3PL SMEs). (iii) Compare the influences of firm and structure on the ICT adoption process, and, in turn, logistics performance among the local 3PL SMEs, and (iv) identify policy initiatives required to improve ICT diffusion in the industry. The outcomes of the study suggest as follows: (i) there are varied ranges of context-specific factors influencing ICT diffusion in the Nigerian transport and logistics industry. (ii) Amongst the main barriers include lack of facilitating conditions and limited scope of business, while the main driver was consumer readiness. The three constructs appear interdependent. (iii) The local logistics operators were motivated differently in terms of the extent of ICT adoption. (iv) There are limited policy-driven initiatives, as well as dysfunctional institutional framework stimulating ICT diffusion in the industry. These outcomes lead to making the following recommendations: (i) The logistics practitioners in the region should concentrate on developing their internal resources, particularly technical skills/expertise, as it represents their primary source of sustaining their competitive advantage. (ii) Relevant policy initiatives (e.g., the national IT policy) require revision to enhance their sectorial applications in the industry, and (iii) The study also recommends significant overhaul/reorientation of the local logistics system, particularly the institutional framework. These relate to the dampening effects (barriers) the lack of a functional institutional framework has posed on the efficient coordination of the local logistics system. The outcomes of the study suggest the need for continuous engagement of the relevant stakeholders in addressing some of the critical issues raised in this study, mainly as represented in the developed ICT diffusion framework. This approach is envisaged to help address issues relating to the ever-increasing complex and dynamic nature of the modern smart logistics system. For the practitioners, the contingency management approach is mostly recommended based on the unstable nature of the local economy and logistics market in particular. Overall, the research findings may help lay the foundation for the pragmatic resolution of ICT diffusion challenges in the local transport and logistics industry.

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Acronyms and Letters

Acronyms	Letters
3PL	Third-party Logistics Operators
3PL SME	Small and Medium Third-party logistics operators
ADSL	Asymmetric Digital Subscriber Line
AHP	Analytical Hierarchy Process
AI	Artificial Intelligence
AR	Augmented Reality
AWMS	Automatic Warehouse Management System
CAD	Computer-aided Design
CAE	Computer-aided Engineering
CAM	Computer - aided Method/Manufacturing
CILT	Chartered Institute of Logistics and Transport
CioTA	Chartered Institute of Transport Administrators
CLM	Council of Logistics Management
CLSC	Closed-loop Supply Chain
CR	Consumer Readiness
CRM	Customer Relationship Management
CSCMP	Council of Supply Chain Management Professionals
DLT	Distributed Ledger Technology
DoI	Diffusion of Innovation
DQ	Decision Quality
DSS	Decision Support Systems
EE	Extended Enterprise
EERP	Extended Enterprise Resource Planning
ELM	Electronic Logistics Marketplace
ERP	Enterprise Resource Planning
FAAN	Federal Airport Authority of Nigeria
FC	Facilitating Condition
FCT	Federal Capital Territory
FGD	Focus Group Discussion
FGN	Federal Government of Nigeria
FMNP	Federal Ministry of National Planning
FRSC	Federal Road Safety Commission
GDP	Gross Domestic Product
GPS	Global Positioning System
HGVs	High Goods Vehicles
IA	ICT Acquisition
IATA	International Air Transport Association
ICT	Information Communication and Technology
IDFs	Individual difference Factors
IEI	In-depth Expert Interview
IoT	Internet of Things
IS	Information Systems
IT	Information Technology

LAMATA	Lagos Metropolitan Area Transport Authority
LAN	Land Area Network
LCVs	Light Commercial Vehicles
LM	Logistics Management
MFGD	Multiple Focus Group Discussion
NCC	National Communication Commission
NDA	Nigeria Defence Academy
NDP	National Development Plan
NEEDS	National Economic Empowerment and Development Strategy
NFC	National Freight Company
NIMASA	Nigerian Maritime Administration and Safety Agency
NITDA	National Information Technology Development Agency
NPA	Nigerian Port Authority
NRC	Nigeria Railway Corporation
NSC	Nigeria Stock Exchange
OECD	Organisation of Economic Cooperation and Development
OEM	Original Equipment Manufacturers
PEOU	Perceived Ease of Use
POS	Point of Sales
PU	Perceived Usefulness
R&D	Research and Development
RFID	Radio Frequency Identification
RL	Reverse Logistics
SAP	Structural Adjustment Programme
SB	Scope of Business
SC	Supply Chain
SCM	Supply chain Management
SEM	Structured Equation Modelling
SPDC	Shell Petroleum Development Company
TAM	Technology acceptance model
T-O-E	Technological-Organisational-Environmental
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UN	United Nations
UNCTAD	United Nations Conference on Trade Development
VE	Virtual Enterprise

Chapter 1 –Introduction

Outline

This chapter involves the background of the study, framing, and the thesis structure. The chapter covers explicitly the overview of the literature and the context in which the research is grounded. It also introduces the various chapters that constitute the thesis.

1.1 Background

The main concern of this study relates to mapping ways in which Information and Communication Technology (ICT) diffusion can be improved in Nigeria's transport and logistics industry, with a view to enhancing logistics performance in the region. Currently, Nigeria's logistics performance has been ranked poor, based on the following indices: infrastructure, timeliness of deliveries, logistics competence, tracking/tracing of local and international shipments, and customs clearance/procedure (World Bank, 2018). Therefore, the research interest relates to understanding how the combinations of locally-evolved factors influence ICT diffusion and in turn poor logistics performance in Nigeria. Some of the ICT resources referred to include freight and vehicle positioning system (GPS), warehousing logistics solutions, interactive websites, enterprise resource planning (ERP), customer relationship management (CRM), electronic data interchange (EDI), advanced routing systems, and other primary ICT tools/applications such as mobile handsets and emails. The relevance of ICT application in the transport and logistics industry relates to issues such as low-cost sourcing, production, and coordination (Harris et al., 2015). Others argue that application of advanced ICT tools in the industry, particularly among third-party logistics service providers (3PLs) helps in developing new services (Cui et al., 2012), functions (Huanga et al., 2019), and alliances (Govindan and Bouzon, 2018, Govindan et al., 2015), deemed necessary to sustain their competitiveness (Li and Olorunniwo, 2010, Tidd, 2001).

Another school of thought claims that the advanced ICT applications in the industry facilitates supply chain (SC) processes and integration, shifting competitions from firm versus firm to SC versus SC, in line with increasing global SC collaborations and integrations (Harris et al., 2015, Christopher, 2005). This aligns with the view of other researchers that applications of interoperable ICT resources in the industry have facilitated the improvement of efficiency, visibility, responsiveness, tracking/tracing (Li and Olorunniwo, 2010, Radstaak and Katelaar, 1998). Additionally, Chen and Paulraj (2004b) grouped levels of ICT-facilitated communication in the industry according to their functions, including transactional, operational, collaborative, financing, and customer relationships. Some of the main challenges associated with ICT

adoption/diffusion in the industry include adaptability and customisability (Kumar et al., 2018), particularly in the context of developing the logistics market, where infrastructural challenges and lack of logistics competence abound (World Bank, 2018). Some of these contextual problems have led to increased research interest in the field in recent years, but mainly within the context of large logistics organisation (Hung et al., 2010, van Hoek, 2002, Larson and Gammelgaard, 2001, Berglund et al., 1999, Peters et al., 1998) than their smaller counterparts (Evangelista, 2011, Gunasekaran and Ngai, 2003). There is also a lack of research within the context of developing logistics markets such as Nigeria (Tob-Ogu et al., 2018). The present study intends to fill these research gaps.

The preview of some of the research undertaken within the context of 3PL SMEs indicate as follows: The majority of 3PL SMEs in the Scandinavian region are reluctant to adopt advanced ICT resources (Kilpala et al., 2005). Similarly, their counterparts in China adopt less-expensive ICT tools, mainly to cut costs and reduce human error (Lau and Huang 2012). Alternatively, Gunasekaran and Ngai (2003) found that the local 3PL SMEs in Hong Kong are technologically innovative and flexible with information technologies (IT), but limited by financial constraints. Similar findings are made in Singapore (Pokharel, 2005). Within the Italian logistics industry, it has been found that the local 3PL SMEs expend only small portion of their income on ICT resources (Evangelista et al., 2013). Evidence from the Nigerian transport and logistics industry suggests that the majority of 3PL SMEs are receptive towards ICT innovation, exhibited by their adaptive capabilities (Tob-Ogu et al., 2018). Ezenwa (2014) also found that the extent of ICT adoption among local 3PL SMEs in South-Eastern Nigeria is significantly correlated to the operational efficiency and quality of services. However, there are significant differences in how these were applied among the different commerce centres sampled in the region, pointing towards the potential effects of individual difference factors on the part of the logistics operators and customers sampled in different study locations. The brief review suggests that the local 3PL SMEs across regions exhibit divergent attitudes towards ICT innovation and may align with the need to map the interrelationships of factors influencing their intentions towards ICT innovation (Evangelista and Sweeney, 2006), with a view to understanding both the direct and remote causes of lack of advanced ICT adoption among local 3PL SMEs. This represents another critical gap this research project intends to cover, using the evidence from the activities of local 3PL SMEs in Nigeria.

Further, the literature indicates a lack of a theoretical framework for accurate prediction of factors influencing ICT adoption among small and medium enterprises (SMEs) (Awa et al., 2015), and 3PL SMEs in particular (Evangelista, 2011). Awa et al. (2015) precisely argue that there is a lack of a theoretical framework that captures inherent intermediate characteristics

of the local SMEs, based on the possible undue influence of their local owner-managers towards the overall decisions of the firms. As such, they claim that the local SMEs' ICT adoption behaviours are not well captured in the existing theories, models, and framework in the field as they rarely belong to the individual or firm levels' ICT adopters. In light of this, the authors proposed the integration of the related ICT adoption/diffusion theories, models, and frameworks to find common ground that can help explain the potential intermediate characteristics of the local SMEs accurately. This study found it necessary to operationalise this proposal, which represents a theoretical contribution of this research project. Methodologically, this study contributed, based on the adoption of mixed-methods approach (Martin, 1990, Snow and Thomas, 1994), particularly advanced analytical techniques, multiple case studies, focus group discussion, and in-depth expert interviews applied in the various phases of the study (see Chapter 4, Sections 4.3 for details).

Overall, the combinations of the issues presented above represent the primary focus of this research project, with the research findings filling the location/industry-specific research gaps identified. The next section covers the framing of the study.

1.2 Framing the study

The study location is grounded in Nigeria. It has a total area of 923.768sq KM, shares boundaries with the Republic of Benin in the West, Chad, and Cameroun in the East, Niger, and the Gulf of Guinea in the South (Internet World Stats., 2011). The nation's estimated population was over 158.3 million, highest in the African Continent (Trading Economics, 2011). The study-specific locations include Federal Capital Territory (FCT), Abuja, Lagos State, and Imo State, all in Nigeria. The selections of the study locations were purposeful, based on the scope of each phase of the study and other contextual considerations; including safety, security, and accessibility (see details in Chapter 4, Section 4.6).

Based on the diversity, large population, oil explorations/exports, and associated commercial activities, logistics demands have been increasing in the region (Ploch, 2011). Continentally, the African logistics market has been reported increasing (6% annual growth), which has outstripped Asia, and is projected to maintain the trend (McKinsey, 2014). However, Nigerian logistics performance has been ranked low, behind South Africa, Egypt, and Kenya, based on the key performance indices mentioned above. Other sources of supply chain risk and logistics disruptions in Nigeria include systematic political corruption, rising insecurity, and socio-political instability (Obiorah, 2016). Several of these issues have triggered insignificant research interest (Tob-Ogu et al., 2018, Ezenwa, 2014b), as well as little knowledge concerning how

diverse range of factors combine to influence efficient ICT diffusion in the Nigerian transport and logistics industry (Tob-Ogu et al., 2018).

Due to the complexity and dynamic nature of the research problems (Dayan and Ndubisi, In Press), a mixed-methods (triangulation) research approach has been adopted for this study. The concept of a mixed-methods approach aligns with the notion of generating theoretically/empirically grounded and robust results to contribute to the rapidly growing research field (see Section 4.1.3, Chapter 4 for details).

In light of all these, the research project adopts the following overarching aim:

- To explore diverse ranges of mechanisms influencing ICT diffusion in Nigeria's transport and logistics sector using evidence from the local 3PL SMEs.

This main aim has been met through four specific objectives and eight associated operational research questions, as outlined in Table 1.1. The development of the research objectives and associated research questions are guided by the identified gaps in literature (see Chapters 2 and 3 for details).

Table 1-1: Outline of the specific research objectives and associated research questions

Objective/research questions	Methods	Results
Objective 1: To unpack diverse ranges of contextual factors influencing ICT adoption among the local 3PL SMEs in Nigeria (i) What are the diverse ranges of contextual factors influencing ICT adoption among the 3PL SMEs in Nigeria?	Chapter 4/ Section 4.6.1	Chapter 5 /Section 5.2
Objective 2: To empirically capture the interrelationships of contextual factors influencing ICT acquisition and decision quality of the local 3PL SMEs (ii) Are the contextual factors influencing ICT acquisition and decision quality among the local 3PL SMEs interrelated?	Chapter 4/ Section 4.6.2	Chapter 5/Section 5.3
Objective 3: To compare the effects of the firm background and industry environment on the ICT adoption characteristics of different categories of the local 3PL SMEs. (iii) How do the firm background and industry environment feature in the ICT adoption process of the selected local 3PL SMEs? (iv) How do the company and industry structure influence the prioritisation of ICT tools of the selected local 3PL SMEs? (v) How do the company background/industry environment and extent ICT uptake influence the logistics performance of the selected local 3PL SMEs	Chapter 4/ Section 4.6.3	Chapter 6/Sections 6.3 & 6.4
Objective 4: To identify policy initiatives and actions required to improve ICT diffusion among the local 3PL SMEs and the broader industry (vi) How do the local developmental schemes (policies) influence ICT diffusion amongst the local 3PL SMEs and the broader industry? (vii) How do the local institutional forces shape ICT diffusion amongst the 3PL SMEs and the broader industry?	Chapter 4/ Section 4.6.4	Chapter 7/Sections 7.2 - 7.5

Table 1-1 continued

(viii) Finally, what are the local stakeholders' perceptions of the ICT diffusion challenges amongst the local 3PL SMEs and their roles in mitigating them?

1.3 Arguments and proposed contributions of the study

The development of the research questions is guided by a range of propositions and arguments, including portraying ICT diffusion challenges in the Nigerian transport and logistics industry in complex and dynamic perspectives, operating around a dysfunctional logistics system. As such, the study argues that the research problems should be assessed from multiple perspectives, covering several internal and external factors. Against this backdrop, a neutral point of entry (inductive approach) was adopted in this study to ensure meaningful and constructive research outcomes. Another proposal posed by the study relates to mapping the interrelationships of identified factors to ensure that direct and indirect impacts of identified contextual factors are uncovered. This aspect of the research proposal was accomplished with the questionnaire survey of the local 3PL SMEs.

Further, based on the possible individual difference factors of the local logistics operators, as well as the different characteristics of local SCs in the region, this study also proposed understanding how different categories of the local 3PL SMEs are responding to the ICT adoption challenges. It concerns to understand what is happening to the local logistics operators, amidst the poor infrastructure and logistics competence in the local logistics system. This study utilised multiple case studies to address this proposal.

The study also proposes to map the effects of external factors in terms of the local institutional framework on the ICT diffusion processes among the local 3PL SMEs and the broader industry. This is termed relevant, based on the inherent influences the local institutional framework has on the overall functionality of the local logistics system. This phase of the study concentrates explicitly on: First, identifying and examining policy initiatives and their sectorial applications in improving ICT diffusion in the industry. Second, this phase also concerns understanding stakeholders' perceptions and roles in mitigating ICT diffusion in the industry. Third, the study envisages that through these revelations and other outcomes from the earlier phases of the study, policy actions/regulations (Gajewska and Njoya, 2018) can be initiated to booster ICT diffusion in the industry. Indeed, this study argues that there is a lack of efficient sectorial application of relevant policies, for example, Nigerian IT policy (NITDA, 2001), which has combined with other external factors to weaken ICT diffusion in the industry. Therefore, it has

been termed critical to seek and aggregate the inputs of the relevant stakeholders concerning developing a strategic framework to mitigate the issues of ICT diffusion challenges in the Nigerian logistics system holistically.

In sum, this study proposes that the research problem can be efficiently addressed if the reasons the research problem exists are understood (Buhaug, 2015). As such, the study outcomes are believed to be locally and regionally comprehensive and strategically designed to advance insight into how locally-evolved issues are affecting efficient ICT diffusion in the developing logistics markets as Nigeria. This is considered critical for improving logistics performance (World Bank, 2018), and, in turn, globalisation of supply chain integration and management (Harris et al., 2015, Christopher, 2005).

1.4 Overview of the literature review process

The literature review is guided by protocol to ensure robust review processes and outcomes (Denyer and Tranfield 2009). These involve mapping the scope of the literature review, the cut-off line, and the review process. The scope of the literature search specifically remained subject to modification as the systematic literature advanced. In broad terms, the scope covered in Chapter two includes literature backing conceptual and theoretical frameworks the research is grounded on, while Chapter three covers the logistics and SCM concepts, technology innovations in the field and its implementations, and transport and infrastructural development in Nigeria. The cut-off line for the review was not definite as every literature that could back the contemporary issues, as well as the theoretical and conceptual frameworks covered in this study, have been rated relevant.

Table 1-2: The distribution of the reviewed literature

Type	No	Percentage (%)
Journal papers	440	75.21
Conferences papers	30	5.12
Online publications	24	4.10
Organisation documentaries	31	5.30
Books/theses	82	14.02
Total	607	~100

The review processes followed different approaches, including Boolean and operators, as well as the funnelling approach. In particular, Boolean and operators involve using different related terms phrases to execute the literature search while funnelling entails a review approach where the literature search moves from broader to narrower references. Some of the search

strings and keywords include “innovations,” “product/service innovation,” “IT/ICT innovations,” “IT/ICT innovations in business,” “IT/ICT innovations in SMEs” and “IT/ICT adoption/diffusion theories/frameworks” for the Chapter 2. On the other hand, Chapter 3 covers ICT innovation/adoption/diffusion in “supply chain,” “logistics,” “3PLs”, and “3PL SMEs”, “big data,” “Nigerian transport and logistics industry,” “Nigerian transport, logistics, and ICT infrastructure.”

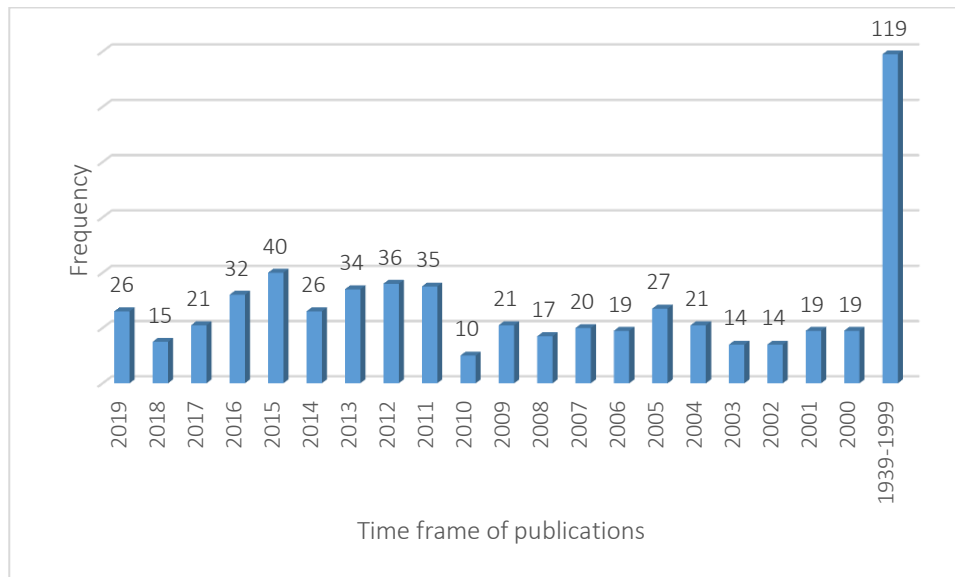


Figure 1-1: The distribution of the reviewed literature across timeframe

Overall, a total of 585 references were covered in both Chapters of the literature reviews, comprising journal papers (440), conference papers (30), online publications (24), organisation documentaries (31), and books/theses (82) (see Table 1.2). The databases explored include Google Scholar, Science Direct, Emerald, Taylor and Francis, and Sage are considered based on the researchers’ experience, the scope of study, and data accessibility, to achieve preliminary test of content (see Table 1.3 for the frequency of the reviewed journal). The time frame of references and the frequency of the reviewed journals are reflected in Figure 1.1 and Table 1.2, respectively. The list of the journals loosely covers the following fields; innovation, social sciences, engineering, technology, information systems, commerce and enterprise, computing, manufacturing, sustainability, health, management, and agriculture, transport, economics and logistics.

Table 1-3: Frequency of the reviewed journals

Journal	Frequency
Physical Distribution and management	27
Production/Industrial Economics	21
Supply Chain Management	16
Operation Management	15
Enterprise Information/Innovation/Internet Management	14
Information Technology/System Management	13
Logistics Management	12
Business Research/Studies/Venture/Finance/Model	12
Cleaner Production	11
Business Logistics	10
Management Science/Review/Sciences	10
Industrial Marketing Management	9
European Operation Research	9
MIS Quarterly	9
Research Policy	8
Transportation Research: Part E	7
The Transport/Logistics Review	6
Information Technology for Development/Technovation	6
European Journal of Marketing/Management/Innovation/Information System	6
Economics Literature/Research Quarterly/Econometrics	6
Strategic Outsourcing	5
Production Research	5
Harvard Business Review	5
Transport Research	4
Omega	4
Management Decision	4
Decision Sciences	4
Logistics Research and Application	4
Internet Research: Electronic Networking Application & Policy	4
Strategic Management/Forum	4
Marketing and Marketing review	4
Business Ethics	3
Computer and Industrial Engineering	3

IEE Transport Engineering	3
Technological Forecasting and Social Change	3
Organisational Science Studies	3
Small Business Economics/Management/Journal	3
Asia Pacific Journal of Market and Logistics	2
Purchasing and Supply Chain Management	2
Advanced Manufacturing	2
Production planning and control	2
Expert System and Application	2
Benchmarking	2
Productivity and performance management	2
Computer in Industry	2
Business Horizons	2
Big data Analytics in Operations and Supply Chain Management	2
Production Research in Transportation Business and Management	2
Supply Chain Forum	2
An American Journal of Health Systems and Pharmacy	2
Product Innovation Management	2
The Mediating Role of Information Technology in Decision Making	2
Wireless Network/Review	2
Organisational Computing and Electronic Commerce	2
California Management Review	2
The Service Industries	2
Engineering Technology Management	2
Future	2
Industry and Organisational Management	2
Multinational Finance Management/Research	2
Tourism Management	2
Global Environmental Change	2
Internet Banking and Commerce	2
American Sociological Review/ Sociology	2
Business and Industrial Management	1
International Studies Quarterly	1
Selected Reading on Global Information Technology	1
Table 1-3 continued (3/5)	

IEEE Computer Society	1
Computing Systems	1
Business and Industrial Marketing	1
Academic of Management Journals	1
Economic Development Research and Investment	1
Journal of Developing Country Studies	1
British Journal of Economic, Management and Trade	1
Sustainable Development in Africa	1
Computer Operation Research	1
Company Data	1
Nigerian Journal of Economics and Social Studies	1
Journal of African Studies	1
Transport Nigeria	1
Emerging Trends in Economics and Management Science	1
Sustainable Production and Consumption	1
Management of Operations	1
Industrial Management and Data Systems	1
Management System	1
European Business Review	1
Intelligent Enterprise	1
Management of Operations	1
Manufacturing Technology Management	1
Official Journal of the Southern Management Association	1
Business Horizons	1
Risks and Uncertainties	1
PC World	1
Life Science	1
Applied Maths Model	1
Internet Technology	1
Operation Research Society	1
Beijing Jaoton University of Social Science Education	1
Banking and Commerce	1
Logistics Transport Focus	1
Transportation Business and Management	1
Table 1-3 continued (4/5)	

European Transport Review	1
Logistics and SCM Research in Transport Economics	1
Transport Part A: Policy Practice	1
Transport Business and Management	1
Business Process Management	1
Change Economics Dynamics	1
Economics and Social Studies	1
Chinese Journal of Mechanical Engineering (English Edition	1
Cloud and Grid Computing	1
Distributed Computing Systems	1
Wired Journal	1
Applied Sciences	1
Decision support system	1
Team management	1
Employment Relation Record	1
Long range Planning	1
Operation production management	1
Computer & Electronic in Agriculture	1
State of the art and current trends trend sensors	1
Industrial Management and Data Systems	1
Forecasting with Big Data: A Review	1
Procedia Computer Science	1
Selected Readings on Global Information Technology	1
Internet Research: Electronic Networking Application and Policy	1
Clinical Nursing	1
Health Information Science and System	1
Political Geography	1
Technology and Investment	1
Entrepreneurship	1
Administrative Science Quarterly	1
Pacific-Basin Finance	1
Structural Change and Economics Dynamics	1
Science Public Policy	1
Agile Management System	1
Table 1-3 continued (5/5)	

Science and Technology Policy Management	1
America Economic Review	1
Sloan Management Review	1
Australian Journal of Business & Management Research	1
Science Technology and Society	1
Organisational Behaviour and Decision Process	1
E-Commerce	1
Human Resource Management	1
Communication of the ACM	1
Academy of Management Review	1
Gerontology Series B, Physical Science	1
Information Society and Justice	1
Inquiry	1
International Journal of Medical Informatics	1
BMC Health Service Research	1
Purchasing and Supply Chain Management	1
Technology in Society	1
World Business	1
Marine Policy	1
Total	440

In summary, it is worth noting that the diversity of the reviewed literature aligns with the complexity of the subject under investigation.

1.5 Structure of the thesis

The thesis is structured around eight Chapters (see Figure 1.2). This first chapter covers the general introduction of the study. Chapter 2 explores the relevant conceptual and theoretical framework in the research domain, which helps to lay the foundation for the several phases of the study. Chapter 3 covers the relevant logistics and SCM concepts, in relation to ICT innovation, found relevant in this study. Chapter 4 focuses on the research methodology, while Chapters 5, 6, and 7 present the various outcomes of the research investigation. The synthesis of the research findings and concluding remarks are covered in Chapter 8, highlighting the research contributions, implications, limitations, and suggestions for future studies.

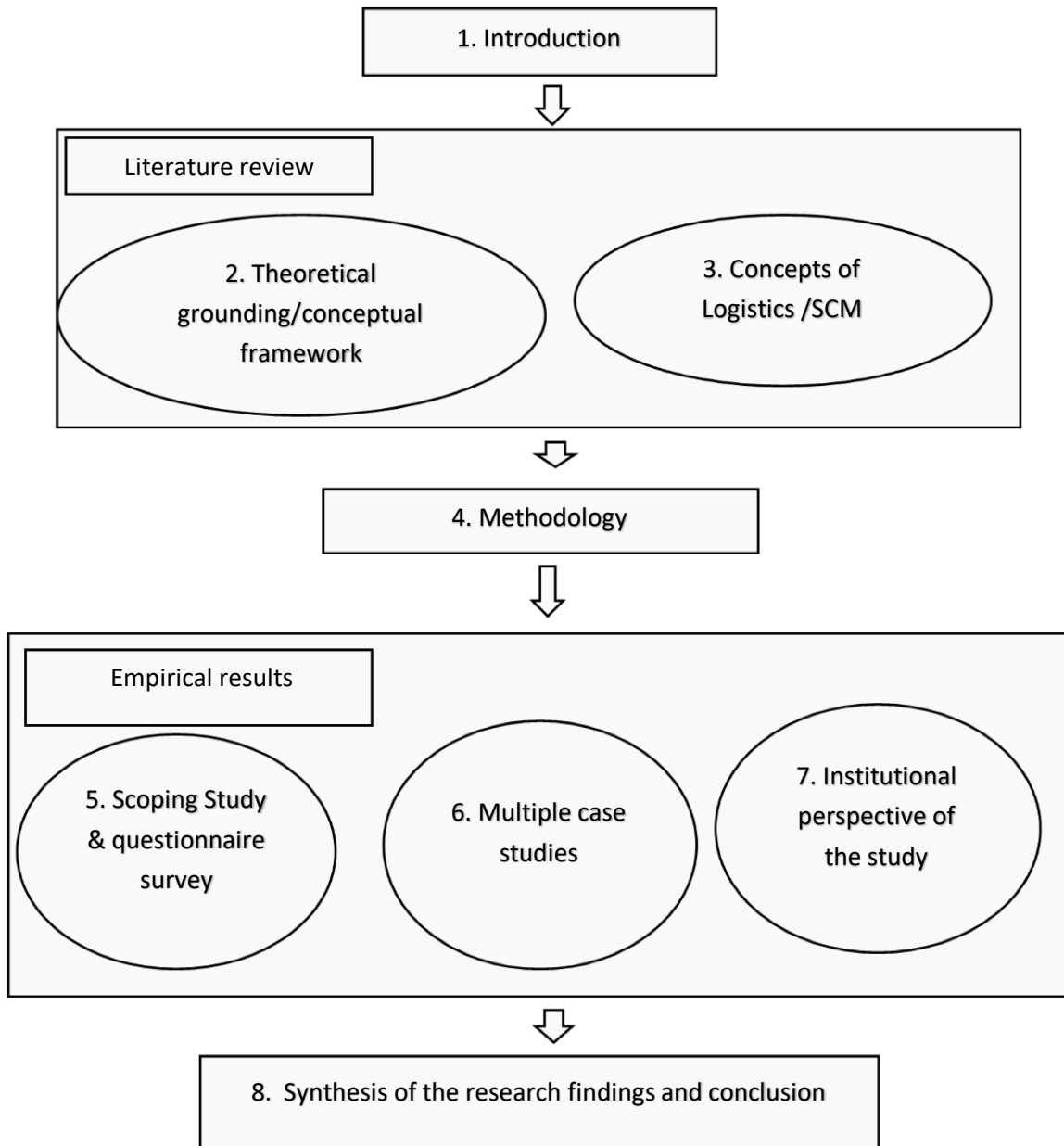


Figure 1-2: The thesis structure

Chapter 2 –Literature review and conceptual development

Outline

This chapter unpacks the key conceptual, theoretical, and analytical literature that pertains to innovation (business perspective), Information and Communication Technology (ICT) adoption/diffusion in order to understand the key debates and advances in the field, as well as to underpin the relevant research gaps. The synthesis places local small and medium enterprises (SMEs) at the centre of extensive debates across the thematic literature reviewed based on the understanding that local SMEs possess unique characteristics for underpinning individual and firm levels' ICT adoption links. The integration of relevant theories, models, and frameworks are presented as the appropriate theoretical foundation upon which to situate the research. The analytical concerns related to empirical quantification of mechanisms influencing ICT uptake among the local SMEs are synthesised to guide the estimation procedures and conceptual development for use in this study. Moreover, reviews of previous studies emphasising 'structure-process-outcome' and 'institutional theories' provide the policy context underpinning pathways towards addressing industry-specific issues and collaborative engagement to resolve various research problems identified in this study. Overall, the review offers relevant theoretical and analytical lenses required to advance understanding of diverse ranges of mechanisms influencing ICT diffusion in developing logistics markets as Nigeria using evidence from the local small and medium third-party logistic providers (3PL SMEs).

2.1. Overview of concepts of innovation

The term innovation can be described as the concepts surrounding invention generation and diffusion (Griliches, 1990). The distinctions between innovation and invention have been contentious in the research domain. However, the main distinction lies on the commercialisation of innovation (Schumpeter, 1942). According to Schumpeter (1939, p 66), product innovation can be achieved through any of the following: (i) the introduction of a new product or qualitative change in the existing product. (ii) The introduction of a method of production, new to an industry. (iii) The opening of new markets. (iv) The development of a new source of supply for other inputs, and (v) Changes in industrial organisation. The author also classified innovation as product and process innovations. The former occurs when a specific product undergoes a significant modification, mainly to improve performance, while the latter depicts the change in the business process, based on the need to improve efficiency.

Innovation benchmarking has become a subject of interest in recent years (OECD-EUROSTAT, 1997), reflecting the development of standard ways to classify product innovation, for

example, new/ improved; technology/ market-induced; radical (disruptive)/incremental product innovations. An example of radical innovation includes the shift from water to steam power, with huge technological/scientific advancement. On the other hand, incremental innovation occurs in subtle patterns, mainly to stimulate economic gains (e.g. an upgrade of soft or hardware of computer systems). Moreover, Henderson and Clark (1990) argue that product innovation classifications are subjective, based on the experience or knowledge of the intended end-users. As a result, they proposed that product innovations can be classified based on the significant changes in the physical structure (modular) or significant alterations in the internal components of an existing product (architectural).

Table 2-1: Traditional innovation classifications

Criteria	Innovation typology	Description
Object of innovation	-Product innovation	-New products/improved features of an existing product
	-Process innovation	-New production process or an improved existing process
Customer perception	-New product	-Product perceived as new by customers
	-Repositioned product	-Customer recognises critical product features common to an existing product
Technology novelty	-Radical innovation	-Profound modification of existing product and production process
	-Incremental innovation	-Marginal improvements of existing product or production process

Source: Evangelista (2011 p, 49)

In summary, product innovation can be classified based on the level of change in an existing product or the delivery processes. This can be linked to how customers perceive new products or services: new or improved (repositioned). Another criterion falls on technological novelty; in terms of radical or incremental (Table 2.1). In Figure 2.1, there is an establishment of linkages between core concepts and their components. Under core concepts, we have reinforced or overturned, also classified as modular and radical concepts of innovation, respectively. For the component category, we have unchanged and changed, also depicting architectural and radical forms of innovation. With these, it can be concluded that product innovation is complex and dynamic. These concepts are buttressed upfront to communicate better on how they have been portrayed in this study.

Linkages between Core Concepts and Components	Core Concepts		
		Reinforced	Overtaken
	Unchanged	Incremental Innovation	Modular Innovation
	Changed	Architectural Innovation	Radical Innovation

Figure 2-1: Defining innovation through the technological structure of product

Source: Henderson and Clark (1990)

2.1.1.1 Manufacturing and service innovations

Manufacturing and service innovations represent two main types of innovations in business. The manufacturing innovations are believed to be ancient and rigid in structure (Barras, 1990), while the service counterparts termed more recent, flexible, and triggered by the recent advancements in ICT resources (Metcalfe and Miles, 2000 Gallouj and Weinstein, 1997, Barras, 1986). As such, manufacturing innovations have been ascribed as the bedrock of business innovation (Gallouj and Weinstein, 1997). Other differences include that radical innovations are more common in manufacturing industries; awhile the incremental innovations are covered more in the service industries (Howells, 2000, Miles, 1993). Also, there is the notion that smaller service firms are more strategic than their manufacturing counterparts, in terms of quest for innovations (Bianchinia and Pellegrinob, 2019, Thether et al., 2001).

Moreover, it is believed that manufacturing innovations are more sustainable, in terms of employment generation and economic growth than the service industries (Bianchinia and Pellegrinob, 2019). It may not be unconnected to the above differences in rigidity and flexibility in operations. Besides, it is believed that service innovations are more of intervention-related innovations with an ad-hoc staffing approach, which aligns with the notion that service sector, lack trained staff in comparisons to their counterparts in manufacturing sector. Also, the literature indicates that service innovation is market-driven than manufacturing that concentrates more on technology-related innovations (OECD, 2000, Johnne and Storey, 1998). However, both manufacturing and service innovations apply exploration and exploitation approaches (Leea et al., 2019) (see Table 2.2).

Table 2-2: Differences between innovation in services and manufacturing

Sources	Differences between service and manufacturing innovation
(Dayan and Ndubisi, In press)	Service innovators are more strategic (market-driven) than their manufacturing counterparts, leading to a shift towards servitization of the manufacturing industry to remain competitive
(Bianchinia and Pellegrinob, 2019)	The manufacturing innovations usually involve long-term staff tenure, while the service counterpart relies more on ad-hoc staffing
(Leea et al., 2019)	Both industries explore/exploit innovations in similar ways.
Thether et al. (2001)	Large service firms are more innovative than their counterparts in the manufacturing industry
OECD (2000)	Service innovators are more concerned with the improvements of service deliveries procedures, while attention is more on product characteristics in the manufacturing industry.
Sundo (1998)	Service innovations are usually not strict, while the manufacturing counterparts are more traditional and rigid.
Sirilli and Evangelista (1998)	There is more lack of trained human resources in the service than the manufacturing industry
Atuahene-Gima (1996)	Innovation imitations are more profound in the service than in the manufacturing industry.
Cooper and De Brentani (19991)	The service innovators are more dependent on the ICT advancements than their manufacturing counterparts.
Barras (1990)	Service innovations are more flexible than those obtained in the manufacturing industry, where rigid innovation processes are prevalent

Based on the scope of the present study, service innovation concepts appear more applicable. Specifically, this study draws insight from the concept of ICT-facilitated innovation, while considering other industry/geographical - specific challenges as reflected in the specific objectives of the study (Table 1.1). According to Thether et al. (2001), service innovations have received an upward research interest in recent years, reflecting three main themes, technology, knowledge, and network (Kandampully, 2002). Also, Tidd (2001) asserts that both the scope and impact of innovation in the service industry depend on the following internal and external factors: organisation, technology, and surrounding market characteristics. With the continued advancements in the information systems in the service industry, the traditional concepts are giving way, particularly in the dynamic and complex industry as transport and logistics. As already presented in the introductory chapter, the application of the advanced interoperable ICT tools has become a great source of competitive advantage among transport,

logistics, and even SC organisations. For a clearer understanding of factors of influencing innovation -business perspective, the next section is incorporated in this study.

2.1.2 Innovation diffusion -business perspective

As previously discussed, innovation specifically entails the ability to commercialise inventions, with the main purpose of achieving economic gains. With this in view, it is evident that exploring ways to increase the rate of innovation (innovation diffusion) represents an aspect of innovation. Therefore, this section assesses various context-specific factors influencing innovation diffusion from business perspective.

2.1.2.1 Conceptualising factors influencing innovation diffusion -business perspective

The concept of innovation diffusion in business appears multi-dimensional, based on the complexities and dynamics associated with business environments. With the advent of e-commerce/business, the complexity and dynamics of modern market systems have increased. For clarity purposes, the study distinguishes between innovation diffusion and adoption concepts as both terms frequently appear in this thesis. Specifically, innovation diffusion can be attributed to the processes through which new products and services are distributed through a particular market system or social structure. On the other hand, innovation adoption comprises the internal mechanisms (processes) involved to achieve efficient adoption of either product or service innovation (Majan and Peterson, 1979, Rogers and Shoemaker, 1971). It can be inferred from the definition that diffusion is linked to external issues, while adoption concerns internal processes involved in efficient utilisation of innovation.

The illustrations above imply that both the external and internal factors influencing efficient innovation diffusion or adoption are worth assessing to ensure efficient innovation processes of specific products or services. Specifically, the external factors entail those factors outside the control of potential innovation adopters, including, political, socio-economic, industry-specific (e.g., external infrastructure), and other locally-evolved issues. On the other hand, the internal factors comprise levels of skills/expertise, internal infrastructure, and other factors that can be reached by a potential innovation adopter. Assessment of how the combinations of these contextual factors influence ICT uptake in the context of developing logistics markets as Nigeria represent what this study stands for.

Several theories, models, and frameworks have been developed in the research domain to predict factors influencing innovation diffusion (Sinha and Chandrashekar, 1992). The authors assert that the foundation studies (1960-70s), have been found rigid in their framework and strict in hypotheses formulation and testing. They also revealed that several of

the older research in the field concentrated on the external factors, making the research outcomes homogenous. One of the foundation theories for innovation diffusion includes diffusion of innovation (DoI) theory (Rogers, 1995), which postulates innovation diffusion as “the process through which an innovation is communicated amongst members of a social system over time.” It has been revealed that the research was initially published in 1962. The author also asserts that innovation diffusion involves four main components: the innovation itself; the communication channel; time frame; and the social system.

These align with the notion that innovation requires several elements to ensure its success, including awareness, described as channels of communication, and determinant of rate of acceptance and rejection of specific innovation. The literature also reveals that innovation adoption models developed around 1980-90s concentrated on the individual adopters, mainly relating to factors influencing technology innovation adoption. Within the business environment, technology innovations have been adopted to achieve competitive advantages, and in turn make skill and knowledge acquisition a critical factor (Wolfe, 1994, Cooper and Zmud, 1990).

Table 2-3: Characteristics of innovation adopters

Themes	Rank (%)	Description
Innovators	2.5	Venturesome and educated have greater propensity to take risk
Early adopter	13.5	Social leaders, popular, and educated
Early majority	34	Deliberate and many informal social contract
Late majority	34	Sceptical, traditional, lower socio-economic status
Laggards	16	The societal group who lacks the resources and willingness

Source: Rogers (1995)

Further, the DoI model by Rogers (1995) developed Bell and S-shaped curve concepts for demonstrating innovation diffusion across different categories of potential adopters over time, as well as factors influencing them to adopt. First, the Bell-shaped curve divides and ranked potential innovation adopters into five groups: innovators (2.5%); early adopters (13.5%); early majority (34%); late majority (34%), and laggards (16%), as demonstrated in Table 2.3. Other categorisations by the same author reflect different stages of potential innovation adopters pass before being convinced about a particular innovation (Table 2.4). Specifically, the first stage concerns awareness of a specific innovation, followed by persuasion (conviction), decision (commitment), implementation (actual use), and confirmation (well - convinced).

Table 2-4: DoI model

Stages	Description
Knowledge	Learning concerning the existence and function of the innovation
Persuasion	Becoming convinced of innovation values
Decision	Committing to the adoption of innovation
Implementation	Putting it into use
Confirmation	The ultimate acceptance or rejection of the innovation

Source: Rogers (1995)

The above illustrations reflect the importance of knowledge (education), societal influence, and time frame on rate of innovation, particular with individual innovation adopters. The S-curve, on the other hand, postulates that though innovation can be fully accepted within a specific societal setting, the profit margin accrued over time tends to improve gradually, until maturity is achieved. According to Kuznets (1930), S-curve represents the bedrock of the evolution of technology innovation. It has also been argued that attention should be given to the geographical and industry-specific factors that influence innovation diffusion, which coincides with the scope of the present study (Manfield, 1961, Griliches, 1957). Apart from the business environment, S-curve has been applied in the health sector to underscore the rate of epidemic diffusion across geographic settings (Manfield, 1961). Several criticisms have been attributed to DoI theory as follows: (i) Over-concentration on the users' component of innovation, with little or no interest in the innovation suppliers. (ii) Lack of attention to dynamics of different environments in which specific innovation occurs, which leads to inflated generalisability of DoI theory. (iii) The approach is accused of over-reliance on the static environment, and (iv) The approach lacks closer attention on the internal process the individual innovation adopters undergo (Attewell, 1992). This therefore identifies a gap in knowledge, particularly about the influences of dynamic environmental factors which the present study intends to fill. Also, this study underscores the effects of different internal processes across different categories of information system adopters within the local 3PL SMEs in Nigeria.

On the other hand, a framework has been developed that captures the economic aspects of innovation diffusion, reflecting the causal relationships between perceived savings and production inputs (Davies, 1979). The concept literally captures firm-level aspect of innovation

diffusion, found lacking in DoI. The specific objectives of the framework cover: (i) identifying factors influencing innovations amongst the sampled organisations. (ii) Mapping the interactions between firms' structure and innovation adoption processes. (iii) Assessing the firms' information gathering and dissemination channels, and (iv) the framework was applied to map the interactions between the forecasted and minimum acceptable pay-offs, which helps to understand innovation adoption permissible regions of the sampled firms.

To cover the supplier's aspect of innovation diffusion -business perspective Metcalfe (1981) improves on work by Kuznets (1929) and Burns (1934) on industrial growth and retardation, revealing how: (i) price and production costs evolve during innovation diffusion process. (ii) Schumpeter's theory of transient nature of innovator's profit represents a vital determinant of the rate of innovation diffusion. (iii) Evolution of innovation is causally related to the rate of diffusion, based on three basic effects; learning by doing, production bottlenecks, inducements. (iv) Finally, the study concludes by supporting the notion that attention should be given to the critical interaction effects of innovators and adopters, based on their potential in boosting technology performance. The study background was built from the understanding that technology innovations potentially diffuse at different patterns/rates across different industries and geographic settings, according to the sets of propositions outlined above. The bottom line is that economic theories play critical roles in determining technology innovation processes. The study also points to the effects of different economic equilibria. Above all, Metcalfe (1981) is of the view that technology suppliers and adopters exhibit complementary characteristics. Therefore, there is a need to sufficiently reflect on how the industry/geographic issues may represent a valuable entry point into empirical analysis of rates of ICT uptake in the logistics business environment. This is one gap this study seeks to fill.

Moreover, Utterback (1994) discloses the significant effects of the market characteristics on the rate of technology innovation diffusion. For example, radio frequency identification (RFID) has attracted an improved diffusion rate in the business environment, based on its critical stance in building competitive strategy. Stoneman (2002) adds that market characteristics combine to predict rate of diffusion of innovations, particularly in a geographic setting. This may also align with the claim as proposed in this study that institutional framework has a significant influence on the rate of technology innovation, following its overriding influence in determining the prevailing market characteristic, especially those within its jurisdiction. This study specifically draws insight from this phenomenon, as demonstrated by one of the research objectives: Mapping the effects of the institutional framework on the ICT innovation diffusion process in the Nigerian transport/logistics industry (see Table 1.1). It has been considered critical based on the inherent overriding influence of the institutional framework in

the region on the rate of ICT innovation diffusion within the entire logistics system in the region. The study envisages that both suppliers and adopters' sides of innovation could be impacted either way, depending on the conditions of the prevailing institutional framework

The 'market hype' concept by Gartner Group (1995) offers further explanations about the impact of market characteristics on technology innovation diffusion, comprising inter-group influences on technology innovation performance and profitability (Wind and Mahajan, 1997). Besides, the concept addresses diffusion as a dynamic process (Montalvan-Burbano et al., In press). Gartner Group (1995) specifically utilises graphic procedure to represent technology innovation diffusion into five diffusion processes, starting from technology trigger; peak of inflated expectation; trough of disillusionment; slope of enlightenment; and plateau of productivity (Table 2.5). The bottom line of the 'hype cycle' concerns over-rating of technology innovation, which renders the intended frustrated, especially when the particular technological innovation fails to perform optimally.

Table 2-5: Hype cycle

Phases	Descriptions
Technology trigger	The launch of technology innovation
Peak of inflated expectation	The over-enthusiasm and unrealistic expectation of technology innovation
Trough of disillusionment	The disillusionment phase, especially when new technologies fail to achieve the set target
Slope of enlightenment	Reassessment of technology innovation, even when the new technology has failed to meet its expectation
Plateau of productivity	New technology innovation is widely demonstrated

Source: GARTNER Group (1995)

Another school of thought builds on the impacts of cultural factors (e.g., language differences, distinctions between Northern and Southern culture, and cultural communication gaps) on the corporate innovation (Weia et al., 2019). Corporate alliance can be loosely defined as the processes involved in implementing innovation opportunities in an existing business model. This can be achieved through R & D, as well as corporate alliances. The authors specifically found as follows: (i) there is a significant relationship between local dialect and corporate innovation. (ii) There is a significant correlation between cross-cultural differences and

corporate innovation. (iii) Both in-group collectivism and institutional collectivism are critical in determining the effects of the culture on corporate innovation. Other empirical studies that share similar findings in the research field abound (Taylor and Wilson, 2012, Zheng et al., 2012, Han et al., 2010, Shane, 1993). Weia et al. (2019) define cultural influences on corporate innovation as the combination of the effects of how a specific set of people process external information.

Other aspects of cultural factors influencing corporate innovation include: (i) the effects of the national and institutional culture on corporate cash holdings (Han et al., 2010, Chang and Noorbakhsh, 2009) (ii) the cultural influences on corporate debt maturity (Zheng et al., 2012). (iii) the impact of geographical and cultural differences on corporate policies (Zhang and Wang, 2015, Bae et al., 2012), and (iv) the effects of the climatic variation on corporate innovation (Taylor and Wilson, 2012, Shane, 1993). Landes (1999) specifically found that corporate innovation thrives better in the tropical than colder regions. These are expected as environmental factors have been tipped as major drivers of ICT uptake, especially at firm levels and informed the development of research hypotheses for the present study (see Sections 2.2 and 4.2.3.5).

Two broad themes emerged from the synthesis of the special issues (SI) on the Corporate R&D and Innovation (CONCORDDi, 2017), including (i) innovation and firms' competitiveness, and (ii) policies and firms' innovation performance (Coada et al., 2019). The most revealing issue raised from the study, includes the need to pay closer attention to industry specific challenges affecting corporate innovation, which is conceptualised in this study. The authors buttress that the increasing complexities, associated with modern market system makes it critical to devise policy initiatives that would tackle industry-specific technology innovation diffusion challenges. For example, the review of the patent rights, this has been identified as barrier to innovation diffusion (Moncada-Paterno-Castello et al., 2017, Cantner and Kösters, 2012). Moreover, it is recommended that policy actions should be directed to SMEs' welfare, particularly concessions that would improve their capacities to innovate (Brown et al., 2017). This again represents a research gap covered in this study

In a similar vein, the review of the institutional framework and regulations in the area of improving cross-border investments has been recommended, which relates to the relaxation of labour/production market regulations. Apart from boosting cross-border cooperation that would facilitate innovation diffusion, the approach has been tipped to stimulate cross-border skill/expertise exchanges, which would, in turn enhance knowledge creation and accumulation. These reflect social aspects of issues affecting innovation diffusion in business (Dosso et al., 2018). In addition, Martin (2016) suggests that the development of the policies

should be evidence based to ensure that the predetermined objectives are achieved appropriately. The assumption made is that aggregating and jointly assessing some of the local issues affecting efficient ICT diffusion at regional levels can deepen understanding of mechanisms influencing ICT uptake and for necessary actions to be taken. This specifically informed the development of the first objective of the study which entails mapping diverse range of contextual factors influencing ICT adoption among the local 3PL SMEs in Nigeria.

Customers being the main target of most innovation and diffusion channels in business, their satisfaction rates represent a critical component of successful innovation. Customer relationship management is a unique area of research interest in the field, with broad relevance. Some of the customer relationship management strategies include ways to improve repeated buying rates to secure reasonably permanent market share (Evangelista, 2011, p 63). The principle can be generic, in relation to the linkage between returns on investment (ROI) and quantity of product or service innovation sold.

To ensure customers' satisfaction, in terms of technology usability and accrued benefits, outsourcing of technology demonstration and advising has recently been associated with technology innovation diffusion. In order to boost customers' satisfaction, customer driven business model innovation (BMI) has attracted improved research interest recently (Wirtz et al., 2016). Precisely, a framework has been developed that facilitates monitoring of customers' experience for new innovation (Keininghama et al., In Press). The scope of the framework is to match customers demand with firms' strategic competences. The success of the framework has been recorded low, based on the managers' over-reliance on their intuition or expertise for strategic decisions, rather than research-based evidence.

Another drawback of the framework relates to the overzealousness of most business organisation to maximise profit at the expense of their customers' satisfaction. These reflect the huge gap between BMI and customers' satisfaction in practice. The following recommendations have been raised to mitigate these gaps, including: (i) Enforcement of managers to rely on evidence-based decision, particularly strategic ones that may have long-term consequences on the competitive capabilities of the firms. (ii) Review of their existing business model to align with current realities in the market, which should be of course in line with the global best practice. (iii) Development of a feedback system to ensure close monitoring of the performance of the BMI. With these, the authors disclose that the lack of the demand aspect of the three-staged framework would be augmented.

Finally, the sustainability aspect of innovation diffusion in business refers to the critical roles played by innovation intermediaries in facilitating innovation process, while maintaining

sustainable principle (eco-innovation) (Kant and Kanda, 2019). The authors argue that the dynamic and complex characteristics of the business environment make the roles of the innovation intermediaries more critical and challenging. The study adopts a comparative case study research method, covering three continents: Europe, USA, and Australia. The study main focus relates to the evolution of the intermediaries to address CO₂ emission and storage, based on four themes; scope, objective, characteristics, and activities. The outcome suggests that neutrality, technology, shared consensus, and internal value creation are the hub for sustaining long-term roles of the intermediaries in boosting sustainable innovation process. The study concludes by emphasising the importance of incorporating substantiality as one of the key performance indicator (KPI) in the innovation and diffusion process in business environments.

2.1.2.2 Information Communication Technology (ICT) innovation in business

ICT innovations in business focus mainly on factors influencing ICT diffusion and adaptive processes to account for the transformation that usually accompanies e-commerce/business activities (E-business Watch, 2008). According to E-business Watch (2008), ICT refers to the “umbrella term that encompasses a wide array of systems, devices used for data processing.” For the industry-based definition, ICT entails information processing, communication, transmission, and display for the sole purpose of recording and controlling of manufacturing of products and provision of the services (OECD, 2002).

Table 2-6: Factors affecting IT implementation

Outcome interpretation	Contextual interpretation
Technology adoption strategies	IT innovation characteristics and the rate/pattern of diffusion (innovation adoptability; operational innovativeness)
Internal and external factors	Internal (characteristic of firms and IS unit) and external (propagating institutions/sectoral environment) factors
Final assimilation	Factors affecting the propensity to adopt/assimilate specific IT innovation (e.g., organisation innovation fit, innovation perception/social influence and innovation delivery system)

Source: Fichman (2000)

In this section, the concentration is mainly on the factors influencing ICT implementations in the business environment (Cooper and Zmud, 1990), which may not conform to the traditional

theories of innovation (Rogers, 1995). This may be linked to the complex and dynamic characteristics of the modern market systems (Eveland and Tornatzsky, 1990, Kelly and Kranzberg, 1978). Within the manufacturing industry, the applications of the ICT resources require efficient integration of both internal and external factors to ensure smooth coordination of manufacturing activities such as Material Requirement Planning (MRP). Apart from the internal physical factors, there are also issues bordering on intrinsic matters (experience and knowledge), which also affect the way compatibility issues are handled in the business environment (Tornatzky and Kleint, 1982). These are somewhat related to the adaptive and assimilation capacities of business organisations (Tornatzky and Fleischer, 1990), as demonstrated in Table 2.6

The three-staged ICT implementation processes reflect the phases several business organisations undergo to achieve implementations of ICT innovation, including mapping the strategies, adoption process (external and internal factors), and final assimilation (Fichman, 2000). Other contextual compatibility issues affecting ICT implementations in the business environment can be summarised with the following headings: two-part adoption process, knowledge barriers, and organisational learning; incomplete production dependency; and linked adoption decisions. The two-way adoption process specifically refers to internal communication challenges (e.g., between headquarters and branches, departments, units, workgroups, and individuals), which can be sorted with the implementations of transactional ICT resources such as ERP and email or telephone for communication purposes. The next internal challenge than can hinder effective assimilation of ICT resources relates to ICT experience and knowledge of staff concerning specific ICT applications. However, Metcalfe (1981) is of the view that both ICT innovation suppliers and adopters should cooperate in the area of producing user-friendly ICT tools, while on the other hand, the organisation can initiate internal ICT training mechanisms for their staff to ensure the overall performance of ICT innovation.

Further, incomplete production dependency refers to a situation where organisations require updating their internal infrastructure and intrinsic skills to be able to implement specific technology innovations. For example, asymmetric digital subscriber line (ADSL) requires particular infrastructure or imaging systems. On the other hand, linked ICT adoption decisions refer to when multiple organisations are required to agree before adopting specific intelligent technology (e.g., ERP and EDI). This is common in the modern market environment, where the cooperation of multiple organisations has become a huge source of competitive advantage in the present knowledge economy (Kelly, 1998). A practical example is the current shift from company versus company to SC versus SC competitions (Christopher, 2005). It has been

established that the imposition of adoption of relevant ICT recourses among the cooperating organisations, with the most powerful usually taking the lead (Angeles, 2005). However, in practice, firms operating in regions with acute infrastructural challenges are generally disadvantaged (Ezenwa et al., In press). This gap represents the primary interest of this research project, relating to the activities of the transport and logistics practitioners in the developing logistics market like Nigeria.

To recap, ICT implementations in business have been acknowledged as huge sources of value creation, efficiency, and competitiveness. These can be achieved by ensuring the compatibility of both internal and external factors (Mentzer et al., 2001). However, larger organisations are more positioned to explore and exploit these ICT resources and the associated benefits than the smaller firms (van Hoek, 2002, Larson and Gammelgaard, 2001, Van Hoek, 2000, Berglund et al., 1999, Peters et al., 1998). The present study also draws insight from this operational gap and uses the activities of local 3PL SMEs in Nigeria as a test-bed for the several phases of study undertaken in this research project. This is backed by their reported vulnerability, in terms of their inappropriate adaptability of ICT resources to achieve specific business objectives (Tob-Ogu et al., 2018). The next section covers understanding the mechanism influencing ICT innovation implementations and diffusion within the context of SMEs.

2.1.2.3 Innovation implementations and diffusion in small and medium enterprises (SMEs).

The SMEs referred to in this study include micro, small, and medium enterprises that have employment capacity, up to 199 persons, and annual turnover ₦500 million (£1.3 million) (SMEDAN, 2005). The details of the sizes of each category are presented in Table 2.7. This definition was adopted based on its convergence with the scope and context of this study.

Table 2-7: Definition of SMEs

Classes	Firm size	Annual turnover (₦)
Micro	≤ 9	≤ 5 million
Small	≥ 10 ≤ 49	≥ 6 ≤ 50 million
Medium	≥ 50	≥ 51 million

Source: SMEDAN (2005)

The possible undue influences of the owner-managers in the overall decision of the local SMEs have been acknowledged as a barrier for their effective ICT uptake (Awa et al., 2015). Others include size, flexibility, and innovativeness (Table 2.8). It is evident that SMEs are inherently disadvantaged due to their small size when compared with their larger counterparts. It has been found that the situation has negatively impacted their competitiveness, in terms of limited market shares, which has subjected them to be price takers. As a result, majority of

them have resorted to functioning as sub-contractors to the larger organisations (New Civil Engineering, 2019). On the other hand, most SMEs have been found more flexible to adopt innovations than the larger organisations (Tob-Ogu et al., 2018). Likewise, most SMEs have been reported to engage in innovative activities more than their larger counterparts (King et al., 2003).

Table 2-8: Differences between SMEs and larger business organisations

Themes	Description
Size	SMEs are inherently disadvantaged due to their small size, when compared with their larger counterparts.
Flexibility	The flexibility of most SMEs has positive impact on their adaptive capacities
Innovativeness	Most SMEs have been found more innovative than their larger counterparts

Table 2-9: The relationship between innovation and competitive advantage

Type of innovation	Description (impact on the competitive advantage)
Disruptive	Re-writing the rule of competition, including creating a new 'value proposition'
Radical	Offering a highly novel or unique product or service, with commensurate economic benefits
Complex	Difficult of learning, regarding sophistication of information systems and regulations
Continuous incremental	Continuous improvements of the cost/performance frontiers

Source: Tidd (2001)

However, controversies trail the above differences between the larger and smaller organisations, in terms of their innovation receptiveness, implementations, and assimilations (Piergiorganni et al., 1995, Acs et al., 1994, Acs and Audretsch, 1990, Jaffe, 1989, Pavitt et al., 1987, Bound et al., 1984, Rothwell and Zegveld, 1982, Galbraith, 1956, Schumpeter, 1942). Overall, it is established that the contradictory views border on industry/geographic-induced divergences, which reinforces the need to relate contextual issues affecting innovation implementations in the business environment in perspective. There is also a claim that the divergences in the research finding can be attributed to methodological deficiencies

(Avermaete et al., 2003). The combination of these issues represents the primary focus of this study, in terms of its concentration on a specific industry, geographical setting, as well as adopting multiple mixed-research methods.

The following research themes have been established as broadly relevant areas in the research domain: (i) Identification of relevant factors. (ii) Measurement of general impacts of innovation (iii) Implementation strategies (Motwani et al., 1999) and (iv) Impacts of several types of innovation in achieving competitiveness (Tidd, 2001). The specific impacts of various forms of innovations are presented in Table 2.9., comprising disruptive, radical, complex, and incremental. The concept remains the same as previously discussed, with only addition competitive applications. For example, disruptive innovations are usually linked to change of rule of competition in specific industries.

Radical innovations are usually technology-driven innovation, with a view to gain more competitive advantage, with the associated economic gains. Complex innovations are widely attributed to the difficulty in learning (internal) and applications (external). The former may concern a lack of requisite skills, while the latter reflects policy issues that could hamper the extent of applications of specific innovations. Last, the incremental innovations here still exhibit the market demand -induced characteristics, in terms of slight improvements in the existing products and services.

Amidst these revelations, there are still recommendations for the need to map how the contextual factors interact to predict the rate of innovation adoption/diffusion amongst the SMEs (Berry, 1996, Seborah et al., 1994). This again represents the research gap covered in this study. The list of the internal-external factors influencing innovation adoptions within SMEs has been offered by Keizer et al. (2002) (see Table 2.10). The authors claim that the main aim of engaging the research is to prove the relative competitiveness of the local SMEs, in line with the on-going transformation in the market systems.

According to the authors, the external factors comprise collaboration with other firms and linkages with the knowledge centre. The collaborations specifically entail collaborating with other relevant organisations (suppliers, manufacturer, and retailer, etc.) to help reduce the cost of implementations of technology innovation, formalisation of relationships, co-manufacturing, and improvement of customers' satisfaction. The linkages with the knowledge centres involve sourcing for consultancy and funding opportunities. For the internal factors, they include strategies, structure, level of education, and investment in R&D.

Table 2-10 : Internal and external variables affecting innovation efforts of SMEs

External variables	Internal variables
Collaboration with other firms	Strategies
-Collaboration with suppliers to overcome size constraints and to spread new technology costs and risks	-Clear strategies to stimulate internal creativity and risk-taking behaviour, and management of new production techniques (automation)
-Continued interaction with suppliers leads to low formalised relations that are difficult to achieve over a long distance	-Sound day-to-day operational framework
-Close working relationship with suppliers and customers in co-design and co-makership	Structure
-Customers are the primary source of improved technology for SMEs	-Application of project management structures
-Strategic alliance as an integral part of the firm's development plan	Technology policy
Linkages with knowledge centre	-Planning for the future
-Contributions by professional consultants, university researchers and technology centres	-Number of technology policy instruments used by firms
-Contributions by innovation centres and Chamber of Commerce	Level of education
Utilising financial resources or regulations	-Level of education of staff
-Availability of R&D funding	-Presence of qualified personnel
-Government financial aid	Investment in R&D
	-Ratio of sales volume versus R&D

Source: Keizer et al (2002)

The internal strategies ensure that relevant skills and attitudes are acquired for effective implementation of new production (automation) and service techniques and procedures. These may take a more prolonged period of planning. On the other hand, effective management of day-to-day operations may require a short period of planning. The structure entails physical equipment or accommodation of the organisations. The structure here also connotes the policy instruments that may help improve innovation adoption. The level of education represents the knowledge level of the entire strength, which may also inform the level of expertise. Last, investment in R&D reflects the ratio of sales volume and investment in R&D.

In Italy, lack of managerial competence, human resources, and financial constraints have been found as the major barriers to technology innovation diffusion among the local SMEs. (Buratti and Penco, 2001). Similarly, Tidd (2001) argues that majority of the local SMEs pay less attention to strategic issues as they are preoccupied with day-to-day operational challenges. The situation is blamed on the lack of finance and human resources.

Leonard-Barton (2004) suggests the need to understand specific contexts influencing innovation adoption amongst the local SMEs, in line with context-specific differences prevalent in the business environment. These have been buttressed in the previous sections. Also, Piater (1984) argues that external factors such as (i) Suppliers' ability to implement the relevant technological innovations would stimulate others in the SC chain to follow suit. (ii) The ability of the customers to either obtain the requisite infrastructure, competence, or willingness to pay higher for customised services. (iii) The availability of the favourable institutional framework as an enabling environment that would make the above factors responds positively. (iv) Also, the author highlights the need for the abolition of cultures that are inimical to innovation adoption and diffusion. For the internal factors, the author reinforces the need for improvement for skills and expertise amongst the SMEs, particularly their owner-managers. Perhaps, this can be used to back the decision to use the local 3PL SMEs for the questionnaire survey adopted in this study. Likewise, Keizer et al. (2002) discovered that the combination of both external and internal factors could significantly influence innovation adoption amongst the local SMEs. These include links with knowledge centre; government-led innovation subsidies, favourable policies, and substantial investment in R&D.

Further, sustained learning processes have also been found as a source of innovation adoption amongst the SMEs (Rominj and Albaledejo (2002). The author proposed a conceptual framework to that effect, involving the professional background of the owner-managers, skills of the employees (internal factors), and intensity of networking (external factor). In a similar vein, entrepreneurial skills, skilled employees, and relevant environmental factors represent significant sources of innovation adoption capabilities among the local SMEs (Abou-Shouk et al., 2016). Edwards et al (2005) conclude that innovation diffusion mechanisms, covering local SMEs, should be framed around the prevailing environmental factors such as institutional framework (policies and regulations), intermediate industry structure (supplier and other collaborators), and internal factors (physical and intrinsic resources). These in-depth revelations guided the formulation of several context-specific issues explored in this study.

2.1.2.4 ICT innovations in SMEs

ICT innovations have been acknowledged relevant for both larger and smaller firms, based on the following broad reasons: (i) efficient collaboration, (ii) quick access to market opportunities, (iii) real-time coordination, and (iv) efficient feedback system. Despite these benefits and more, local SMEs have been found lagging, regarding ICT innovation implementation and assimilation (Yap et al., 1994). The comparative study of the European Commission (2005) establishes that larger firms in Europe adopt up to 25% and 13 % of ERP and CRM, respectively. On the contrary, the smaller firms are far behind with 10% and 3% adoption levels of the same ICT resources. Similarly, it is revealed that SMEs are slow in exploring and exploiting e-commerce services (Brown and Lockett, 2004). The authors argue that there is lack of theoretical frameworks for accurate predictions of factors influencing ICT adoption among SMEs. Likewise, it has been revealed that qualitative studies are failing to explain factors influencing ICT innovation among the local SME (Wagner and Fillis, 2005). Large firms have also been found to be more involved in manufacturing automation than their smaller firms (Corso et al., 2001).

Few studies within the context pinpoint cultural differences (Erumban and De Jong, 2006) and changes in the market structure (Caselli and Coleman, 2001) as the primary sources of ICT innovation adoption barriers. Also, Thong (1999) is of the view that previous studies in the field have concentrated mainly on mapping individual issues affecting implementations of ICT innovation rather than focusing on the interrelationships of the factors. The author also linked lack of context-specific studies as the major barriers for limited robust research findings. Others conclude that lack of empirical studies in the field is the primary cause of little or no theoretical framework guiding ICT innovation uptake among local SMEs, as well as impacts in their operations (Ezenwa et al., In Press, Fichman, 2000).

Generally, there is a notion that a lack of unified theory, model or framework in the field relates to the complexities that trail benchmarking of innovation. It is within this premise that it is recommended that research interests should be drawn towards the development of mid-range innovation diffusion/adoption theories, models, or frameworks for specific contexts (e.g., ICT innovation in SMEs) (Vidgen et al., 2004). It is against this backdrop that the authors proposed a web-service transformation model, divided into five stages (see Table 2.11).

The first stage reflects the need to enhance web-services, in terms of integrating it with the existing information systems (IS). Second, creating awareness for web-services and technologies. Third, developing framework for assimilating web-services/technologies into the

existing IS. Fourth, integration of web-services/technologies into business models to achieve specific business objectives (e.g., collaboration and networking).

Table 2-11: Web-service transformation model for SMEs

Stages	Description	Remarks
First	Web-service enhancement	Integration with existing IS
Second	Web-service sourcing	Creation of awareness
Third	Application brokerage	Assimilation
Fourth	Collaborative commerce	Integrating into business models
Fifth	Business reconfiguration	Radical or disruptive innovation

Source: Vidgen et al. (2004, p 376)

Last, business reconfiguration (radical or disruptive innovation). At the end, the authors recommend further studies to concentrate in developing frameworks that would guide sustainable ICT innovation, particularly within the context of SMEs. Some of the shortcomings of the model include lack of recognition of the effects of contextual issues such as firm size, resources, industry characteristics, geographical-induced limitations. Methodologically, the model is limited by engagement of single case study.

The above finding aligns with the claim of Gengatharen and Standing (2004) that frameworks for efficient ICT innovation diffusion among SMEs are sorely lacking. The above arguments align with the notion that previous and existing research in the field concentrate on larger organisations rather than their smaller counterparts. The primary consequential effect includes lack of applicability of prevailing models and frameworks among the SMEs due to inherent differences in scopes of businesses and management as previously discussed. In a bid to ensure that SMEs are carried along in the modern market system, where ICT-facilitated disruptive innovations have become a usual practice, Poon and Swatman (1997) propose a stage-based process model. The main input is the recognition of the need for organisational adjustments to be able to accommodate the wide-spread disruptive ICT innovations in business. Some of the recommended areas of adjustments include, inter organisational networking, selective and full local integrations to maximise the strategic positioning of the local SMEs. Some of the potential benefits according the authors include optimal exploration and exploitation of the sophisticated ICT innovations.

The above proposals relate to the assertion that recognition of the inherent constraints of the local SMEs, regarding size and resources may represent a way forward towards addressing their ICT innovation adoption challenges (Buchanan et al., 2005). Other recommendations by the authors include (i) Simplicity of the ICT implementation mechanisms. (ii) Correction of the assumption that ICT innovation adoption follows a progressive linear trend. (iii) Recognition of the non-homogeneity of the local SMEs. (iv) Utilisation of evidence-based facts in making strategic decisions, relating to implementation of specific ICT innovations. (v) Improved emphasis on contextual issues affecting ICT innovation implementations among the local SMEs rather than relying on generic assumptions. These buttress the need for developing real-time mediums (e.g., live chat platforms) where the ICT innovation suppliers and users engage to ensure efficient implementation of ICT innovations. These help to inform the research questions of this study especially research questions iii-v (see Table 1.1) which concerns understanding the impact of the potential diversity of the local 3PL SMEs on the quality of their ICT uptake.

Alternatively, other scholars recognise the need to increase awareness concerning the inherent strength that the local SMEs can explore, for example, flexibility (Vidgen et al., 2004, Venkatraman, 1994). This may be linked to the increasing dynamics and complexity of the modern market systems that require flexible adjustments as a competitive advantage. With this in view, Thong (1999) found the following factors as the major determinants of SMEs' characteristics: background of the owner-managers, quality of IS, organisational, and environmental characteristics. This still reflect the combined effects of the both internal and external factors on firms' characteristics. The author recommends that future studies should concentrate on the most important factors influencing ICT innovation among the SMEs, which would help in mapping strategic plans as well as directing policy actions accordingly. However, the following limitation applies in the research findings; lack of recognition of the overriding influence of local institutional framework.

Still on the owner-managers' influence on ICT innovation among the local SMEs, it is discovered that individual difference factors such as experiences and knowledge combine to influence the type of approaches (proactive and reactive) applied by firms to achieve ICT innovation (Wagner and Fillis, 2005, Martin and Matlay, 2001). The consequential effects include firms' readiness and exploitation of potential benefits of specific ICT innovations. Also, external pressures has been named one of the major determinants of ICT innovation implementation in SMEs (Mehrtens et al., 2001). Lack of strategic positioning and data protection challenges have been found the main barriers of ICT innovations among SMEs, as well as customers' quest for customised services (Boyes and Irani, 2004).

Within the context of developing countries such as Nigeria, research has shown that environmental challenges, mainly lack of facilitating conditions is the major barrier of ICT innovation adoption among the local SMEs conditions (Apulu, 2012). The study adopts a qualitative study approach in the form of case studies to make the findings. The study site includes mainly Lagos State, Nigeria, mainly for being the major commerce nerve centre of Nigeria and the entire Sub-Sahara Africa (SSA). In a similar dimension, literature shows that environmental pressures such as movement towards globalisation, future survival pressure, technology adaptation challenges, and pressures for business partners and competitors pressure combine to influence extent of ICT innovation adoption among SMEs (hospitality) in Egypt (Abou-Shouk et al., 2016). The study adopts advanced statistical technique to test the conceptual framework and used it to extend the technology acceptance model (TAM) (Davis et al., 1989, Davis, 1989). Other specific revelations from the study suggest that marketing and internal business efficiency represent main driver of ICT innovation, mainly for developing strategic plans. Overall, the small hospitality organisations in Egypt are motivated by perceived benefits by 32%, and discouraged by perceived barriers with 68%.

Moreover, industry-specific characteristics such as SC helps to determine the level of ICT innovation exploitations, particularly among the smaller collaborating partners (Windrum and De Berranger, 2002). Specifically, it was reported that rate and types of ICT innovation application differ across SC, for example haulage companies, vehicle manufacturing and assembly companies, insurance, and clothing organisations are keener about implementing transactional ICT resources such EDI. On the other hand, chemical and advertising firms concentrate on communication ICT tools, mainly external communication (Spectrum/DTI, 2001). The report buttresses that implementation of the EDI in the vehicle manufacturing industry ensures closed loop SC network to main just in time (JIT) product deliveries. Similarly, EDI helps in monitoring and tracking production process and timely delivery of products. However, the report did not capture the strategic position of the smaller firms, regarding effective implementation of EDI in the mentioned industries. Several of these issues informed the development of the research objectives and the corresponding research questions (see Table 1.1). Issues affecting efficient ICT implementation in SC and logistics are covered in the next chapter, which helps to shed light on the direction of the present study.

In these studies, lack of adequate framework to underpin various contextual factors influencing ICT adoption among the local SMEs are conceived broadly to represent the research gaps the present study intends to fill. Specifically, there is a lack of understanding of how the combination of regional, industry and operational issues combine to influence rates of ICT uptake among local SMEs. This thesis draws insight from these broad perspectives to

develop three major themes covered in this study – operational, industry, and regional (institutional) specific research objectives and corresponding questions. The next section covers the theoretical groundings and analytical considerations involved in the research methods.

2.2 Theoretical groundings

This section explores the theoretical groundings and analytical considerations that guide the development of the four-phased study.

2.2.1 Conceptualisation of the causal model

The concept behind the development of the causal model (see Chapter 4, Section 4.2.3.5) relates to the need to accurately predict factors influencing ICT adoption amongst the local SMEs (Awa et al., 2015), as well as to identify interrelationships of factors influencing ICT adoption amongst the small and medium third-party logistics operators (Evangelista and Sweeney, 2006). The latter is envisaged to help identify the direct and remote causes of the rate of ICT adoption amongst the local 3PL SMEs. According to Awa et al. (2015), there is limited information concerning the intermediate characteristic of the local SMEs concerning ICT adoption. This is based on the argument that the possible undue influences of the local owner-managers on the strategic decisions (including ICT adoption) of their firms may trigger local SMEs to exhibit intermediate characteristics, which is yet to be captured in the research domain.

In an attempt to bridge this theoretical gap, Awa et al. (2015) proposed an integrated framework, covering theory of reasoned action (TRA) (Fishbein & Ajzen, 1975), theory of planned behaviour (TPB) (Ajzen, 1991), theory of technology acceptance model TAM (Davis, 1989), and technology-organisation-environment (TOE) framework (Tornatzky and Fleischer, 1990). The author added perceived trust (PT), individual difference factors (IDF), organisation mission (OM), and perceived service quality (PSQ) (see Figure 2.2).

The present study tapped into this understanding to develop the causal model, with the recommendations of relevant stakeholders that helped in the selection of the relevant constructs. Overall, seven constructs were selected, including consumer readiness (CR) (readiness of the local logistics operators and their collaborators towards ICT uptake), scope of business (SB), and facilitating condition (FC) as the external (exogenous) constructs. Others include perceived usefulness (PU) and perceived ease of use (PEOU) as the mediator variables, followed by ICT experience and education status of the owner-managers as the moderating

variables. The combination of the proposed three distinct process relationships led to the development of 12 hypotheses (see Chapter 4, Section 4.2.3.6).

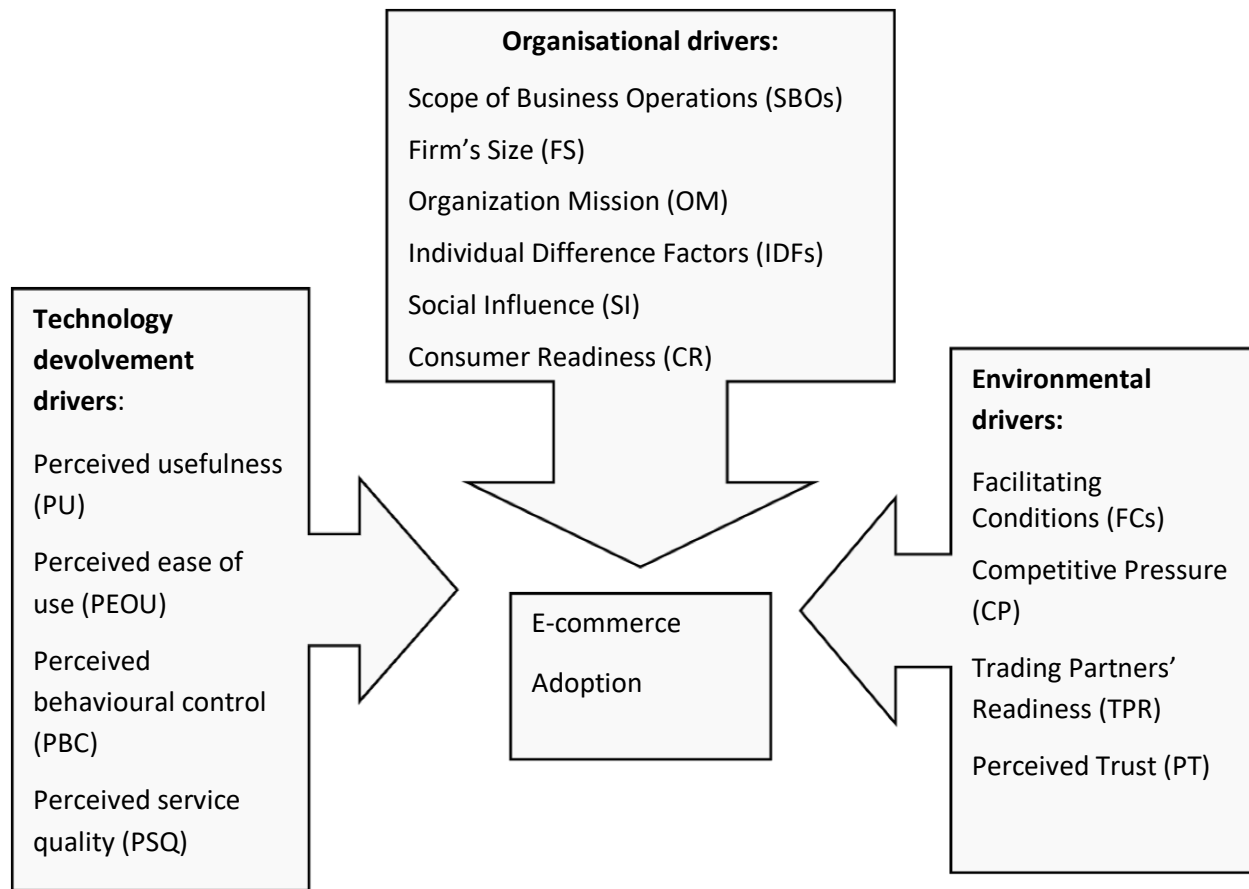


Figure 2-2: Integrated framework for SMEs' E-commerce adoption (Awa et al., 2015)

Specifically, the causal model (process relationships) proposes that: (i) there are causal relationships between the external (exogenous) constructs (CR, SB, and FC) and the dependent (endogenous) constructs (ICT acquisition and decision quality) and mediated by PU and PEOU. (ii) The external constructs interact amongst themselves to influence the mediator constructs, and (iii) the proposed causal relationships between the external constructs and the mediators, as well as the dependent constructs, are moderated by the ICT experience and education status of the owner-managers (see Chapter 4, Section 4.2.3.5 for details). The literature behind the selected constructs and discussions about the proposed causal relationships, particularly concerning the intermediate characteristics of the local 3PL SMEs, are presented below.

2.2.1.1 Technology development drivers

The traditional theories that predict system adoption at the individual level include theory of reasoned action (TRA), theory of planned behaviour (TPB), and theory of acceptance model (TAM). Specifically, TRA postulates that adoption of a new system is guided by the attitudes of

the intended user, together with the surrounding social norms. TPB is rooted in this concept with the addition of perceived behavioural control (PBC), which argues that behavioural intention to adopt a new system is influenced by the evaluation of consequences of adopting a new behaviour. TAM is also rooted in TRA, with the inclusion of two mediation constructs, perceived usefulness (PU) and perceived ease of use (PEOU), which combines to predict actual use of a new system (Davis et al., 1989). Specifically, PU concerns how much the adoption of a new system will be able to enhance the ability to execute specific tasks. On the other hand, PEOU concentrates on how much effort is needed to use a particular system efficiently. The simplicity of TAM is attributed to the removal of the attitudinal concept proposed by TRA and replaced by PU and PEOU constructs (Venkatesh & Davis, 2000).

Some critics of the TAM argue that it lacks sufficient explanatory power, relating to the effects of external factors on the mediating influence of PU and PEOU on actual use of system use (Annosia et al., 2019, Awa et al., 2015). Further, it is argued that the proposed relationship between behavioural intention and actual use of a system does not capture the inherent complexities that trail adoption of a new system (Straub, Keil, & Brenner, 1997). Some are of the view that the need for actual adoption should be the primary determinant and not behavioural intentions (Chuttur, 2009). It is within this premise that TAM has been extended with the unified theory of acceptance and use of technology (UTAUT) (Venkatesh & Bala, 2008), which aims to explain intentions and subsequent use of a particular system. The theory holds that performance expectation, effort expectation, social influence, and facilitating conditions are the major determinants of behavioural intentions to adopt a new system. This is often the case for ICT innovation in business, driven by financial gains and social structure. In this study, a similar concept is followed to map the intermediate characteristics of the local SMEs, where the owner-managers are perceived to be a major deciding factor.

Moreover, Rogers (1995) argues that innovation adoption follows a definite order, with the initial knowledge of existing innovation, persuasion, the decision to adopt or not, implementations, and final confirmation (assimilation). The author further argues that the decision to adopt is guided by the following characteristics of a new system: relative advantage over other competing systems, compatibility with existing infrastructure and values, complexity (ease of use), trialability, and observability of impacts in an existing system. The above literature reflects the mechanisms influencing ICT adoption within the contexts of individual-level settings. As observed, the review outcomes revolve around the potential benefits to be achieved through the application of a new system and the associated efforts needed to efficiently adopt a system, comprising the acquisition of relevant skills, values, and physical infrastructure. The value aspect reflects the subject norm. It is based on these

revelations that PU and PEOU are adopted in this study as the mediating variables, as demonstrated in the causal model (Figure 4.10, Chapter 4). Also, the decision is taken to achieve the integration of the individual and firm ICT adoption factors for accurate prediction of mechanisms influencing ICT adoption among the local SME (Awa et al., 2015). For a clearer understanding, factors influencing ICT adoption influencing ICT adoptions at the firm level are assessed next.

2.2.1.2 Organisational drivers

The firm-level perspective of factors influencing ICT adoption comprises broadly technological-organisational-environmental factors (T-O-E) (Tornatzky and Fleischer, 1990). T-O-E is criticized primarily based on its broadness and over-emphasis on larger organisations (Awa et al., 2015). The technological development aspect (Kauffman & Walden, 2001) concerns those factors that influence the decision to adopt new systems, which coincide with Rogers's (1995) characteristics of diffusion of innovation (DoI). These suggest that firms with requisite internal infrastructure and requisite skills are likely to adopt a specific system, with the intention to achieve competitive advantage (Zhu & Kraemer, 2002; Zhu, Kraemer, & Xu, 2002, Kwon & Zmud, 1987). It also depicts that a specific system needs to be relevant for a particular circumstance before adoption takes place. IT skills is also classified as critical and intangible assets of organisations, which is difficult to imitate and in turn, boosts competitive advantage (Metaxiotis, 2009, Scupola, 2009). Importantly, the technological issues correspond to the perceived benefits and barriers issues highlighted above.

Organisational factor concerns those factors that influence organisational conditions and reconfiguration (Chatterjee, Grewal, & Sambamurthy, 2002), including scope of business (SB), consumer readiness, administrative support, company culture and structure. The structural aspect reflects management styles, such as centralisation, formalisation, and vertical differentiation that firms adopt. Others include the quality of staff and specialty (Jeyaraj, Rottman, & Lacity, 2006; Sabherwal, Jeyaraj, & Chowa, 2006; Tornatzky & Fleischer, 1990). The scope of business (SB) concerns its influence on the rate of ICT implementation in an organisation (Hitt, 1999). It also corresponds to the critical importance of the ICT resources in enhancing coordination, collaborations, customer relationship, and visibility, running cost reduction, inventory management, and record-keeping (Zhu et al., 2003 Chopra & Meindl, 2001, Bakos, 1998). Consumer readiness (CR) refers to the ability of intended users to understand the usefulness of a new system and acquisition of the relevant skills, which in turn, determines the market volume of specific IT innovation (Zhu et al., 2002). Literature indicates that lack of ICT resource penetration in developing countries as Nigeria dampens their potential to conduct e-commerce, which in turn affects CR (Ayo, 2008). However, the trend is

believed to have improved recently due to the proliferation of desktop computers and mobile devices, but not for economic purposes (ITU, 2016). It has also been recommended that the development of common language, technology networks and virtual space can help stimulate CR through enhancement of learning capability, trust-building, and motivation (Sawhney and Prandell, 2000).

Another organisational factor considered in this study is the individual difference factors (IDF) (Awa et al., 2015), linked to the uniqueness of organisations regarding aspects such as vision, mission, culture, and leadership (Hambrick & Mason, 1984). Leadership is identified as the most critical in terms of decisions regarding ICT implementation in organisations, connected to their attitudes, perception, and motivation of the top-management staff. Others include their age, gender, experience. Experience is also tipped as the most relevant factor amongst the list (Zmud, 1979), based on the potential replicability of previous experience on a similar new ICT resource (Dabholkar, 1992). It also aligns with the notion that individuals with prior experience about ICT innovation are more likely to simplify supposed complexities and boost perceived usefulness in returns.

Similarly, self-innovation and invention are found to be positively influenced by education status, relating to risk-taking, cognitive preference, belief/value system, and receptiveness to technology innovation (Hambrick & Mason, 1984, Becker, 1970). Similarly, Bass (1969) argues that enhanced education status stimulates social relationships and activities, which in turn boost ICT innovation. There is also the notion that people with quality education are aggressive seekers of innovation as they utilise their knowledge and skills to handle ICT innovation complexities (Rogers, 1995). Agarwal and Prasad (1999) found that people with enhanced education and experience are more likely to achieve the five characteristics of innovation diffusion - relative advantage, compatibility, complexity, trialability, and observability (Rogers, 1995). These combine to suggest the importance of ICT experience and education in stimulating ICT innovation in organisations.

The combinations of the issues presented here helped in guiding the decisions for selecting scope of business (SB) and consumer readiness (CR) as external (predictor) constructs of the causal model. Likewise, the study adopts ICT experience and education status as the moderating variables. The next external (predictor) construct covered in this study is the facilitating conditions (FCs), covered in the environmental issues below.

2.2.1.3 Environmental drivers

The environmental factors encompass primarily external factors that influence the rate of ICT diffusion within industry environment (Annosia et al., 2019, Kowath and Choon, 2001),

including competitive pressure, trading partner's readiness, socio-cultural issues, government and technological supports, and infrastructure (Scupola, 2009, Al-Qirim, 2006; Jeyaraj et al., 2006, Zhu, Kraemer, Xu, 2003). Other factors include law, policies, trade union and association activities, and awareness. The combinations of these issues are termed facilitating conditions (FCs) (Thompson et al., 1999, Triandis, 1980). Hence, it is argued that firms operating in an unfavourable business environment where the requisite FCs are lacking are bound to close business as the internal factors are inherently subjected to external counterparts (Mische, 2000). However, firms are advised to engage in environmental analysis and diagnosis in order to base their critical decisions on evidence-based facts rather than mere speculation or intuition of their top-management (Raymond & Blili, 1999). The suggestion is based on the market volatility and dynamics of the business environment. It is against this backdrop that the facilitating conditions (FC) construct is tipped as one of the external (predicting) constructs in the causal model.

2.2.1.4 Summary and analytical considerations

Based on the reviews, this study proposes that the dependent constructs (ICT acquisition and decision quality) are positively influenced by the external constructs (CR, SB, and FC), and mediated by the PU and PEOU constructs. The proposal is supported by the notion that the propensity of the local 3PL SMEs to acquire the relevant ICT resources and their ability to assimilate them in their activities to the point of yielding economic values (decision quality) depend on the readiness of the owner-managers, their scope of business, and the business enabling environment (facilitating conditions). Besides, due to the possible overriding influence of their owner-managers, the mediation constructs are introduced to highlight the possible modulating effects of the owner-managers perception of the usefulness of a specific ICT tool, as well as their ability to adopt the individual ICT resource(s) conveniently. It is against this background that this study hypothesises that PU and PEOU significantly mediate the causal relationships between the external variables and the dependent variables (see Section 4.2.3.5, Chapter 4 for the developed hypotheses).

Secondly, the study proposes that the external (exogenous) constructs interact amongst themselves to influence the mediators. These align with the complexity and the dynamics that trails scope business and its local operating environment, with their potential effects on the causal relationships between the readiness of the owner-managers and mediator constructs. The study envisages that the potential causal relationships of the owner-managers' readiness to adopt relevant ICT resource(s) and their PU and PEOU are also dependent on the scope of business and the environment (facilitating conditions). Likewise, the study proposes that causal relationships of the firms' scope of business and the mediator variables are also

dependent on the interaction effects of the FCs. The proposals are backed by the notion that PU and PEOU alone cannot sufficiently mediate the external effects on actual system adoption (Awa et al., 2015). Also, the proposals help to address another shortcoming of TAM, particularly regarding its limited explanatory power of adopters' opinion. Hence, the study hypothesises that the causal relationships between CR and the mediators' variables depend on the interaction effects of the SB and FCs. Similarly, the study hypothesises that the causal relationships between SB and the mediator variables are dependent on the interaction effects of the FC (see Section 4.3.1.4, Chapter 4 for the developed hypotheses).

Third, the study proposes that ICT experience and education status of the owner-managers influence the potential causal relationships between SB and PU; CR and IA, respectively. These are based on the notion that the extent the SB can be causally related to the PU will depend on the ICT experience of the owner-managers. This is supported by the specific roles that past experiences play on simplifying the potential complexities/learning curve of using a new system, and the associated impact on PU (Zmud, 1979, Dabholkar, 1992). Similarly, education status plays in boosting the confidence of the intended new user of a system, and in turn, the actual acquisition (Hambrick & Mason, 1984, Becker, 1970). These combine to reflect the potential overriding influences of the owner-managers on the strategic decisions of their firms, which is the concern of the present study. Overall, these proposals align with the proposed intermediate characteristic of the local SMEs, which is rarely captured in the research domain. Therefore, the study hypothesises that ICT experience and education status of the owner-manager significantly moderate the causal relationships between SB and PU; CR and IA, respectively (see developed hypotheses in Section 4.3.1.4, Chapter 4).

Finally, the analytical considerations comprise those adjustments made through the recommendation of the selected local stakeholders for the suitability of the causal of the model, relating the specific circumstance of the study investigation. Some of those adjustments include the classification of CR as an organisational factor and facilitating conditions as an environmental factor. These factors appear to have dual characteristics in literature, depending on the perspective the authors explore. For example, FC and CR can be internally or externally generated. In this study, FC is considered from the external perspective, while the CR is explored from the internal angle. Due to the specific attention given to the local 3PL SMEs in this study, the CR variable represents internal readiness of the local 3PL SMEs, as well as their collaborators to adopt the relevant ICT resources to boost their operations. These follow the lack of commonality in the definition in the field, which has often meant that research variables or indicators must come from specific contextual issues considered (Wolf et al. 2013).

2.2.2 Adaptation of Structure-process-outcome model

This study adapts the structure-process-outcome model (Donabedian, 1988), based on the need to map and compare the linkages between the local 3PL SMEs' internal and external resources, ICT adoption processes, and the logistics performance. The approach is in line with the contingency approach that the study proposes for the local logistics operators, relating to dealing with ICT adoption issues in the industry. The approach coalesces around the principle of no best way to organise an organisation, especially when it comes to taking strategic decisions with potential long-term effects in a volatile business environment as Nigerian transport and logistics industry.

The model originates from the health sector, where it is used to identify various dimensions involved in delivering quality healthcare, divided into structure, process, and performance. For example, the structure can be attributed to the interaction between the personnel characteristics and the environment where healthcare services are delivered. The process involves the activities surrounding healthcare service deliveries, including technical and scientific applications and interpersonal relations, to improve the quality of healthcare. Lasts, the performance can be ascribed to how much the predetermined activities are achieved (Ammenwerth et al., 2007, Kunkel et al., 2007, Ransom et al., 2005).

In the logistics research domain, the concept is applied to uncover the extent adopted ICT resources are supporting the improvement of SC processes (Xie and Breen, 2018). The outcome of the study suggests that logistics performance is influenced by the functionality of the SC structure (ICT skills, infrastructure, and quality of data). Other findings of the study suggest that logistics performance in health care is rated based on the effectiveness and efficiency of healthcare management, unlike in the business, where achieving competitive advantage is usually the primary target. The study concludes by recommending implementations of track and tracing devices in health organisations to help in updating records (e.g., maintenance and replacement data) of medical devices. Overall, it is expected that such data would help in taking evidence-based decisions. A similar study suggests that significant links exist between inventory and freight management and cost reduction and quality of health care deliveries (Baffo et al., 2009). Chen and Paulraj (2004a) assert that CT-facilitated SC processes can be transactional (finance transactions) or communication across various components of the SCS to achieve SC performance

The above concept is adopted in this study where the interactions between the internal and external resources such as the ICT skills, ICT resources, and the overall structure of their affiliated SCs are termed the structure; the activities surrounding the ICT uptake, are termed

the ICT adoption process; and the logistics performance being the predetermined outcomes, relating to efficiency, accuracy, effectiveness, alignment, agility, adaptations. It is envisaged that the concept would help underscore the various ways the local 3PL SMEs are responding to the ICT diffusion challenges in the industry. Besides, the approach is deemed a necessary way to explain salient points around the earlier outcomes of the study. For example, to explain why there are significant differences in the moderating effects of the ICT experience and education status of the owner-managers (Ezenwa et al., 2018).

Overall, the approach would help explain how a lack of logistics competence on the part of local operators constitutes low logistics performance in Nigeria (World Bank, 2018). Also, the approach would help unveil different approaches (reactive and proactive) the local 3PL SMEs adopt in dealing with strategic issues such as ICT adoption in their organisations. The study envisages that such information would be critical in designing a holistic approach in dealing with ICT diffusion challenges in the Nigerian transport and logistics industry and others in a similar setting.

2.2.3 Institutional theory application

The approach is tagged critical concerning the potential overriding influence of institutional framework influences on the overall factors influencing ICT diffusion in the Nigerian transport and logistics industry (Ezenwa et al., In press). Precisely, institutional theory reflects how the formal structure of organisations is shaped by the surrounding institutional framework (Bell, 1973). A similar definition suggests that organisational structure and functions are subject to surrounding rationalised institutional rules (Meyer and Rowan, 1977). The authors argue that the relationships between institutional rules and organisational efficiency often conflict and retards organisation productivity in returns. The primary shortcoming of institutional theory is the lack of recognition of firms' ability to evolve and innovatively re-strategize, in line with the prevailing institutional framework (Palsson and Kovacs, 2014, Tate, 2014).

The above revelation is critical for the development of the ICT diffusion framework from the study, which aligns with the prevalent institutional voids in the Nigerian transport and logistics industry (Ezenwa et al., In Press). The application of institutional theory in this study is to help cover the lack of recognition of the consequential effects of the institutional framework on the ICT innovation and application in business. As such, the study argues that external factors such as institutional framework play a critical role in ICT diffusion and adoption in regions and amongst organisations. In this case, institutional issues are categorised as the bedrock of ICT diffusion challenges in the Nigerian transport and logistics industry, based on its potential linkages on the local logistics system (Banomyong, 2017, Banomyong et al., 2008).

Conceptually, a measure along with the influences of the institutional framework on the local logistics structure, and, in turn, the operations of the logistics operators makes sense, based on the inherent overriding characteristics. This scope of the study appears to be lacking in the research domain (Grant, 1991, Wernerfelt, 1984, Dimaggio and Powell, 1983).

2.3 Conclusion

This chapter concentrates on conceptual development and theoretical groundings that guides the present study. The outcomes of the thematic literature review suggest the need to connect empirical testing as done in this study with relevant theories to boost the validity and robustness of the research findings (Seter, 2016). This aligns with the complexity and dynamics that trail the research problems. Moreover, it is believed that findings are more convincing when research inquiries are based on the relevant causal links, with associated hypotheses as they help establish deep and insightful results (Burke et al., 2015).

Importantly, the literature review helps to put different theories, models, and frameworks in the research domain in perspectives, mainly as they affect ICT adoption among the local SMEs and within the context of developing countries. It is argued that without such considerations, the research finding may fail to capture the actual context the present study represents (Lawrence and Tar, 2010, MacGregor and Kartiwi, 2010). The literature review also indicates the need to place ICT adoption and diffusion issues in business under socio-economic and political lenses (Dayan and Ndubisi, In press). Other pertinent issues raised in the literature review related to the heterogeneity of findings, particularly in terms of internal and external factors and firm and individual ICT adoption characteristics. The development has been linked to the lack of benchmarking of several factors that influence system adoption and diffusion in the research domain (Dayan and Ndubisi, In press).

It is against this backdrop that the selection of the various constructs adopted in this study was made with great caution to ensure that locally-evolved issues involved are not misrepresented. Similarly, desktop research pinpoints different motives that guide ICT innovation in different organisations that logistics services are outsourced; for example, the case of health organisations that concentrates on efficiency and effectiveness rather than maximisation of profits. It is based on this notion that the multiple case studies of different local SCs in the study site are considered critical, with the intention to have a complete overview of different contextual issues involved in the identified research problems. Moreover, despite the theoretical progress in the ICT innovation diffusion and adoption, particularly in business, there remains apparent gap regarding how intermediate firms (local SMEs) are influenced, theorised or modelled as critical components of local and global

economies (Awa et al., 2015). The authors argue that there is a need to sufficiently reflect on how local SMEs are represented in the information system discourse. This is one significant gap identified in this chapter that the present study intends to fill.

It is worth mentioning that the developed research objectives/questions (Table 1.1) are guided by the identified research gaps in this chapter. Specifically, Previous research has focused on larger organisations (van Hoek, 2002, Larson and Gammelgaard, 2001, Van Hoek, 2000, Berglund et al., 1999, Peters et al., 1998), particularly the manufacturing sector (Thether et al. 2001). The absence of identification and measurement of relevant factors influencing ICT adoption, especially amongst the local SMEs (Awa et al., 2015) represent some of the reasons for developing the first and second objectives of the study. Similarly, perspective regarding ICT diffusion/adoption challenges in the developing countries as Nigeria (Tob-Ogu et al., 2018), as well as lack of industry-specific issues (Moncada-Paterno-Castello et al., 2017, Cantner and Kösters, 2012, CONCORDDi, 2017), encourages the development of the third objective of the study, which concentrates on the in-depth industry issues affecting ICT adoption amongst the local 3PL SMEs across the major industries in the region. Like an aggregate approach at the national and global scales, the fourth objective of the study is developed to account for the potential overriding influences of the institutional framework over other components of the logistics system (Banomyong, 2017, Banomyong et al., 2008). This aligns with the notion of framing ICT diffusion strategies, particularly amongst the local SMEs around prevailing environmental factors such as institutional framework (policies/regulations), industry structure (suppliers and other collaborators), and internal factors (physical and intrinsic resources) (Brown et al., 2017).

The developed research objectives of the study hinge on the notion that addressing ICT diffusion and adoption challenges in way that promote strategic positioning of the local 3PLSMEs, particularly in the transport and logistics industry is vital in advancing globalisation of supply chain management and integration (Katiyar et al., 2015, Wright, 2006, Carter et al., 2015). The adoption of the multi-phased research objectives in the form of mixed-method (triangulation) (see Section 4.2, Chapter 4 for details) is believed to represent a critical route towards the actualisation of the smart logistics services in Nigeria. Finally, this chapter has been presented as the theoretical base for the ICT diffusion challenges within the context of developing logistics as Nigeria carried out in this research. The next chapter presents the second part of the literature review, covering supply chain, logistics, and contextual issues affecting efficient ICT diffusion in the Nigerian transport and logistics industry.

Chapter 3 -Supply chain/logistics management and ICT innovations

Outline

This chapter builds on Chapter 2, highlighting in details relevant thematic issues surrounding ICT innovations in - supply chain management (SCM), logistics management (LM), third-party logistics (3PLs), small and medium enterprise third-party logistics (3PL SMEs) (Sections 3.1-3.4) and transport/logistics and Information Technology (IT) development in Nigeria (Section 3.5). The adoption of Boolean/operators and funnelling literature review approaches for this study (see Section 1.4) is guided by the inherent diversity and complexity of issues investigated in this study. Specifically, Section 3.1 involves the review of ICT innovations in SCM, highlighting the background, contextual issues affecting supply chain (SC) integration, and factors influencing ICT innovation in SCM. Section 3.2 follows a similar pattern based on narrower logistics management (LM) perspective. Here, the background and technological trends in LM are reviewed. Section 3.3 covers ICT innovation in 3PLs, comprising background and factors influencing ICT innovation in 3PLs. The fourth section (3.4) encompasses a review of factors influencing ICT adoption among the local 3PL SMEs. Finally, Section 3.5 involves a review of transport/logistics and IT development in Nigeria. Each section presents a wide range of contextual issues that combined to influence the development of the research objectives and the corresponding research questions (see Table 1.1). While Sections 3.1 – 3.4 concentrate on systematic reviews of various backgrounds and contextual issues influencing ICT uptake in the field, Section 3.5 focuses on underpinning locally-issues surrounding transport/logistics and IT development in Nigeria. Taken together, the reviews offer deep insights concerning mechanisms influencing ICT adoption among the local 3PL SMEs as well as identifying relevant research gaps which the current study intends to fill.

3.1 ICT innovations in Supply chain management (SCM)

3.1.1 Background

The term SCM originates in the 1980s, making its first appearance in literature in 1982 (Oliver and Webber, 1982). Since then, it has continued attracting research interest and featuring prominently in various databases. However, the term SCM has become an object of contradiction, meaning different things in different contexts. The philosophical school of thought refers to SCM as a set of activities and management processes (Mentzer et al., 2001). Some other scholars see SCM as an integration process (Lancioni, 2000); a shift from fragmented logistics to a more integrated framework (Battaglia, 1994). The definition of SCM also follows its evolution phases, traced to the early 1960s: fragmented era, 1960-70s; early

integration of physical distribution, 1970 - 80s; 1980 - 90s, maturity of the integration process; and 1990 - till date, modern SCM (Christopher, 2005). The definition of SCM also refers to the collaborative links, from suppliers through manufacturers, distributors, end-users, and reverses logistics (circular economy) (Cooper et al., 1997).

Another school of thought sees SCM as an agent of transformation in the industry (disruptive innovation), following its disruption of the traditional rules of competitions, both in the manufacturing and service industries. As previously mentioned in the introductory section, SCM facilitates the shift from company versus company to SC versus SC competitions, with associated merits such as timely deliveries and efficiency (Christopher, 2005). Strategically, SCM can also be attributed to levels of integrations, such as restrictive or full SC integration (Bask and Juga, 2001). These correctly depict the types of functions that can be integrated into respective SC networks, such as planning and control, financial transactions, freight services, and information systems (data sharing) (Gattorna, 1998).

Further, SC integrations are grouped into physical or virtual integration, where the former concerns the integration of physical assets (e.g., human resources and physical infrastructure), and the latter, engagement of advanced information technologies. Both aspects have their merits and demerits, as follows: Physical assets integration is constrained mainly by limited flow of information, while on the other hand, the collaborative partners worry less about data protection issues. For the virtual SC integration, it helps in improving SC integration processes by enhancing the quality and quantity of information that can be shared by collaborating partners. Lack of trust amongst the collaborating has remained a critical issue hampering SC integration and forecasting (Neuman and Samuels, 1996). The importance of human chain (soft wiring) in logistic and SCM has also been raised to balance the much attention given to the technological (hard wiring), structural, and process issues in SC architecture (Sweeney and Bahr, 2019). This aligns with the need to start attending to practitioners' perception of SCM, which is argued to be one of the critical channels to bridge the gap between SC theories and practice (Sweeney et al., 2017, Sweeney et al., 2015).

Having assessed various contextual issues surrounding the evolvement of SCM, this study adopts the definition by CSCMP (2016), thus "planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities, comprising coordination and collaborations with the channel partners such as suppliers, intermediaries, third-party services, and the consumers." The combination of the above-stated functions of SCM can be achieved through the advent of e-commerce/business, otherwise known as the knowledge economy (Kelly, 1998). As a result, SCM has turned a global phenomenon, while continuing the disruption of traditional SC processes and rules of market

competition. A practical example regards to changes in global sourcing of raw materials, sales, customer relationship management, and reverse logistics (Evangelista, 2011), leading to what is commonly known as the circular economy.

It is against this backdrop that the implementation and assimilation of relevant ICT resources across various components of SC processes has become critical. As such, research interest has shifted accordingly. For example, Papetti et al. (2019) propose a web-based platform to track/trace SC processes, globally. The study specifically involves structured modelling of complex SC network to capture how data sharing can be facilitated amongst collaborating partners, using leather shoe production as a case study. Allaoui et al. (2019) concentrate on modelling transactional supply chain networks, using a pilot study of a range food SC network across Europe. Literature also shows that ICT innovations can improve integrative SC strategies, thereby boosting business opportunities and sustainability (Moretto et al., 2019, Palsson and Kovacs, 2014). However, limitations still abound towards the achievement of globalised SC networks (Dayan and Ndubisi, In press), mainly as a result of digital gaps in developing countries (Gunasekaran et al., 2017).

The combination of contextual issues affecting the globalisation of SC integration, processes, and collaborations (Stonehouse and Pemberton, 2002, Glaister and Falshaw, 1999) can be summarised within the following contexts; political, economic, social, technological, and environmental (PESTLE) (Grant, 1991). A review of what these different terms mean shows that there are various interpretations of factors influencing global SC integration and management as buttressed below (Sections 3.1.1.1-3.1.1.6). However, there could be other interpretations that fall between industry and regional issues influencing ICT innovation in the field, as discussed upfront in this chapter. This combine to constitute various individual research objectives covered in this study.

3.1.1.1 Political factors

These involve political issues hindering effective implementation of SC networks, which include lack of compatibility of transport and communication infrastructure across regions, as well as nonhomogeneous policies (European Commission, 2011). A practical example of policy issues affecting inter-regional SC networks can be demonstrated by the ongoing BREXIT quagmire (Symesa and Phillipson, 2019). The study outlines contentious issues like placement of tariffs on trade and regulations for hiring skilled and non-skilled labour between the United Kingdom and the rest of the European market.

3.1.1.2 Economic factors

Economic issues reflect vertical disintegration of production system where companies depend mainly on the inputs of the collaborating firms to survive as one of the consequences of the globalisation of SC collaborations (Evangelista, 2011). The situation has been promoted by the removal of several world trade restrictions. For example, about 25 world trade restrictions have been abolished within 1950 – 2003 (WTO, 2004). Another economic implication of the SC globalisation involves the outsourcing of logistics function to boost efficiency as companies concentrate on their core business in order to remain competitive (Oates, 1998). The author reveals that logistics outsourcing can come in different dimensions, including asset ownership and management of SC relations, which can be termed as an extended enterprise (EE) and virtual enterprise (VE). These align with both asset and virtual SC integration functions mentioned earlier, with consequences, including companies losing control of independent strategic decisions (Hugos, 2002), as well as altering traditional competitive strategies (disruptive innovation) (Reddy and Reddy, 2001). Also, the decision to enforce companies to take environmental and social responsibilities of their activities leads to economic implications (Hartmann and Moeller, 2014).

Other economic issues include extra costs incurred while ensuring that customers' satisfactions are met, which has witnessed many complications as a result of the advent of e-commerce (Harrison and van Hoek, 2005). The unprecedented insatiability of customers, relating to change of tastes/fashions, timely deliveries, after-sale services, and other value-added services have become an integral part of the modern SC functions, with substantial economic implications (Christopher, 2005). However, research has shown that research is still at an infant stage concerning the customer's perspective of SCM, which has combined to aggravate the complexity of some of the issues raised (Gattorna, 1998). Moreover, the literature indicates that some of the issues raised above are worse in the context of developing logistics markets which tends to hinder the efficiency of the local logistics firms (Carter et al., 2015). The authors specifically mention the lack of SC visibility in most developing logistics markets. This aligns with World Bank (2018) report that Nigeria lack logistics performance, based on lack of public infrastructure that can facilitate efficient tracing and tracking of both international and local shipments. This represents some of the contextual issues this study intends to explore.

Moreover, Golicic and Smith (2013) suggest that economic performance in the field can be quantified based on market, operational, or accounting-related metrics. Some of these align with the established causal linkages between SC resilience, social capital, and absorptive capacity, where absorptive capacity plays a significant mediating role. Likewise, SC alignments

play huge roles in moderating the causal relationships amongst absorptive capacity and SC resilience, to achieve logistics performance (Gölgecia and Kuivalainen, In Press). The paper utilised data obtained from dual respondents from 265 Turkish firms.

3.1.1.3 Social factors

These represent critical issues as safety (Tob-Ogu et al., 2018) and other environmental concerns such as pollution and congestion (Grimm et al., 2014). Literature has established that social issues in the industry can be tackled from both policy and technology angles. The former relates to using policies and regulations to address some operational practices that may constitute environmental threats. Grimm et al. (2014) suggest that such policies and regulations should be regional-specific due to the diversity of SC activities across regions. For the technological aspects, it has been recommended that safety concerns should be integrated during vehicle design and production (Tob-Ogu et al., 2018). Other policy-specific issues may include enforcement of drivers' training, speed limits, as well as working hours to reduce road accidents, which can be included as labour laws (Castka and Balzarova, 2008). Policies can also be enacted to boost social performance in the areas of human rights and labour practice, to ensure that SC activities are undertaken with due considerations for the social impacts (Yawar and Seuring, 2015). Also, to ensure compliance, application of information systems have been recommended, mainly to track, trace, and monitor SC activities, particularly for safety and environmental (CO₂ emissions) concerns (Furgel and Lemke, 2006).

3.1.1.4 Technological factors

These comprise the impact of ICT innovations in the modern SCM, both in terms of achieving competitive advantage (Busse et al., 2016, Sancha et al., 2016, Gualandris et al., 2015, Gimenez and Sierra, 2013, Andersen and Skjoett-Larsen, 2009) and support for SC sustainability (Koberg and Longoni, 2019, Jiang, 2009, Macdonald, 2007, Mamic, 2005). Specifically, technological challenges underscore physical issues that potentially undermine the efficient utilisation of ICT resources. These can be in the form of lack of compatibility of related technological components within and across firms and regions. Others relate to technological competence (DISCWISE, 2012) and lack of trust to share data made possible through technological advancements (PROMIT, 2009). However, there is lack of research concerning how the integrative functions of third-party logistics (3PLs) are affected by the applications of the information systems (Koberg and Longoni, 2019), particularly amongst the local 3P SMEs (Evangelista et al., 2013, Gunasekaran and Ngai, 2003). Likewise, some of these issues have been scarcely investigated within the context of developing logistics markets as Nigeria (Tob-Ogu et al. (2018) and this represents the primary concern of this study.

3.1.1.5 Environmental factors

These represent the combination of the influence of the external factors on SCM, some which have been discussed above, including politics, culture, safety, and CO₂ emissions (McKinnon, 2007, McKinnon and Ge, 2006). The increasing environmental consequences of the SC activities have triggered huge research in the field recently, manifested by the emergence of green logistics as part of SCM (McKinnon, 2012). The main focus of the new discipline is to strike a balance between the economic performance of SC activities and its social impacts, which has been broadly termed sustainable SC. It is worth noting that freight transport is the major contributor of transport externalities (McKinnon, 2012).

3.1.1.6 Legislative factor

These concern systematic regularisation of multimodal transport activities across the globe (McKinnon, 1998). The author claims that the concept has been a huge source of flexibility, innovations, customisation of services, competitiveness, and creation of new opportunities. Within the global scale, it can be problematic, considering the complexity of issues involved, such as the types of goods, carriers, and transport operators (Grainer, 2017). The author sheds light on the current absurdity in handling global SC legislative issues, where major concerns have been on economic rather than environmental concerns. However, the primary concern has been the differences in legislative rules across regions, making global SC activities more complex and dynamic (Carter et al., 2015, Wu and Pullman, 2015, Hoejmoose et al., 2013). The next section discusses ICT innovation in SCM.

3.1.2 Factors influencing ICT innovations in SCM

As discussed in the previous sections and chapters, the continued advancement in information systems has brought various disruptive innovations in business circles, particularly in the service industry as transport, logistics, and SCM. Hence, the shift from asset-based to information stimulated SC and logistics integration (Craighead et al., 2007). Some of the potential benefits include collaborative decision-making and visibility of SC processes (Allaoui et al., 2019); efficient data sharing amongst collaborating partners for tracing and tracking SC activities (Papetti et al., 2019). Literature also reveals that ICT innovations in the field have been applied to integrate traditional credit and vendor rating models to improve strategic planning amongst relevant collaborators (Moretto et al., 2019).

The advent of big data has also been linked to advancements in ICT resources for efficient SCM (Waller and Fawcett, 2013); SC analytics for efficient decision making, including planning, sourcing, deliveries, and returns (SCOR model domains) (Souza, 2014). It is also revealed that big data applications in SCM help in facilitating maturity, sustainability, and conducting

comprehensive business analysis (Wang et al, 2016a). Issues pertaining to the management of veracity, volume, velocity, and variety (5Vs) of big data have been a huge source of challenge in the industry (Addo-Tenkorang and Helo, 2016). However, reduction of bullwhip effects across various levels of SCs remains one of the critical effects of the application of big data in SCM (Gunasekaran et al., 2017, Hofmann, 2017, Zhong et al., 2016). Other challenges surrounding the effective application of ICT innovations in SCM could be linked with the following thematic issues; information sharing, transfer, and utilisation (Dayan and Ndubisi, In Press). The details are presented below:

3.1.2.1 Information sharing

Information sharing is critical for efficient SCM, for example, distribution databases that can be exploited by several categories of SC partners for accurate data computations (Evangelista 2011). However, the main challenge is usually lack of trust amongst the collaborators (Dayan and Ndubisi, In press, Guo et al., 2016). Other critical areas where information sharing be useful include strategic sourcing, supply chain network design, product design and developing, demand planning, procurement, production, freight/transport, and supply chain agility as follows:

First, information sharing helps in establishing and managing SC chain partners and collaborators in the area of sourcing of raw materials and labour. The potential benefits include cost reduction, improvement of quality of product and services, and timely deliveries (Talluri and Narasimhan, 2004). Others include efficient investment planning and quality decisions concerning the engagement of new suppliers (Panchmatia, 2015). Moreover, Jin and Ji (2013) apply analytical hierarchical process (AHP) and fuzzy synthesis evaluation to develop a framework that may help SC managers in deciding whom to engage in the future as a supplier(s).

Second, information sharing facilitates network design and configuration for efficient physical distribution (Tiwaria et al., 2018). It also helps in accurate prediction of customer demand flow, investment needs, and transport/freight demands (Wang et al., 2016a). The author utilised a mixed-integer nonlinear model, using randomly generated data set to design to develop a framework that demonstrates the above findings. Information sharing is also critical for efficient coordination of humanitarian SC process in terms of enhancing resilience and agility in abnormal SC circumstances (e.g., war situations or natural disasters) (Prasad et al., 2016).

Third, information sharing helps to integrate product design and development into SC to boost competitive advantage (Khan et al., 2012). This aligns with the notion that information sharing

facilitates product adaptability (Labbi et al., 2015, Afshari and Peng, 2015). Besides, information sharing helps to achieve accurate record-keeping of customers' transactions. This has been deemed useful for accurate forecasting future market demand and trends (Jin et al., 2016), particularly in the automotive industry (Johanson et al., 2014).

Fourth, the usefulness of information sharing in demand planning is related to product design and development as both refer to how to predict future market demands (Chase, 2013). These involve price, customer relationship, new market opportunity, feedback, after-sales services, and feedback analyses (Balar et al., 2013). Hassani and Silva (2015) assert that the lack of research in the field is the major drawback of efficient application of information sharing in determining market demand. Utilising historical real-world and weather data, Arias and Bae (2016) forecast electric vehicle demand, with low and high demand trends that enables strategic planning to meet future demands. Similarly, data from search engine queries have been applied to estimate short-term passengers' demand (error margin, 5.3%), which is found useful for efficient operational planning in the airline industry (Arias and Bae, 2016).

Fifth, information sharing is useful in procurement activities, based on its usefulness in tracking auction and contracting firms (Souza, 2014). Research has also shown that SC risks (potential disaster) that are inherent with procurement activities can be efficiently managed by information sharing (Wang et al., 2016b). Fan et al. (2015) develop a framework for real-time monitoring of SC risks, found relevant for improving SC agility. Schlegel (2014) adds that information sharing can be useful in predictive analysis for efficient management of SC risks through accurate forecasting.

Sixth, information sharing is useful in achieving efficient production, demonstrated by RFID (with big data) to support shop floor logistics planning and scheduling (Zhong et al., 2014). Similarly, the Internet of Things (IoT) innovation has been applied to create an RFID-enabled intelligent business environment (Zhong et al., 2015). Some of the research implications relate to their relevance in achieving production efficiency and SC sustainability.

Seventh, the relevance of the information sharing in inventory and warehouse management relates to its potentials to integrate basic SC functions such as raw material sourcing, production, and sales (Sharma and Garg, 2016, Cohen, 2015). (Ayed et al., 2015) found that information sharing boosts efficient freight and transport planning to meet specific market demands. Similarly, Brouer et al. (2016) reveal that information sharing helps in efficient maritime transport planning. In the health sector, it has also been revealed that information sharing improves transport capacity through efficient planning and accurate forecasting of demand (Mehmood and Graham, 2015). The importance of information sharing cannot be

overemphasised in SCM, mainly in improving SC integration, which coincides with the roles of the 3PLs across various levels of SC process, hence, the need to put the activities of the 3PLs at the centre of the subject, though lacking in practice.

Eight, information sharing helps in achieving SC agility (Giannakis and Louis, 2016) and sustainability (Hazen et al., 2016), based on its real-time effects on efficient planning during emergency situations and SC wastes management. Zhao et al. (2017) integrate acquisition and quality control data using a multi-level mathematical model. The outcome of the study reinforces the importance of big data in reducing SC risks and on the other hand, improving SC sustainability. Likewise, Wu et al. (2017) findings support the notion that improvements of SC capacity, efficient operations, and reduction of SC risks are positive attributes of effective information sharing amongst the collaborating members. The study combined social media, transactional, and operational data of firms for the analysis. Literature indicates that information sharing helps in boosting expert judgement, demonstrated in the LED industry, where it was applied for risk assessment, which in turn, reduced levels of uncertainty (Tiwaria et al., 2018). Finally, literature indicates that information sharing boosts SC agility in the area of swift responses to customers' demand (Wang et al., 2016b, Bertsimas et al., 2016).

3.1.2.2 Information transfer

Another critical factor for efficient ICT innovation in SCM includes the availability of relevant infrastructure, both external and internal. These should be able to carry basic information technologies such as e-commerce, electronic data interchange (EDI), telephone, telex, improves SC processes (Chao (2013). Even now that web-based technologies such as cloud computing is emerging to mitigate the consequences of lack of physical infrastructure (Neaga et al., 2015), internet security challenges have remained a huge source of concern (Lu et al. (2003), and proven to be problematic in SC risk management (Zage et al., 2013).

Moreover, literature suggests that investment decisions, particularly concerning return on investment, is one of the primary hindrances of creating adequate information transfer platforms (Liu and Yi, 2016). Tan et al. (2015) are specific about the lack of platforms for effective manipulation of big data innovation. The consequences are becoming more evident as the traditional information ICT resources as such EDI IS becoming less suitable for the ever-increasing complex business environment. Some of the examples of EDI applications in transport automotive and shipping comprise (EDIFACT)¹, (ODETTE)², and (DISSH)³ respectively, (Evangelista, 2011).

¹ EDIFACT is the international EDI standard under the United Nations

3.1.2.3 Information processing and utilization

Having considered the importance and overall implications of engaging information sharing (big data) through the application of the interoperable ICT tools (Tiwaria et al., 2018), it is natural that potential adopters need to put their decisions into perspective, in line with investment decisions. That is to say that a lot of trade-offs are worth consideration for productive ICT resources implementations. In light of these, specific areas of applications of ICT resources in the field, including responsibility/ reliability, sustainability, and visibility (Tiwaria et al., 2018) are presented below.

First, response and reliability refer to those ICT resources that may be relevant in executing SC agility. For example, the Internet of Things (IoT) and machine learning can help provide real-time and reliable information needed for prompt decision-making processes (Sarrocco et al., 2016). Specifically, Tiwaria et al. (2018) reveal that IoT can provide real-time telemetry data for an efficient production system, while machine learning algorithms can be useful in realising accurate prediction of machine failure. Apart from improving efficiency and accurate planning, the above instances practically demonstrate the ongoing automation of the manufacturing industry, where human inputs are becoming increasingly non-relevant. It is also revealed that analysis of GPS, traffic, and weather data can be utilised in developing intelligent delivery routes, found relevant in achieving just in time (JIT) deliveries (Tiwaria et al., 2018). Literature supports the notion that internet technology (since the early 1980s) is the bedrock of the continued advancements in intelligent systems in the modern business environment (McDonnell et al., 2007).

Second, sustainability-related ICT resources concern those that facilitate reduction of CO₂ emissions, safety, and other transport externalities. An example is IoT that provides real-time traffic data that can be used to predict traffic flow in order to save time and reducing fuel consumption/CO₂ emissions (Tiwaria et al., 2018). Also, with the application of relevant ICT resources, proactive approaches can be devised to tackle potential supply chain disruptions that could pose transport externality problems.

Third, the sample of ICT tools that can facilitate SC end-to-end visibility includes RFID and GPS. For example, RFID has been applied to generate automatic replenishment signals, while GPS provides real-time inventory location data that helps in reducing inventory lead-time (Rowe and Pournader, 2017). Similarly, suppliers' data is found useful in detecting potential SC risks

² ODETTE is an international organisation that effectively provides the automotive industry with supports and tools for SCM and e-business

³ DISSH is a third-party provider that supports the implementation of the National Privacy Principle for the fair handling of personal information, including customers' orders, online purchases, and payment, for example.

that SC managers can utilise. Also, sensor data can be applied to monitor equipment manufacturing and make real-time adjustments as adequate (Tiwaria et al., 2018). Point of sales (POS) is also useful in generating real-time demand data with price information. Poor data quality and lack of analytical skills in the field have been named the major barrier to SC visibility (Rowe and Pournader, 2017). As already mentioned, the lack of trust amongst the collaborating partners has remained another primary pitfall in achieving SC visibility. Within the context of developing nations, digital gaps have been identified as major challenges in attaining SC visibility (World Bank, 2018).

In summary, ICT innovation and big data facilitate information sharing to boost SC functions, as demonstrated. However, the rate at which it can be achieved depends on the availability and reliability of the information transfer channel (infrastructure) and requisite skills for efficient implementation. These combine to reflect the causal interactions between the usefulness of information technology, the available infrastructure, and the requisite skills, depicting the totality of information systems. The practical application of what these interactions represent in the developing logistics market as Nigeria aligns with the focus of the present study. The next section covers the application of ICT innovations in different industries, to map the applicability and potential benefits.

3.1.2.4 ICT innovations in different industries/sectors

The motives for ICT innovation implementations in different industries differ but usually coalesce around boosting productivity, using the right information with the right person, at the right time (Brandl, 2007). In this section, the impacts of ICT and big data innovations across various industries are explored, including manufacturing/service, healthcare, finance, agriculture, and international supply chain. The selections are based on the relevance in the contemporary economy and the study scope.

Manufacturing industry:

ICT innovations in the manufacturing industry are profound, confirmed by the 2010 electronic data, where the manufacturing recorded up to 2 Exabyte (Nedelcu, 2013), including sensors, digital machinery (RFID), electronic data (CAD, CAM, and CAE.). As previously mentioned, RFIDs have wide applications on the shop floor, product lines, and factories (Zhong et al., 2017, Zhong et al., 2015). On the other hand, electronica data are generally utilised to track progress in manufacturing processes to achieve overall efficiency and performance (Wang and Alexander, 2015).

Practical instances include the application of smart software to coordinate efficient applications of real-data from different sources. Some of the real-data can be in the forms of

instruments, sensors, internet transactions, CAD model, digital recording, simulations to facilitate real-time coordination of multiple factors of production process (Noor, 2013). Schmitz Cargobull (a German firm) applies sensor data and telecommunication to monitor cargo weight/ temperature and route conditions to avert potential operational breakdown (Chick et al., 2014). General Electric Company applies censored big data from finished products such as from locomotive, jet engine, gas turbine, and medical image devices to map strategic plans (Davenport, 2013).

Others include the application of big data by Toyota Motors to enhance their management capabilities and development of new business opportunities, which relates to safety, security, and feedback system (Toyota Motor Corporation, 2016). Cochran et al. (2016) assert that there is a remarkable shift from descriptive to predictive business models (e.g., what-if analysis, cause-effect, and simulation), as a result of advancement in ICT innovation and big data. Finally, it is revealed that several ICT innovations have been deployed in the area of human resource management, particularly tracking and analysis of employees' performance (Tiwaria et al., 2018).

Health sector:

This is a unique sector with quite a different motive for adopting ICT innovations. For example, while the business community relies on maximizing profit through competitive advantage, the health industry focuses mainly on improving efficiency, mainly for health needs (Xie and Breen, 2018). The data is usually generic, covering, record keeping, compliance, and regulations (Tiwaria et al., 2018). Nambiar et al. (2013) recommend that research interest should be channelled towards preventive care and population health management. ICT innovations in the field also help in the coordination of overall activities of the health system through efficient information sharing (Xie and Breen, 2018). Specifically, improvements in operational activities have been cited as the major attraction for investment for ICT innovations as it facilitates waste reduction (Proudlove and Boaden, 2006). Inventory management is also identified as an area of concern where ICT innovations are highly required, mainly for lead time reduction and improvement of storage capacity and efficiency (Mustaffa and Potter, 2009). Automations have also been made possible through Bar/QR code scanning and RFID tagging, required for security and safety concerns (Parnaby and Towill, 2009).

Furthermore, ICT innovations improve visibility in the health sector SCs (Hatton and Weitzel, 2013) and consequently facilitate SC agility, transparency, and accuracy of data (Ray et al., 2013). Home care deliveries are also impacted, positively through telecare services (Tranor et al., 2011). Xie and Breen (2018) conclude that investments in ICT innovations in the sector are

motivated mainly by the need to improve efficiency, unlike in the business domain, where the primary focus has remained maximisation of profits through competitive functions of ICT innovations. The study utilised multiple case studies of the impact of e-business in the health sector in the United Kingdom. The major drawback of ICT innovations in the sector, according to Raghupathi and Raghupathi (2014), is related to lack of adequate internal infrastructure.

Service industry:

The service sector is among the early adopters of advanced ICT innovation at the industry level, mainly for achieving efficiency and competitiveness. The main focus area is usually towards improvement of customers' satisfaction through customer relationship management (CRM) information systems. Specifically, CRM helps in tracking customers' behaviour, real-time to ensure their optimal satisfaction through the feedback system (Sarroco et al., 2016). The authors are of the view that applications of real-time information technologies generally boost organisation performance as well as profitability. They further reveal that the impact of advanced information systems became more evident in the sector in 2008 after the global financial crisis. These conform to Bean (2016), who also found that applications of interoperable information technology in finance and asset management have recorded a huge success, based mainly on the integration of the industry.

The economic growth projection (2015-2019) of the application of CRM in the sector is about 26% (worth of seven billion US dollars) (Technavio, 2015). From the risk management perspective, Connors et al. (2013) reveal that ICT innovations in finance assist in providing accurate risk assessment and establishing adequate regulations, based on their predictive capacities, which has been appreciated, considering the volatile nature of the banking industry. Some banks have been tipped for optimal applications of big data innovation, including Barclays Banks (Barclays Banks, 2015) and Deutsche Bank (Deutsche Banks, 2014). Specifically, for Barclays Banks, big data has been widely applied for treasury management, financial crime detection, intelligence gathering, and financial risk assessment. On the other hand, Deutsche Bank concentrates on data analytics, consultancy, business analysis and forecasting, and technical supports.

Agriculture:

ICT innovations in the agri-food industry are found relevant in boosting SC agility, in line with the ever-increasing demand for agri-food products (e.g., grains, live stocks, and horticulture (Riley and Srivastava, 2016). The increasing market demands have been linked to population growth, climate change, and market uncertainties, hence the need for sustainable SC framework for food production and distribution mechanisms (Bourlakis et al., 2011). Disruptive

ICT innovations such as mobile computing, IoT, cloud computing, sensor technology, and blockchain have been considered valuable assets in the industry (Leymann et al., 2012, Bourklakis et al., 2011). These are linked to their creativity and value-added services in terms of smart packaging that facilitates extended shelf life, particularly for high-value perishable goods.

ICT innovations in the industry are found critical in improving visibility (Bryceson and Yaseen, 2018). For example, farmers utilise interoperable ICT resources for generating real-time market data, quick and easy access to government extension services, boosting farmers – market linkage, reducing the extent of perishable goods, and developing intelligent logistics services. The study reveals that IoT can be used to collect real-time biographical data which is useful for environmental monitoring, precision farming/irrigation, and cold chain operations and services. The study concludes by recommending that further studies should concentrate on how to use ICT innovation and big data in creating value-added services in the industry.

The study of 96 Italian agricultural SMEs by Annosia et al. (2019) suggests that the adoption of 4.0 technologies by the local farmers rely on the managerial capabilities, managerial cognition, and managerial perception of the external environment for the adoption of 4.0 technologies. The bottom line of the research findings suggest that organisational capabilities align with evidence-based knowledge of the owner-managers. Likewise, the study underscores the importance of enabling business environment in the form of professional services and institutional support as potential 4.0 technology adoption drivers.

Automotive industry:

The automotive industry has been widely acknowledged, in terms of its efficient global supply chain integrations, made possible by advanced ICT innovations (Katiyar et al., 2015, Wright, 2006). Some of the SC innovations, witnessed in the automotive industry recently, comprise component-based SC, outsourcing of peripheral production, and decentralisation of the production and assembly plants (Wright, 2006). Specific areas that have attracted ICT innovation in the industry encompass SC integrations, inventory management, production design, and development (Lofti et al., 2015). Specifically, SC integrations within this context involve exchange of information between independent, virtual, and distribution teams (Bal and Gundry, 1999). The focus areas coalesce around achieving cost reduction, speed of production, and quality through effective data sharing amongst the relevant partners (e.g., shippers, designers, and manufacturers).

However, some of the barriers for effective global SC integrations comprise lack of strategic alignments, limited firm size, and scope of business, lack of awareness, lack of motivation, and

regional-induced challenges (Hartland et al., 2007). The authors argue that some of these challenges are responsible for polarised SC integrations, especially amongst the partners where there is a scarcity of facilitating conditions. The digital disadvantaged nations such as Nigeria represent a practical example of where lack of relevant infrastructure has spurred low logistics performance (World Bank, 2018). Apart from the potential shortfalls of SC integrations as mentioned above, the local 3PL SMEs are subjected to vulnerable states when they resort to the inappropriate adaptation of the relevant ICT tools to be able to remain in business. Some researchers believe that if the situation is not mitigated, global SC risks and inefficiency would be inevitable (Zeng and Xia, 2015). The combination of these issues/gaps informed the development of the various research objectives (Chapter 1, Table 1.1) investigated in this study.

To recap, the reviews in this section suggest that outcome and contextual interpretations of factors influencing ICT uptake differ in their descriptions, application and scope across various industries. Although ICT applications are regarded as critical in the various industries, the scope of applications usually differs. For example, while the business sector concentrates on achieving competitive advantage through efficient application of ICT resources, their counterparts in the health sector are less keen about but competitive advantage but achieving quality care deliveries. This implies that differences in interpretations across various industries should be emphasised to guide the accurate assessment of factors influencing in SC integration and management. This demonstrates the need for industry-specific studies to be explicit and transparent as adopted in this study. This notion specifically informed the development of the third objective of the study – ‘To compare the effects of the firms' background and industry environment on the ICT adoption characteristics of different categories of the 3PL SMEs’. The next section covers logistics management concepts and ICT innovations.

3.2 ICT innovations in logistic management (LM)

3.2.1 Background

Logistics management (LM) is argued to originate from the military, comprising design, development, acquisition, storage, mobility, and recovery (Tob-Ogu et al., 2018). Conventionally, logistics management has drawn various definitions in the literature, including physical distributions and material management (Gourdin, 2006). These specifically involve strategy formulations, and implementation procedures, which are geared towards meeting the needs of customers (end-users). Another concept refers to logistics management as a set of managerial and operational tasks, which reflects the definition by Council of Logistics Management (CLM), thus: “Part of supply chain process which plans, implements, and control

the effective flow and storage of goods, services, and related information from the point of origin to the point of consumption in order to meet customers' requirements" (CLM, 1997).

However, other contentions exist concerning the distinctions between LM and SCM, with many suggesting that LM is a subset of SCM and vice-versa (Simchi-Levi et al., 2005, Larson and Halldorsson, 2004, Chen and Paulraj, 2004b, Simchi-Levi et al., 2003). On the other hand, others suggest that LM and SCM are two sides of the same coin, with the collective purpose of achieving provision of the right product (service) to the right person at the right time, right quantity, right time, right condition, right price, and right place (7Rs) (Gurdin, 2006 and Simchi-Levi et al., 2005). There are also arguments that the main distinguishing factor between LM and SCM relates to the notion that the former does not cover inter-firm activities, while the latter does. In a bid to buttress this point further, several schools of thought emerged, comprising the unionists, inter-sectionist, relabelling, and traditional perspectives (Larson and Halldorsson, 2004).

Specifically, the unionists view SCM as an independent component of activities, involving operations management, logistics, information systems, and marketing. The inter-sectionist group suggests that SC is a business framework, covering various functions, including logistics, with a strategic vision of integrating activities of various organisations. On the other hand, the traditional concepts refer to SCM as a new terminology for LM, implying that SCM is a subset of LM. It is important to note that this study draws insight from the inter-sectionist view, based on the notion that it reflects what the modern SCM stands for. The next section presents ICT innovations in LM.

The implications of ICT innovations are a subject of controversy, based on the inherent distinctions of industries where logistics functions apply as discussed above. Based on the scope of the study, the study adopts the notion of using ICT innovation achieving competitive advantage (Fosso-Wamba et al., 2015, Grover and Kohli, 2012, Wang et al., 2012). Here, the principle of achieving competitive advantage connotes using ICT innovation to achieve efficiency and responsiveness as also reflected in the various sections of this chapter (Gunasekaran and Ngai, 2004, Gunasekaran et al., 2011, Subramani, 2004, Prajogo and Olhager, 2012, Gunasekaran et al., 2015, Gualandris et al., 2015). Technological innovations in the field of logistics have evolved over the years, covering analogue, digital, optical, and fibre transmission systems for efficient data sharing and management across various levels of supply chains. It is believed that these technological phases can be attributed to the equivalent changes in the dynamic market environment, as demonstrated in the previous sections. Based on the unprecedented impacts of ICT innovations on the modern LM and SCM, technological trends in the industry as presented in the next section.

3.2.1.1 Technological trends in LM

As reflected in Table 3.1, electronic data interchange (EDI) represents one of the earliest ICT innovations for LM (1950s), mainly for transactional functions. Others that followed include material requirement planning (MRP), used mainly for calculating material requirements which was introduced in the 1960s. It was later upgraded to MRPII in the early 1980s. Similarly, electronic resource planning (ERP) was introduced in 1980s, which later became well-known due to its integrating capabilities of different SC functions such as sourcing, design and development, manufacturing, and marketing (Dickersbach, 2006, Grabot and Botta-Genoulaz, 2005). These led to the full integration of SC processes since early 2000s (Perego et al., 2011a, Christopher, 2005, Bowersox et al., 2002, Bloomberg et al., 2002) (see Table 3.1). Another ICT innovation that emerged between 1990-200 are transport management systems (TMS) which became critical as the market demand for customised transport operations and services increased (Harris et al., 2015, Perego et al., 2011a, ENABLE, 2010). The details of the five-phased technological development in LM are presented in Table 3.1.

Some of the recent ICT innovations in LM belong to the cloud-based internet resources. It is usually run and managed by third-party organisations who support the selection, deployment, and overall management of the web-based resources. They cover both manufacturing and service functions (Weber, 2010) and affordable for both larger and smaller businesses (Harris et al., 2015).

Table 3-1: Indicative timeline of ICT innovations in logistics and SCM

ICT tools/systems	1950 - 1960 (1 ST phase)	1960 -1970 (2 nd Phase)	1980s (3 rd phase)	1990s (4 th phase)	2000s (5 th phase)
Early EDI	•				
MRP		•			
MRP II			•		
Intranet				•	
ERP systems				•	
Integrated systems					•

Source: Evangelista (2011 p 121)

These benefits are made possible by the self-provisioning characteristics of cloud-based internet resources, which makes it different from traditional ICT resources. For clarity, the difference between web and cloud-based services relate to their applicability and usage. For example, while web-based services reflect machine-to-machine communications, cloud based-

internet resources concentrate on the provision of internet resources to individuals or organisations, mainly on financial subscriptions. Some examples of web-based services include smart mobile phones, QR code, RFID, and telematics tracing, while cloud-based resources cover office productivity self-served tools such as SaaS and internet of things (IoT).

The increasing acceptance of modern internet resources is based mainly on their cheap cost, accessibility, and ability to provide real-time information. These are said to be critical in the management of the increasing uncertainties and complexities, prevailing across various levels of SCs (Brusset and Teller, 2017). The applications of the advanced ICT innovations can be grouped according to four logistics planning levels: strategic, tactical, operational, and execution of planned activities (Evangelista, 2011). Specifically, strategic planning usually involves long-term planning (years) with expected impacts on the future activities of the organisations such as collaborations, forecasting, and replacement. Other strategic issues involve siting of production locations, sourcing of future suppliers, warehousing siting, and other physical asset installations (Allaoui et al., 2019). For tactical planning, it involves mid-term (months) decisions, covering product planning, purchasing, customer relationship management, transport optimisation, and fleet routing and scheduling. Others include warehousing planning and configurations, purchasing and supply planning, and inventory management. The operational decisions are short-term (days), encompassing mainly implementations of planned activities such as scheduling, allocation of production tasks, and assignment of vehicles. Last, the executions phase comprises transport and freight activities, computing, and tracking and tracing.

The applicable ICT resources include extended enterprise resource planning (EERP), enterprise integration application (EIA), advanced planning system (APS), decision support systems (DSS), artificial intelligence (AI), blockchain technology, and internet of things (IoT). Others include ICT resources for the execution of activities such as GPS, mobile phone, e-marketplace, and on-board computer. Specific functions and ICT resources include (i) warehouse reporting using EDI, barcoding, and RFID. (ii) Inventory reporting and tracking using e-market, EDI, and barcoding, and (iii) exceptional handling and reporting with POS, barcoding, and RFID. However, literature indicates that applications of advanced ICT innovations are still in infant state, relating to transport and freight activities (Dubey and Wagle, 2007). Some details of web and cloud-based internet resources are presented below.

Cloud computing technology:

This refers to layers of computing services that can be sourced from the internet, for example, IBM, TIBCO and HPE (Hewitt, 2008, Chavali, 2014). As previously mentioned, most of the

cloud-based resources help to reduce underutilisation of ICT innovations and cost savings in return. Moreover, it stimulates access, proficiency, and quality as location and counterfeiting issues are minimally reduced. It also helps to solve issues of internal and external infrastructure constraints, and the associated consequential effects on the environment as software and platform are provided as infrastructure and services, respectively (O'Sullivan, 2007). Besides, cloud computing helps to address the lack of IT personnel for independent ICT resources acquisition and maintenance. The main barrier relates to internet security issues. An example of cloud computing technology that is applicable for logistics integration is IaaS (BOOZ&CO, 2011).

Electronic logistics marketplace (ELM):

This is a web-based resource whose main function relates to linking shippers, carriers, and customers for real-time transactions (open ELM). It can also be applied as real-time data sharing web services for long term collaborations (closed ELM) (Wang et al., 2007). Often, the transaction is usually initiated by the customers, in the form of purchase orders sent to suppliers, who, in turn, contact the carriers for deliveries through, with GPS, for updates. Another function of ELM comprises raising platforms for financial settlements, and retrieval of data for reviews. Also, ELM can be used to integrate various modes of transport to streamline SC processes and integrations, with the associated benefits.

Internet of Things (IoT):

This is a network of physical objects containing embedded technologies that facilitate electronic communication, censoring, interactions, and data transfer with less human inputs (Gartner, 2017). Some examples of IoT encompass RFID tags with embedded microchips, which can be used to track/monitor transport operations such as temperature of frozen consignments and detection of mechanical faults (Wang et al., 2007). Other practical examples relate to improvement of SC visibility (B2B transactions) and development of online transaction platforms through the implementations of Near Field Communication (NFC), an aspect of RFID and GPS technologies (Yuan and Huang, 2008). Also, NFC can be applied to strengthen seamless SC process as it helps in updating logistics tasks, specifically, regarding updating of international and local shipment procedures/processes and instructions regarding the handling of hazardous goods (Jones, 2011). The author also asserts that through the application of the intelligent, traditional ICT innovations, barriers in business such as size and financial constraints may be reduced. However, Harris et al. (2015) argue that the benefits may not apply for the logistics operators in the developing markets where lack of intelligent transport systems may not allow the installation of RFID readers. The above issues align with

the lack of adequate transport infrastructure in developing logistics markets as Nigeria that constitutes to lack of logistics performance in the region (World Bank, 2018).

Moreover, on-board photoelectric sensors are a form of IoT application, which assists in tracking safety (conditions) and security of consignments, which enhances efficiency and reduction of SC risks (Smith and Hale, 2010). These functions are specifically achieved through automated texts and emails by the intelligent device, giving real-time updates concerning disruption and tampering of consignments. It also helps in efficient information sharing information through proprietary web and mobile interfaces amongst shippers, consignees, 3PLs, customs, and port managements (Maersk and IBM, 2005, BDP1, 2005).

Social networking:

This concerns a group of internet-based resources that connect individuals and corporate bodies through user-related knowledge content, which is used to share media and communicate insights and experiences (Hemsley and Mason, 2013, Kaplan and Haenlein, 2010, Karakas, 2009). The generated data is always helpful in developing customer relationship management and retention strategies, as well as a feedback system. Likewise, social media networking can be used for instant/cluster messaging across collaborating partners. For example, Yammer (enterprise social media app) has been widely applied by organisations such as Tesco, Vodacom, and LG electronics for inter-organisational communication. Specifically, LG electronics utilises the Yammer App to boost their response speed in addressing technical and other customer-related issues (Harris et al., 2015). Also, Tesco adopts the Yammer App to track real-time information to improve organisational efficiency and feedback system (Tesco Annual Report, 2012). Some other examples of social networking sites include Facebook, Twitter, FaceTime, Instagram, Wikipedia, Social gaming, and LinkedIn, which are used to monitor performance through customer feedback.

Mobile computing:

This covers network standards, switching protocol, and high bandwidth wireless communication services. A practical example of mobile computing devices is Web 3.0, widely used for that analysis of customers' data to determine market trends and preferences, which makes SC processes more dynamic. The data analyses usually involve application of computer languages such as SPARQL, SWRL, and RDF for the formulation and evaluation of relevant queries. The data is mainly IoT generated from different sources (BOOZ and CO, 2011).

Augmented reality (AR):

This is an example of interface technologies that help to provide real-world products as virtual or graphical images. It is commonly used in warehouse and port management, which facilitates

product viewing in virtual and graphic images before actual sales take place. Tesco is among retail stores that utilises this technology (Whiteaker, 2011). Kisoft is an aspect of AR that assists in optimising navigations in an automated warehouse system using a head-mounted screen. It also utilises visual instruction and serial numbers to track goods with minimal error-picking. Usually, Kisoft installation does not require special structural arrangements (KNAPP, 2013). AR technologies have been improved recently in the form of Google smart glass, which combines voice and visual reality (Bilton, 2012). Moreover, AR technologies are applied in freight distribution as delivery maps using real-time information for efficient navigation within pre-determined routes. The technology also helps in efficient decisions through virtual connections with the local-evolved realities that facilitate strategic actions. For example, rail freight operators utilise AR technologies to enhance asset management and visibility of services.

Big data:

This is one of the recent innovations that harness and use voluminous generated data using intelligent technologies. The main objective of innovation is to bolster quality decisions through real-time data sharing amongst collaborating partners. It has been revealed that effectiveness of big data depends on the data collection procedure, formats, analyses, and interpretations (Bryceson and Yaseen, 2018). The combination of these can be ascribed as the volume, variety, velocity, veracity, and value (5Vs) qualities of good data, which can yield actionable ideas, improved performance, and competitive advantages (Fosso-Wamba et al., 2015). In the transport and logistics industry, big data is found useful in stimulating sophisticated SC and logistics analytics, with quality strategic, tactical, and operational decisions as outcomes (Harris et al., 2015). It has been applied in inter-modal freight management to improve the quality of collaborative decisions (Caris et al., 2008).

Blockchain:

Blockchain, also known as the distributed ledger technology (DLT), is another recent innovation in the field, whose main objective is to improve the security and safety of information sharing amongst the collaborating partners in the SC. The recorded transactions include financial and financial activities (Kosba et al., 2017). Research has shown that blockchain can develop new SC services and government registries (Staples et al., 2017).

E-freight:

This term describes as the paperless flow of information that track and trace freight movements. Some of the electronic devices that facilitate e-freight encompass RFID and GPS (Islam et al., 2013). E-freight was initiated in 2006 by the International Air Transport

Association (IATA) and has gained extreme acceptance in the industry (IATA, 2017). The adoption of the paperless air-cargo (iCargo) services was approved by the Federation of International Freight Forwarders (FIATA) and endorsed by the IATA Cargo Service Conference as a sustainable innovation in the air freight industry. In the European continent, e-freight has been integrated into the multimodal transport system, increasing its dynamics in the industry (Harris et al., 2015). A study also shows that efficient application of e-freight can reduce backhauls through efficient handling of complex freight scheduling and assignments (Bock, 2010). Other studies suggest that the application of paperless cargo stimulates competitiveness and customer satisfaction (Kengpol et al., 2012, Macharis et al., 2011).

While data sharing may be central for efficient logistics and supply chain management, there are fundamental challenges in the form of lack of trust to share data amongst the collaborating partners. Current ICT innovation in the field such as blockchain technology has developed to help mitigate the challenges of mistrust through the implementation of distributed ledger framework (information linked in a peer-to-peer network. Apart from mistrust, there are also issues of lack of homogeneity (unstructured) data across multiple sources in a particular supply chain network (Harris et al., 2015). To address this, the authors recommend peace-meal (step-by-step) approach in analysing big data in the field.

Moreover, some of the User-related barriers concern internal barriers such as size/scope, finance, and logistics competence of the logistics operators. These are usually the distinguishing factors between small and large logistics organisations (Kuan and Chau, 2001). Specifically, scope and size of firms determine the quality of ICT resources to be acquired among the logistics firms, with the smaller firms opting for the basic ICT tools (Pokharel, 2005). Concerns have also been raised about the lack of strategic visions of the smaller logistics firms as they spend much time handling short-term operational challenges (Rantapuska and Ihanainen, 2008). The financial issue (acquisition and maintenance costs) is also more evident among the local smaller logistics providers than their larger counterparts, based on their limited scope of business (Evangelista and Sweeney, 2006). The competence challenges encompass a lack of requisite skills and management capabilities (Hollenstein, 2004).

Overall, most of the contextual affecting ICT uptake in the field are more related to the developing logistics market, hence the research interest. Other contextual issues hampering efficient ICT innovations are buttressed within the context of 3PLs as presented in the next section.

3.3 ICT innovations in third-party logistics (3PL)

3.3.1 Background

The term third-party logistics (3PL) like SC and LM suffers from lack of a definite definition of what it signifies. The common understanding of 3PLs' services ranges from providers of outsourced logistics functions, where external firms perform logistics functions that have been provided internally by organisations (Lieb and Schwarz, 2002). Another view sees 3PLs as middlemen, hired on a long-term contract basis to provide specific logistics services (Virum, 1993). Others refer to 3PLs as logistics services performed on behalf of shippers, consisting of at least transportation, warehousing, inventory, information (e.g., tracking or tracing), and secondary-related services (Evangelista, 2014, Berglund et al., 1999). 3PLs have also been viewed as the engagement of external logistics organisations on long-term mutual bases, bound by either formal or informal contractual agreements (Berglund, 1997). Similarly, Bagchi and Virum (1999) refer to 3PLs' offerings as a corporate partnership between shippers and logistics service providers to gain mutual benefits in the form of strategic alliances.

Table 3-2: Activities associated with 3PLs

Logistics processes	Activities
Transportation	Road, rail, air, sea; inter-modality management; shipping; forwarding; packaging express carrier; custom brokering; managing; freight bill payment/audit
Outbound Distribution	Merge in transit; order fulfilment/processing; picking; sorting; dispatching; post-production configuration; and installation of products at the customers' site.
Warehousing	Storage; receiving cross-docking; consolidation; perishable/hazardous goods
Inventory management	Forecasting; slotting/lay-out design; location analysis; storage/retrieval management
Packaging	Design; labelling; assembly/packaging; palletising
Reverse logistics	Pallets flows management; recycling; reuse; remanufacturing disposal management; repair; testing/products serving; return shipments management

Source: Aguezzoul (2014 p 70)

Moreover, the activities of 3PLs have been attributed as secondary logistics services provided by external organisations, with the primary intention of improving SC processes (Sink et al. (1996). From a similar perspective, 3PLs services entail the provision of value-added services in

the industry to enhance customers' satisfaction. Additionally, Aguezzoul (2014) presents 3PLs based on logistics processes and activities, as summarised in Table 3.2, including transportation, outbound distribution, warehousing, inventory management, packaging, and reverse logistics. The thematic descriptions of the activities of 3PLs suggest the multi-dimension areas 3PLs cover and still evolving in line with SC globalisation and circular economy.

Based on the scope and context of this study, the definition refers 3PL as logistics services performed on behalf of shippers, consisting at least transportation, warehousing, inventory, information (e.g., tracking or tracing), and secondary-related services (Evangelista, 2014, Berglund et al., 1999) has been adopted. The emergence of the 3PLs' services can be linked to the SC globalisation, which led to the outsourcing of some logistics functions to enable organisations to concentrate on their core functions in order to achieve competitive advantage (Wong E. et al., 2018, Christopher, 2005, Berglund, 2000, Sheffi, 1990). 3PLs' activities have been assessed based on their integrative roles across various categorises of SCs, with outcomes such as efficiency, strategic alliance, and improved logistics performance (Aguezzoul, 2014). Other researchers are of the view that 3PLs' services gained prominence through the advent of e-commerce as they play intermediary roles to improve customers' satisfaction (Daugherty. P. et al., 1992, McKinnon, 1999, Ashenbaum et al., 2005, Cooper et al., 1997).

The several definitions of the 3PLs above align with their multifunctional activities over the years, starting from the full traditional approach. This earliest phase occurred around 1970-80s, covering mainly freight services. The following phase was full commercialisation, which depicts early integration within 1980-90s. The next was the emergence of fourth-party logistics (4PLs) in the early 2000s to date (Evangelista, 2011). Some researchers are of the view that the evolvement of the 3PLs followed the advancement of ICT resources (Pedrosa et al., 2015, Cainelli et al., 2004, Skjoett-Larsen, 2000). As such, ICT uptake capabilities of local 3PLs has become a huge source of differentiating factor, even regarding merger and acquisition by the larger multinational firms (Lappin, 1996). This may align with the notion that interoperable ICT tools facilitate SC processes, even across distant regions (Sauvage, 2003, van Hoek, 2002). Hence 3PLs with requisite ICT capabilities are easily merged with multinational SC and logistics organisations as sub-contractors. A practical example is Cainiao 4PL (a subsidiary of Alibaba Group) that engages services of contracted 3PLs to cover intermediary e-commerce activities in China for the satisfaction of their customers (Huanga et al., 2019). Lack of trust for the sharing of information is reported as the main challenge of the business model.

The ICT-facilitated services offered by 3PL providers come under various categories, including support for international shipments (freight payments); (45%); transportation planning and

optimisation (45%); warehouse management systems (27%); shipping tracking (18%); international documentations (18%); supply chain planning and scheduling (6%); and order management (6%) (Table 3.3) (Lieb and Schwarz, 2002). There is also the notion that 3PLs can be distinguished by their provision of financial and consulting services (Regan and Song, 2001).

Table 3-3: The information-based services often outsourced to 3PLs

Applications	% of applications
Freight payment/accounting	45
Transportation planning and optimisation	45
Warehouse management system	27
Shipment tracking	18
International documentation	18
Supply chain planning and scheduling	6
Order management	6

Source: Lieb and Schwarz (2002)

However, there is limited information concerning factors influencing ICT adoption among the local 3PL SMEs (Evangelista, 2011, Gunasekaran and Ngai, 2003), as well as in the context of developing countries (Tob-Ogu et al., 2018). Moreover, there is a lack of information concerning how some of the identified factors interact to influence ICT adoption among the local 3PL SMEs, which is covered in this study. The next section discusses factors influencing ICT innovation within the context of 3PLs.

3.3.2 Factors influencing ICT innovations in 3PLs

The importance of ICT innovation is profound in the integrative roles of 3PLs in achieving seamless SC processes (Lee and Billington, 1992), which make a subject of relevance (Atkinson, 2001). Besides, ICT innovations have been found useful for developing new e-services (value-added services), new functions (new opportunities), and new alliances (strategic collaboration) with relevant organisations (Ketchen and Hult, 2007). These issues represent the focus of this section.

3.3.2.1 *New e-services*

The applications of advanced ICT resources to achieve the creation of new services to enhance customers' satisfaction have become critical, in line with e-commerce and SC globalisations (Bellingkrodt and Wallenburg, 2015, Pedrosa et al., 2015, Cui et al., 2012, Flint et al., 2005). Apart from enhancing customers' satisfaction, the development of new e-services would help to stimulate competitive advantage, as well as achieving market expansion (Pedrosa et al.,

2015, Wagner, 2008). These combine to stimulate research interest in the field (Busse and Wallenburg, 2011, Grawe 2009, Busse, 2010, Flint et al., 2005), together with the overall improvement of research interest on ICT-facilitated service innovation (see Section 2.1.2.2). However, the literature indicates lack of research concerning factors influencing the adoption of specific ICT resource(s), in terms of their absorptive capacities, customers' requirements, environmental factors, scope of business, and regional-specific issues (Cui et al., 2012, Panayides and So, 2005). Other studies have also indicated a general lack of research interest pertaining to 3PL services (Busse and Wallenburg, 2011, Grawe, 2009).

The 3PLs are well known for their flexibility for ICT uptake as applicable to ICT innovations in the service sector (Cui et al., 2012, Busse and Wallenburg, 2011, Busse, 2010, Wagner, 2008) (see Section 2.1.1, Chapter 2). Logistics innovations generally refer to the adoption of an idea, device, system process, policy, programme, product or services (Panayides and So, 2005). The service aspect refers to helpful service to customers, procedures and practice (Daugherty et al., 2011). Moreover, logistics innovation is referred to as any logistics offering that the market perceives as new and helpful, irrespective of the simplicity and complexity of the logistics service (Flint et al., 2005).

Moreover, others argue that logistics innovation is dynamic and complex and lacks a clear definition (Biemans et al., 2016, Witell et al., 2016, Snyder et al., 2016). These have been attributed to lack of theory in the field, particularly regarding ICT uptake (Evangelista, 2011). Other identified elements of logistics innovation include applicability, usefulness, and reproducibility (Snyder et al., 2016), which aligns with the Schumpeterian view. Based on the scope of the study, encapsulated view of service innovation is adopted, which depicts the provision of superior logistics services that is new and helpful to a potential user (Bellingkrodt and Wallenburg, 2015, Flint et al., 2005).

Several factors have been attributed to barriers of innovation amongst the 3PLs, including lack of scope of services (Busse and Wallenburg, 2011); lack of financial and human resources (Cui et al., 2012); and lack of scope of business (Cui et al., 2012). The combination of these issues has necessitated incremental logistics innovations amongst the local 3PLs in China (Chu et al., 2018, Rahmana et al., 2017), mainly as a result of their insistence on improving on their existing services than taking radical steps to engage entirely new services through intelligent application of ICT resources. That attitude is blamed on a lack of capability. Some of the logistics innovations achieved by the local 3PLs in China encompass the introduction of automated freight consolidation and intelligent vehicle routing (Wagner, 2008); New packaging for food and products (Lorenzini et al., 2018); third-party purchase (Shi et al., 2016); and consulting and financial services (Chu et al., 2018). Generally, 3PLs in the developed

countries apply more sophisticated ICT resources than their counterparts in the developing logistics markets and there is lack of research to ascertain contextual factors responsible for the digital gap in the industry (Shi et al., 2016). This research gap represents the key focus of this study. The next section covers new functions that are attributed to the advancements of ICT resources.

3.3.2.2 New Functions

This concept refers to the development of new business opportunities by the 3PLs. It can be equated to the new roles, in terms of secondary services of the 4PLs. A practical example includes the assignment of contracts to the local 3PLs by the 4PL organisation in China (Huang et al., 2019). The outcome of the study suggests that 4PL operators run on a near-zero investment on physical infrastructure as they concentrate on providing the framework that helps coordinate their contractual dealings with the local 3PLs.

Another form of new function relates to the proposals by Guo et al. (2016) that evaluating functions should be integrated as one of the local 3PLs' capabilities, particularly in the agricultural SCs. The framework is specifically designed to improve integrity and risk preference by the local 3PLs operating at various levels of the SC processes and integrations. The risk preference concerns concession preferences, based on resources (time and financial) and opponents' behaviour. The study is hinged on the criticality of engaging the principle of negotiations to resolve internal issues such as trust issues to improve the efficiency of the application of intelligent systems to achieve SC performance (Simatupang et al., 2004). A practical instance is an informal collaboration amongst the operators and management of the following organisations; Wal-Mart, Warner-Lamber, SAP, and Manugistics (James and Spier, 2001). The authors assert the approach is necessitated to ensure productive collaborations that can sustain new functions such as collaborative planning, prediction and replenish model (CPRM)

Further, it has been argued that attention should be given to agricultural SCs due to the dispersed nature of produce by the local subsistence farmers, which makes seamless SC processes difficult (Guo et al., 2016). Similarly, the authors reveal that the industry is pervaded with mistrust among the potential collaborators as they compete among themselves. The above situations have been identified as barriers for effective collaboration through intelligent systems and may, in turn, hamper the development of new functions amongst the local 3PL SMEs. A new function in the area of optimal choice from multiple transport routes and modes is proposed by Arabzad et al. (2014) using an algorithm capable of generating a set of distribution centres (DCs). Likewise, Shu et al., (2012) utilised polynomial-time models,

couched with the iteration of cutting plane algorithm to tackle non-linear discrete optimisation in warehousing management. A nonlinear continuous model (closed-circuit equation) has also been developed to harness fixed transport cost computing problems, as well as linear programme for distribution centre (DC) costs (Tancrez et al., 2012). Another related function aligns with the development of a framework for assigning DCs, receive payments, and make contingency adjustments for sudden need for warehouse capacity (Jha et al. (2011). The study also involves a mixed-integer model and differential evolution algorithm.

Also, non-linear integer-programming and Lagrangian relaxation algorithm have been adopted to evaluate the location of new DCs, involving access by retailers and inventory policy as critical indices. The overall objective is to minimise inventory costs Berman et al. (2012). The author also proposed a two-echelon prototype for integrating production and distribution in order to coordinate multifunctional plant supply with multiple types of products and customers through capacitated warehousing. Another development is the framework for balancing the allocation of customers to multiple warehousing outlets using the SA algorithm (Rajesh et al., 2012). The choice for the model is related to the non-deterministic polynomial-time problem. There are also attempts to eliminate the waiting time associated with last-mile deliveries and pick-ups of parcels through the application of intelligent technologies (Ducret, 2014, Ni and Sun, 2013). This may be linked to the self-service delivery systems, which is still new in most developing countries such as China (Lu, 2013).

In summary, several of the new functions in the industry are powered by cloud and web technologies (Islam et al., 2015, Jing et al., 2014, Wang et al., 2014, Niyato et al., 2011, Wan et al., 2010) as discussed in the previous sections. Moreover, most of the new functions can be linked to operational activities. The next section borders on new alliances.

3.3.2.3 New alliances

New alliances encompass all new outsourced logistics functions, including reverse logistics, customers' strategic alliance, international and regional alliances/collaborations, industry-specific 3PLs alliances, facilitated by ICT innovation. The concept of new alliance is built on the belief that the more the sophisticated the outsourced services become, the higher the overall performance of the SC processes. This is in line with the previous achievement attained by the approach in the industry, improving logistics performance and sustainability. However, it is important to note different specialties of the local 3PL, as presented in Tables 3.2 (Section 3.4.1). From the reverse logistics perspective, the integrative roles of the local 3PLs have been heightened due to the increasing need to embed sustainable (green) logistics in the modern business models. Specifically, the United Nations has a long-term agenda (2015-2030) to

achieve energy conservation and low-carbon economy (United Nations, 2015). The long-term goals depict issues of concern surrounding the modern logistics activities, such as economic profitability, green policy, ecological concerns, and competitive advantage, in which the local 3PLs play significant roles. (Govindan and Bouzon, 2018, Govindan et al., 2015).

Based on the scope of the subject, this study adopts definitions of reverse logistics (RL) as the role of logistics operators in recycling, waste disposal, and management of hazardous materials (Li et al., 2018). Given the complexities and the dynamics of the RL, in comparison to the forward logistics (Govindan et al., 2017, Prahinski and Kocabasoglu, 2006, Fleischmann et al., 1997), the outsourcing of the critical components of the operations such as financial, technological, and recovery process have become critical (Zareinejad and Javanmard, 2013, Sahay and Mohan, 2006). Some of the outsourced RL services involve skilled manpower, physical infrastructure, and technology innovation (ICT) (Senthil et al., 2014).

However, what happens when the local 3PLs are not able to discharge these outsourced logistics functions due to locally-evolved factors represent what this study intends to investigate. This may be linked to the World Bank (2018) report that lack of infrastructure and logistics combine to constitute a lack of logistics in Nigeria. This report has been reinforced by the empirical research finding that institutional voids in Nigeria are the main barrier of ICT diffusion in the local transport and logistics industry (Ezenwa et al., In press). Nevertheless, research on collaborative performance management, which is an important aspect of logistics outsourcing, is lacking (Busi and McIvor, 2008, Busi and Bititci, 2006). This may be linked to the notion that the success of strategic alliances such as resource acquisition and synergy creation partly depends on the existing collaborative performance management across several levels of SCs (Todeva and Knoke, 2005). Following the integrative roles of 3PLs, they stand in the right position to mitigate the lack of collaborative performance in the industry as it has profound implications in establishing new e-services, functions, and alliances to enhance customers' satisfaction (Dobrzykowski et al., 2010).

There are multiple ways ICT innovation can improve SC integration, including enhancing joint decision making amongst the collaborating partners (Bamford et al., 2003) and sustenance of inter-firm long-term relationships which is critical in mitigating SC risks (Sambasivan et al., 2011, Lowensberg, 2010). However, majority of local 3PLs appear backwards in the implementation of intelligent solutions and constitutes up to 70% failure of inter-firm strategic alliance (Sharma and Choudhury, 2014, Parkhe, 1993). Some key militating factors against quality ICT uptake amongst the local 3PLs include human and financial resources, and lack of strategic initiatives (Zineldin and Dodourova, 2005). The financial and human capital factors concern mapping strategies to strike a balance between cost reduction and profit-making,

which is the bedrock for achieving competitiveness in the current market structure. The strategic initiatives concern the creation of new market opportunities through efficient collaborative performance management (Sharma and Choudhury, 2014). The authors concluded by stating that inter-organisational collaborations and ICT innovation are the bedrock for developing new alliances.

Other challenges for effective collaborative performance management concerns different motives amongst the potential collaborating partners. This aligns with their differences in geographical settings and individual difference factors (Wagner and Sutter, 2012). This may be linked with the argument that no matter how attractive strategic alliances appear, they are always difficult to sustain for a long- term (Zineldin and Dodourova, 2005). It may be based on these that Vitasek and Manrodt (2012) suggest that 3PL and their customers need to establish genuine interest for collaborations, tested over time as a panacea for sustaining long-term collaborations. Also, it has been suggested that long-term collaborations require enough time to evolve and mature, for example starting with single successful transactions (Wagner and Sutter, 2012, Bask and Juga, 2001, Bowersox et al., 1989). It is recommended that the scope of potential collaborations need to be defined in line with the individual business strategies of the intending collaborators. These are to ensure optimal and sustainable collaborations (Baloh et al., 2008). The concept is termed “co-innovation space.”

These combine to reflect the importance of integrating informal and formal approaches to building a sustainable and efficient collaborative framework. This aligns with the notion that though intelligent information technologies have evolved to boost the security of information commonly shared by the collaborating partners, there is always the need to have an informal arrangement to harness potential differences in individual business alliances. Indeed, Sharma and Choudhury (2014) confirm that the attainment of technology innovation through strategic alliance can be achieved if the collaborative partnership is allowed to evolve into maturity. This study draws insight from this conception to develop ICT diffusion framework as one of the research outputs.

In summary, the discourses in this section draw upon enlightenment of factors influencing ICT uptake within the context of 3PLs. This study envisages that more knowledge about the dynamics and complexities, especially within the context of developing logistics markets will enable the relevant stakeholders to improve better the three thematic issues discussed in this section, locally. The next section covers ICT innovations within the contexts of the 3PL SMEs. This perspective is critical based on its implications for the present study.

3.4 ICT innovations in small and medium third-party logistics providers (3PL SMEs)

This section deals with reviewing of previous studies in the subject and identifying research gaps that the present study intends to cover. As previously mentioned in the introductory section, issues pertaining to ICT innovations amongst the small and medium third-party logistics operators (3PL SMEs) have received little research attention (Gunasekaran and Ngai, 2003, Evangelista, 2011), with research outcomes conflicting (Pokharel, 2005, Kilpala et al., 2005). It is not surprising as various contextual factors tend to differ across regions and contexts where the studies were conducted. The main contradiction lays in the reluctance and innovativeness of the local 3PL SMEs towards adopting intelligent ICT resources.

The major concern of this study is that whether the local 3PL SMEs are reluctant or flexible towards ICT innovation, it is inconceivable how they can sustain their operations and services in the increasing complex and dynamic industry as logistics without efficient implementations of the relevant ICT resources. Hence, the need for the adoption of the mixed-methods research, divided into four phases to pin down both direct and remote causes (interrelationships) of issues affecting ICT innovation implementations amongst the local 3PL SMEs (Evangelista and Sweeney, 2006). The concentration on the 3PL SMEs and the developing logistics markets align with the notion that both represent less researched and vulnerable, comparing to their larger organisation and developed logistics market counterparts (Tob-Ogu et al., 2018, Rahmana et al., 2017).

As observed in the previous sections, the intensifying competitiveness in the industry requires the local 3PL SMEs to be more innovative to be able to efficiently cover their integrative roles across various levels of SC processes. Accordingly, the three leading areas that require their strategic repositioning include new e-services, function, and alliances, deemed necessary to remain competitive in the modern logistics market. As indicated below, previous studies in the field merely cover impacts, roles, and factors influencing ICT adoption amongst the local 3PL SMEs with less insights on specific strategic steps to improve ICT uptake amongst the local 3PL SMEs or the broader industry.

The study of Gunasekaran and Ngai (2003) covering the activities 3PL SMEs in Hong Kong concentrates on understanding what constitutes successful 3PLs, using five indices, including strategic alliance, inventory management, transportation, capacity planning, and ICT applications. The outcome of the qualitative study (case study) indicates that the majority of the local 3PL SMEs are constrained by financially and by human capital to implement advanced ICT resources such as EDI and EPI to improve their services. However, the outcome of the study shows that the majority of the local logistics firms are flexible with application ICT

resources. The strategic alliance was found linked to the other factors and hence termed the most critical factor for the success of the local 3PLs. Besides, the importance of web-based ICT resources was highlighted and may align with the recommendation to invest in ICT acquisition amongst the local logistics firms.

The study of ICT adoption and perception among the 45 logistics firms (transport and warehousing) in Singapore indicates (Pokharel, 2005) as follows: The local logistics firms adopt mainly basic ICT resources such as computers, internet technology, and EDI. The transport operators are keener about ICT resource implementations than their warehousing counterparts. The main drivers of ICT adoption amongst the firms include operational efficiency, low data error, cost reduction, and to enhance customers' satisfaction. On the other hand, the barriers comprise the lack of adoptive capacity and measuring metrics for intangible factors as coordination and motivation. Other barriers include irregular policies, cost, and maintenance of ICT resources.

According to Kilpala et al. (2005), the local 3PL SMEs in the Scandinavian region (Finland, Norway, and Sweden) are dominated by the freight operators. They are motivated differently towards ICT adoption. For example, those operating in the Norwegian region are most motivated (in terms of skills and level of ICT adoption) than their counterparts in the other regions. Overall, the applications of advanced ICT resources such as EDI and route planners are still at their infancy stages, while GPS has gained more prominence. The main drivers of ICT implementations include improved planning and control, while lack of compatibility with the internal and external infrastructure is the primary inhibitor. The study involves 168 questionnaire survey, focus group discussion, and case studies.

Within the context of the Italian transport and logistics industry, Evangelista (2011) found as follows: The local 3PL SMEs in the region expend insignificant portions of their returns on investment (ROI) to acquire ICT resources. As such, they adopt less sophisticated ICT tools for their operations and services, particularly amongst the full haulage⁴ operators. On the other hand, the basic⁵ and advanced⁶ logistics operators apply ICT resources such as CRM and ERP moderately to boost their customised services. Almost all logistics operators are keen to adopt internet technology in the future. The main drivers of ICT adoption encompass customisation of services and cost reduction, while the main inhibitor is the high cost of acquisition and

⁴ Full haulage operators refer to the freight operators who offer 100% haulage services

⁵ Basic logistics operators refer to the provision of haulage services, together with other basic logistics functions such as warehousing

⁶ Advanced logistics operators are a form of value-added services (ICT-related services), as well as SCM solutions, rendered by local logistics operators EVANGELISTA, P. 2011. *ICT diffusion in SMEs, an investigation into the Italian transport and logistics service industry*, Italiane, Edizioni Scientifiche.

maintenance of ICT resources. Overall, there is limited application of intelligent systems to boost supply processes in the region. The study involves a mixed-method approach, with the questionnaire covering 153 respondents. The qualitative aspect involves multiple case studies and focus-group discussions used as the exploratory part of the study.

Omotayo and Melan (2017) examine the factors influencing ICT adoption of 3PLs in Malaysia, using a questionnaire survey of 150 respondents. The outcomes of the multiple regression analysis indicate that the selection of appropriate ICT tools has a significant impact on the competitive advantage of the firms. This aligns with the need for benchmarking of relevant ICT resources in the industry with the intention to improve their strategic application and achieving logistics performance in return. Literature also shows that local 3PLs in Italy adopt few ICT resources, mainly to coordinate routine operational activities (Marchet et al., 2009). The study utilised a qualitative case study approach. Smart (2010) investigates factors influencing e-procurement adoption across three industries. The study shows that most firms lack knowledge of factors influencing their e-procurement, using in-depth interviews with the company managers. Likewise, an e-business adoption amongst telecommunication and tourists' firms using factor and logistics regression suggests that indecision about the extent of ICT adoption is the primary inhibitor (Oliveira and Martins, 2010). Another study with logistics regression reveals that most Australian transport and logistics companies indicate that the high cost of ICT acquisition is the main barrier, as well as financial constraints (Nguyen, 2013). A multiple case study survey of factors influencing ICT adoption in multi-modal seaport terminal operations suggests that stringent government policies and limited firm size are the main inhibiting factors of ICT adoption (Mondragon et al., 2017).

For the developing logistics market as Nigeria, Tob-Ogu et al. (2018) study (ten case studies and twenty-one in-depth) shows that there is significant difference in the levels of ICT uptake between the large and small freight operators in the region. For example, larger firms (e.g., ABS, Vertex, and Fluid plc) adopt mainly ERP to support their freight operations. In contrast, unlike smaller freight operators (e.g., Honey, Radar, and Water Energy) who adopt primary ICT tools (mobile phones and emails). However, these does not reflect the true reflection of innovativeness of the local freight operators as the smaller firms were found to more innovative than their larger firms' counterparts, in terms of adaptation of ICT resources to achieve specific business purposes. Also, the study shows that the main drivers of ICT adoption amongst the sampled firms include monitoring of freight operations, accounting (record keeping and auditing), and visibility of operations (real-time data) to boost speed and quality of decisions. The study recommends sustained enforcement of application of ICT resources (e.g., AQUILA by PAF agency) to boost the safety of operations, particularly in the petroleum

downstream, where the study is domiciled. This is in line with the achievements recorded by some of the existing enforcement programmes. The main limitation of the study relates to its concentration on petroleum downstream operations in the region.

Another study from Nigeria suggests that local 3PL SMEs in the South-Eastern region adopt about 37% of prevalent ICT resources in the local transport and logistics industry (Ezenwa, 2014a). The extents of ICT adoptions are positively correlated with impacts and customers' satisfaction. There are significant differences in the impact and customer satisfaction across the five different cities involved in the study, which reflect the effects of the different orientations of both the service providers and the customers, as well as the possible effects of cultural differences. The study involves a questionnaire survey research method. The study conducted by Adebambo and Toyin (2011) with 100 manufacturing firms in South-Western Nigeria shows that there is a significant correlation between ICT innovation and logistics activities. The main ICT adoption drivers found include competitiveness and cost reduction, while customisation of services was found less significant.

Last, the study of 100 transport companies across South-Western Nigeria indicates that smartphones, SMS, emails, company websites, ticket reservation systems, and POS are adopted by about 24% of the sampled firms. About 52% of the sampled respondents claim they are ICT literate (Idowu et al., 2017). The study adopts polynomial functions to formulate the infusion model to obtain the yearly cumulative distribution of each ICT resource adopted by the sampled firms.

In summary, the review shows that the majority of the local 3PL SMEs lack the adoptive capacity of the relevant ICT resources to boost their services. There are limited theoretical underpinnings of the various categories of the reviewed studies. Several of the studies adopt either quantitative or qualitative research methods, with only one study adopting both methods (mixed-methods). The level of ICT resource adoption differs amongst the operators, in line with their scope businesses. The 3PL SMEs are more innovative, regarding their adaptive capabilities than their larger counterparts. As such, the majority of them are willing to adopt advanced ICT resources but hindered by limited financial and human capital, lack of compatibility with the existing infrastructure, and irregular policies. On the other hand, the main drivers include the ability to use ICT resources to boost strategic alliance, error reduction, customisation of services, coordination, and monitoring and accounting (auditing and record-keeping).

Lack of measures for intangible assets such as motivation and coordination were found the research limitations. Other research gaps include lack of the adoption of robust methods in the

form of mixed-research methods and incorporation of sound theoretical frameworks to guide studies. Also, lack of determining causal relationships of identified factors and over-concentration on the internal factors rather than the external counterparts are found as research gaps. The determination of the causal interrelationships of relevant factors is deemed critical to help underpin both the remote and direct factors stimulating or dampening ICT adoption amongst the local 3PL SMEs. Some of these issues are reasonably covered in the present study. The next section covers the review of Nigeria's transport (freight) and the IT industry.

3.5 Review of Nigerian transport and Information Technology (IT) industry

3.5.1 Nigerian freight industry

According to Alokun (1995), Nigerian road transport development can be traced to 1900s (agricultural exportation era) when road haulage was primarily for providing feeder support to rail and water modes of transport. The popular route network was 'hub and spoke', with road transport short hauls (< 100 KM), between hinterlands and train stations/ seaports, conveying mainly the sparse agricultural produce (e.g., cocoa, groundnut, cotton, and palm oil), which was primary source of foreign exchange then. The first and last leg of journeys was part of the haulage, covering both walking distances from the farmlands to haulage parks and to train stations/seaports, respectively. The hauliers were mainly local traders (Syrians, Lebanese, and indigenous) who combined haulage and other businesses (e.g., produce buying, and brokerage services) (Walker, 1995). The indigenous operators were reported to use their truck for passengers, particular during backhauls or off-peak seasons. Also, literature indicates that haulage waiting time was more pronounced in the hinterlands as they wait for consolidation of the farm produce from different locations in small quantities from the subsistence farmers (Alokun, 1988).

The hauliers are faced high running costs associated with frequent vehicle repairs as the road networks were in various degrees of disrepair (Alokun, 1995, Powell and Sheffi, 1983). This situation led some of the local hauliers into brokerage services to cover costs who later became licenced buying agents (LBAs) and whose services helped to consolidate farm produce to achieve full truckload (FTL) (Cruttenden, 1989, Federal Ministry of Commerce and Industry, 1964). The local freight operators were categorised broadly into Westernised and African operators. The former referring to more formalised freight operators, with the requisite managerial skills and fleet, while the African operators were crude, with fewer facilities and low competence (Hawkins, 1958).

This was the situation until the early 1970s when Nigeria started experiencing oil boom, leading to a decline of export of agricultural produce as petroleum product export became the primary source of foreign exchange (Hawkins, 1958). The major consequence was increased importation (of finished and intermediate goods for local consumption and manufacturing) and port congestion. These led to the establishment of National Freight Company (NFC) by the Federal Government to help decongest the ports, reversing the flow of freight traffic from seaports (mainly Apapa Wharf, Lagos) to the hinterlands and has remained to date (Onwuachi, 1983). The haulage industry recorded huge expansion and improved return on investment (RoI) after the oil boom, measured by cost-revenue analyses (Olanrewaju, 1983, Alokun, 1988). This was achieved mainly by using larger capacity vehicles, which, in turn, yielded economies of scale for the local hauliers. Some of the hauliers were reported to integrate consultancy activities in these services (Onwuachi, 1983). The author also reported that warehousing services were less common amongst the local logistics operators as most of the imported goods were shipped directly to their final destinations. It was under this circumstance that 'fly by night' haulage originated, where the majority of freight was moved at night by mostly owner-drivers who obtained their fleet primarily by contractual hire-purchase terms. As such, the majority lacked managerial competence and technical skills, irrespective of the new freight opportunities created by the oil boom (Olanrewaju, 1987).

The structural adjustment programme (SAP) era emanated around 1985 due to decline of the exportation of crude oil, with negative consequences on the volume of freight activities. The majority of freight was sourced locally (Alokun, 1995). The situation led to the premature closure of business for the majority of the owner-managers and the emergence of more organised haulage operators for the distribution of industrial products (Ogwude, 1986). Above all, the Nigerian haulage industry is characterised by ecological differences (uneven distribution of natural resources) across the region, the speed of urbanisation; cultural factors, and the existence of food surplus and deficits across the country (Hay and Smith, 1970).

Importantly, some of the issues raised above have not been improved, irrespective of the return of the oil boom in the country. According to Okunsola (2018), the Nigeria haulage industry is still marred by disrepair of road networks, irregular policies, security challenges, and unprofessionalism on the part of the local freight operator. The author, based on the continued lack of logistics performance in the region, advises that local logistics operators should begin to look inwards, regarding forming a collaborative force to pursue their common objectives jointly. This is hinged on the perceived insensitivity of the regional government to address logistics challenges in the region. The author suggests consolidation as a way forward to help mitigate the current fragmented operations of the local logistics operators.

3.5.1.1 Nigeria's transport infrastructural development

The purpose of this section is to briefly introduce issues affecting transport infrastructural development, with a particular focus in the road mode. The planned transport development has been in vogue in Nigeria after independence (1960 to date). Until then (since 1914), transport development in Nigeria followed agricultural demand and activities (mainly subsistence), mainly by beast of burden, human-powered transport, and caravan (Ezeife and Bolade, 1984). The planned transport infrastructural development in Nigeria is overseen by the Federal Government of Nigeria, with State and Local counterparts playing supporting roles. The first planned transport development occurred within 1962-68, which was covered in the 1962-85 first National Development Plan (NDP), termed a fixed-term era.

The subsequent NDP eras include rolling (1990-1998) and the new democratic (1999 to date) plan, which is believed to capture transport infrastructural development, alongside other developmental schemes in the region. However, there is the notion that maintenance of transport infrastructure is not covered in the NDPs, hence the continued disrepair of the transport infrastructure in the region (Ezeife and Bolade, 1984). The authors argue that the situation is ironic as the NDPs are also responsible for international interventions, for example, the development of the multinational transport system, by the United Nations, which led to the establishment of National Road Freight Company and Nigeria Rail Corporation. These were designed to realise door-to-door first and last-mile deliveries, which is still lacking to date. Likewise, National Shipping Policy was enacted to advance the strategic repositioning of the national marine activities, in line with the UNCTAD Code of Conduct. The authors further argued that these inconsistencies might be responsible for the continued disrepair of the Nigerian transport infrastructure.

It is on record that the development of the transport infrastructure in the region has received a huge allocation from the Federal Government with less to show for it. For example, after the Nigerian civil war (1970 -75), the allocation for transport infrastructure development soared (N0.472 billion to N2 billion) to ensure rapid repairs of the dilapidated transport infrastructure, caused by the civil war (Ezeife and Bolade, 1984). Since then, the allocation has remained on the increase as a result of surplus accrued from the oil boom, particularly for the road mode. The claim is supported by the 2018 national budget breakdown, where the transport budget ranked second, behind the combination of power, works, and housing capital expenditure (Daily Post, 2018). This perceived institutional void has been levelled mainly against the Federal Government, who oversees the sales of crude oil and other national resources, general tax revenue, appropriation of capita, and implementations.

Specifically, the approval of the transport infrastructure development fund is by the Federal Ministry of National Planning (FMNP), who receives applications from the relevant agencies from both Federal and State governments. The applications are usually assessed, harmonised, and approved by the supervising ministries (e.g., Federal Ministry of Transport and Aviation, Federal Ministry of Works, and Federal Ministry of Mines and Power). Based on this arrangement, it has been pinpointed that there is a lack of efficient coordination by the government ministries and their agencies (Ezeife and Bolade, 1984).

It is against this backdrop that the authors recommend that there should be transparent coordination between different transport agencies and the supervising ministries at the federal level. The same should be applied to dealings between Federal and State Governments, as well as transparent auditing of transport infrastructural projects. Others are of the view that apart from corruption, lack of discipline and commitment on the part of the government handlers, over-ambitious developmental plans, lack of continuity plans for government projects, and lack of reliable data constitute to the colossal failure of most of the government development plans in Nigeria. Other issues include lack of awareness, political instability, lack of efficient communication system and lack of public and private partnerships (Iheanacho, 2014, Ejimudo, 2013, Ologbenla, 2007, Onah, 2006, Obi, 2006, Oladapo, 2004).

Road mode infrastructural development in Nigeria:

As mentioned earlier, the review will end with road infrastructural development due to the scope of the study. The road mode has been playing feeders' role to other transport modes such as rail and water, but the trend is changing recently as the various transport modes in the region are becoming competitors, particularly, regarding regional freight deliveries in Nigeria. Resultantly, Road mode has been tipped for its flexibility over other modes, which results to over-centration on road mode infrastructural development in Nigeria (Ezeife and Bolade, 1984). Road mode infrastructural development in the region dates back to 1951, with up to 4400 KM roads constructed, followed by 72,000KM in 1962; 100,000KM in 1980 (Ezeife and Bolade, 1984). The authors assert that road networks in Nigeria are more coordinated than rail, covering up to 30,000KM bitumen-meshed roads.

The Nigerian road network is believed to align with the conventional hinterlands -seaports road network, consisting mainly ports of Lagos, Port-Harcourt, Warri, and Calabar in the South, with arterial highways to the North. Other road networks in Nigeria comprise 14 East to West links and 18 shorter links that connect the main North-South and East-West trunk roads. It also involves up to 2000KM of dual carriage and single carriage highways that connect important cities. The recent considerations include developing road networks between the state capitals

and the new Federal Capital Territory, Abuja. Others include developing new road networks to federal industrial reserved locations such as Ajaokuta iron and steel complex (Ezeife and Bolade, 1984).

Private individuals and companies dominate the road transport industry in Nigeria, operating mainly on the free competitive market principle. However, inter-state roads are not entirely free for commercial operators as the State and Local governments collect hackney permit fees through their agents (Ogwude, 2016). The accountability of such levies has also attracted public concern that they appear not to be used for designated purposes (e.g., the improvement of dilapidated road infrastructure). Overall, the government approach to address transport infrastructural challenges has been seen from the interventionist perspective, as the rate of imported goods continues to rise and causing undue congestions in the ports. Hence, the primary concentration has been on ways to improve the road network to decongest the ports, and also led to the establishment of National Freight Company in 1975, which did not last due to poor management (Ezeife and Bolade, 1984).

In light of these and other issues discussed in this section, Ezeife and Bolade (1984) summarise issues affecting transport infrastructural development in Nigeria with recommendations as follows: First, lack of efficient coordination of various modes of transport in the region. The coordination is subdivided into administrative and economic coordination, with the former implying application of institutional framework address lack of harmonisations transport infrastructural development. The economic perspective concerns efficient appropriation and monitoring of funds utilisation for the intended developmental projects. To achieve these, the authors recommend collaborative efforts of the relevant stakeholder, including researchers, development actors, practitioners, and policymakers, to avert potential wasteful duplication and disjointed implementation of transport projects in the region.

Second, it is advised that the maintenance and management of the transport projects in the region should be taken seriously. Specifically, more emphasis is laid on maintenance of the existing infrastructure than creating new ones. On the other hand, the management aspect entails ensuring that the right human resources are hired for the right job to boost efficiency in the industry. Similarly, to ensure effective management of the infrastructural development in the region, it is advised that requisite policies and regulations should be enacted to ensure efficient and judicious utilisation of the public funds allocated for transport infrastructural development. Moreover, the activities of commercial transportation in the region should be monitored, particularly on the part of controlling entry into various categories of commercial road transportation.

The authors conclude by projecting area of concentration for the future transport infrastructural development in Nigeria, including (i) development of interstate dual carriageways, connecting both the state capital, as well as the major cities in the country. (ii) Development of modern standard gauge railway system, much better than what was produced in the 1980/1981 master plan. (iii) Introduction of modern fast passenger trains that would favourably compete with air their air mode counterparts. (iv) Establishment of water-rail intermodal platform around Baro area for Niger-Benue River waterways intermodal services for decongesting the inland waterway port. (v) Development of seaport fitted with requisite facilities for handling mainly raw materials rather than finished goods. This concerns changing the trend from over-dependence on foreign finished good to producing locally, including refining of crude oil for export purposes. (vi) More efforts should be given to the reduction of the rate of accidents on Nigerian roads, and (vii) finally; adequate attention should be given to sustainable transportation in the region, particularly reducing CO2 emissions

Above all, it is recommended that economic development should dictate the directionality of transport infrastructural development in Nigeria. With this, it is crucial to highlight the need to concentrate on developing intelligent transport and logistics systems in Nigeria, which is missing in the above proposals. The omission may not be unconnected to the period the study was conducted (industrial era). It is this gap that this study intends to cover, looking at ways to improve ICT diffusion in the Nigerian transport and logistics industry. The pursuance of this objective cannot be overemphasised as it has been found that the lack of intelligent systems in the Nigerian transport industry is one of the primary causes of lack of logistics performance in Nigeria. Specifically, according to World Bank (2018), Nigerian logistics performance ranks low (2.53 out of 5.0-point scale), with the following six indices: customs clearances and procedures (1.97), infrastructure (2.56), international shipment (2.52), logistics competence (2.40), tracking and tracing (2.68), and timeliness deliveries (3.07). With the above logistics indices, Nigeria ranks 110th in the world, behind South Africa that ranks 33. The national logistics performance index is used to monitor the competence of countries in facilitating domestic and international trade (Anderson and Villa, 2015). It based on these that this research project was conceived to highlight issues affecting ICT diffusion in the Nigerian transport and logistics industry, using the pieces of evidence from the local 3PL SMEs' activities and Nigerian IT policy. The section concentrates on issues affecting the Nigerian IT industry, which is also critical for this study.

3.5.2 Review of Nigerian IT industry

The current knowledge economy necessitates the need to improve the opportunities to access ICT resources globally (Dzidonu, 2010). The implications abound, as discussed previously. The

penetration of ICT resources, such as mobile communication devices in Africa in recent years, is unprecedented (Kayisire and Wei, 2016). The record hit 650 million in 2012, outpacing several other continents, leading to the continent's categorisation as the fastest growing user of mobile communication technology (Yonazi et al., 2012). Within the Nigerian context specifically, the country ranks the fastest-growing subscriber of a global system of mobile communication (GSM), after China, with up to 58 million subscribers in 2017) (Omotoso and Muyima, 2016).

These outcomes may be linked to the continued dropping of the cost of mobile handsets and lines. However, the issues lie in the ability to transform this positive development into economic gains (adoptive capacity) (UNCTAD, 2008, ITU & UNCTAD, 2007, Pohjola, 2003). The situation has placed many developing economies such as Nigeria vulnerable in tapping the economic benefits of ICT resources, leading to their ranking 147th out of 176th in ICT development amongst the comity of nations. The specific ranking indices include access (145th), use (147th), and skills (147th), placing Nigeria as one of the lowest-performing countries in terms of ICT development (ITU, 2016).

Several contextual factors have been blamed for the above situation, including lack of economic development, low quality education, and lack of requisite infrastructure (Bagchi and Udo, 2007). Others include cultural challenges and beliefs (Zhao et al., 2008, Erumban and De Jong, 2006); institutional (political) framework (Corrales and Westhoff, 2006). It is against this background that it is recommended that research interests shown be drawn into understanding salient issues hampering economic applications of ICT resource applications in Nigeria (Kamal and Qureshi, 2009, Puri, 2006).

The Nigerian government has made some efforts to address this issue by establishing the National Economic Empowerment and Development Strategy (NEEDS) and National Information Technology Development Agency (NITDA) (Omotoso and Muyima, 2016). NEEDS was explicitly created to develop a framework that can sustain economic development in the region, with the view of the following: (i) Develop a reform process that would stimulate financial stability in the region, particularly for supporting economic developmental activities. (ii) Develop a framework that would ensure addressing the low capitalisation and poor practice of the financial intermediaries in the region, and (iii) enactment of policies that will help boost financial affordability and diversification in the region. On the other hand, NITDA is charged with the responsibility of addressing IT policy issues regarding infrastructure, skill, and other capacity development strategies across various sectors of the economy (see Chapter 7, Section 7.2). However, several of the proposals are yet to materialise, owing to some of the prevailing revelations above. Some remarks have been made concerning poor implementations of

governmental proposals in Nigeria, including challenges of fiscal decentralisation, linked to lack of full autonomy of States and Local governments (Anyanwu, 2008). Some of the context-specific issues involved in Nigerian IT infrastructural development is presented in the next section.

3.5.2.1 Nigerian IT infrastructural development and operations

As mentioned previously, several factors influence business operations, relating to the combinations of the external and internal factors, include infrastructure, political, economic, social, and cultural challenges. Within the context of the Nigerian IT industry, the literature shows it is bedevilled with irregular policies and regulations, which are hampering the efficient operations of the practitioners at all levels. Recently, the situation has worsened, forcing major players out of the market (e.g., ETISALAT), with dampening effects on the economic development of ICT resources. Apart from the irregular policies, shortfall of the local currency as the result of the slump of oil price (2015/2016) has compounded the problems as the practitioners' struggle to source foreign currencies (Gillwald et al., 2018).

Still on the operational challenges, it is evident that the industry has faced price wars amongst the major network providers in the region, lowering their potential to upgrade their infrastructure, in line with global best practice. A practical example is the inability to transition from the traditional voice to data service (Gillwald et al., 2018). Other contextual issues encompass a lack of an adequate framework to support the merger of acquisitions and unwarranted sanctions by the Nigerian Communication Commission (NCC). The lack of transformation of the local IT industry has been linked to financial insolvency of most of the major players in the industry, which has led to some of them closing business. The issue of sanctions is recently witnessed by MTN, who faced severe sanctions due to SIM registration issues and other operational-related challenges. That has led to asking how the practitioners could be expected to operate optimally without the enabling environment as sited above.

Recently, NCC introduced a framework intended to harmonise spectrum trading, leasing, and sharing to facilitate its optimal use in the local market. However, it is ironical that up to 60% operational fee has been allocated to the commission. This still aligns with the irregularities and inconsistencies that trail government-sponsored projects in the region. There is no doubt that some of the proposals have good objectives, but the manner the implementations are carried remains a huge source of challenge. In the stance of the subject (spectrum), the motive appears right; how the proposed operational fees will be reconciled with the achieving optimal use spectrum in the local market remain a subject of concern to the relevant stakeholder. It is based on this paradox that it is concluded that the majority of the network providers in Nigeria

(e.g., MTN, ETISALAT, and GLOBACOM) are subjected to undue hardship to the point that the majority of them have resorted to adopting lifeline strategy as a means of survival (Gillwald et al., 2018).

The multiplier effects of the prevailing institutional challenges in the region are far-reaching, in terms of dampening the development of the local economy. It is on record that the network providers in the region depend on the private source of energy to survive as the conventional public sources have remained in a state of comatose, with unsteady power supply. The world is advancing, technologically, even in the IT industry, which makes it critical to ensure that the Nigerian IT industry is supported genuinely. For example, transition has been recorded from a strong voice to big data through technological advancements, which may, in turn, trigger compatibility challenges to regions that are left behind. Some neighbouring African countries are reporting serious progress regarding commercial usage of ICT resources. For example, mobile money has been operational in Ghana, Kenya, and South Africa. Lack of regular policies in the Nigeria IT industry has been tipped as one of the major barriers of economic applications of ICT resources (Gillwald et al., 2018). The authors also assert that policy issues are also responsible for lack of efficient data management in the industry, with the consequential effect of consumers developing apathy to conduct business online.

In light of these, it is recommended that Nigerian IT industry needs to be genuinely supported in terms of enforceable policies and modern infrastructure to ensure that its sectorial applications such as in the case of transport and logistics industry are not continually hampered. In the developed economy, issues concerning practical implementations of ICT resources in the transport and logistics are taken serious (Giannopoulos, 2004). It is some of these issues that the present study addresses. The revelations in this section suggest that both the service providers and consumers of ICT resources in the region are committed to bridge the persistent digital gap pervading the region. The onus lies on the regional government in providing an enabling environment that can stimulate the overhauling of the industry. This study responded to some of these issues from the perspective of the transport and logistics industry.

3.6 Conclusion

The literature review carried out in this Chapter is designed to complement Chapter 2. The specific sections covered concentrate on supply chain/logistics management/concepts and mechanisms influencing ICT innovations and implementations in the industry, with specific considerations on issues affecting local 3PL SMEs and the developing logistics markets. It is based on the lack of research on these areas. Nigerian transport/logistics and IT infrastructural

development and operations are deeply reviewed in this Chapter to build background for the context-specific issues investigated in this study. Specifically, insight from the supply chain literature suggests that limitations abound concerning the achievement of global SC integration/processes (Dayan and Ndubisi, In Press) as a result of huge digital gaps in the developing logistics markets (Gunasekaran et al., 2017). For example, one of the critical issues affecting logistics performance in Nigeria relates to lack of intelligent systems for efficient tracking and tracing of local and international shipments (World Bank, 2018). As mentioned in the social factor studies in SCM, some of the issues may require adjustment of regional-specific policies (Grimm et al. 2014).

Some of the most frequently posed challenges are the compatibility of transport and ICT infrastructure and technological competence (DISCWISE, 2012), particularly among the local 3PL SMEs (Evangelista et al., 2013, Gunasekaran and Ngai, 2003). Literature also indicates that factors influencing ICT adoption among the local 3PL SMEs have been scarcely investigated (Evangelista et al., 2013, Gunasekaran and Ngai, 2003), especially within the context of developing logistics markets (Tob-Ogu et al. 2018). Although the influences of internal and external factors on ICT innovation are always brought forward in the field of logistics and SCM, it is still a subject of controversy among scholars (Raghupathi and Raghupathi 2014), suggesting somewhat diversity of contextual and regional-specific issues affecting the industry (Grimm et al. 2014). For example, Harry et al. (2015) argue that benefits of RFID may be hindered in the developing logistics markets in comparison with their counterparts in the developed countries due to technological gaps. Some of the resultant effects include focusing on energy and time on survival strategies or building adaptive capacities among the local 3PL SMEs in the developing economies as Nigeria (Tob-Ogu et al. 2018).

Indeed, depending on the context, lack of business facilitating conditions (FC) can hinder the scope of business (SB) and consumer readiness (CR) for intelligent logistics systems. On the other hand, the abundance of favourable FC can breed improved and diversifications of SB (Hitt, 1999) and enhanced CR (Awa et al., 2015). These relate to the notion that ICT acquisition and decision quality can be exorbitant and challenging to implement in an unfavourable FC, so also in constrained SB and CR conditions. Based on the context-specific issues facing ICT acquisition and decision quality, this study does not seek to universalise issues affecting efficient ICT diffusion in Nigerian transport and logistics industry. Instead, the study argues that responses to ICT diffusion challenges in the local transport and logistics industry can be shaped by the locally evolved issues; especially within the context where there is persistent poor FC that inherently weakens the propensity to achieve optimal ICT adoption at firm levels (Tornatzky and Fleischer, 1990). It is based on this context that the specific objectives and

associated research question of the study (Table 1.1) were crafted, based on the local stakeholders' recommendations after desktop research.

Previous studies in the research domain have focused on the impacts and individual factors influencing ICT adoption among the local 3PL SMEs (see Section 3.4). Evangelista and Sweeney (2006) argue that the absence of understanding the underlying mechanism influencing ICT adoption among the local 3PL SMEs represents one of the reasons for heterogeneity in results. Similarly, perspectives regarding the regional and industry-specific issues are scarce, which encourage channelling research efforts on these areas (Abou-Shouk et al., 2016). Popular empirical analyses in the field utilise simple statistical technique (e.g., regression and descriptive measures) via questionnaire data in which different factors influencing ICT adoption among the local 3PL SMEs are predicted (see Section 3.4). It is apparent that quantitative research techniques are faced with several drawbacks (e.g., inability to quantify intangible research problems) (see Chapter 4, Section 4.1.2), implying that several approaches must be undertaken to obtain robust results. The logic entails aggregation of data from multiple sources with a view to yield multiple/chains of evidence to support research findings (see details in Chapter 4, section 4.1.3). This study draws on these various insights to empirically investigate diverse ranges of mechanisms influencing ICT diffusion in the developing logistics market context, contributing further on contextual (geographical and industry-specific) factors influencing ICT diffusion in the industry. To achieve this goal, consideration is given to the activities of the local 3PL SMEs in Nigeria due to their inherent vulnerability and lack of research in the area (Tob-Ogu et al., 2018).

Further, this study envisages that addressing ICT adoption challenges in developing logistics markets in ways that promote a holistic approach is vital in advancing global SC integration/processes. Assessment of cross-thematic issues such as institutional, structural, and operational challenges represent one vital approach towards this goal, considering the research problems identified in the literature. Understanding diverse ranges of factors influencing ICT adoption can offer the needed insight to drive the research project (first objective of the study). Establishing the causal interrelationships of the context-specific factors remains controversial, with different contextual factors across regions. This chapter has synthesized the key debates and gaps in the literature, which combines to inform the selection of the specific constructs adopted in this study (second objective of the study). The different categories of industries (food, health, automotive, and international shipments are flagged, which guided the multiple case study (third objective of the study). Finally, the institutional issues have been presented as the foundation for the institutional perspective of the study.

The next chapter will present and critically discuss the research methodology, starting from the broader introduction of the research design through several research methods that guide the specific research phases of the study.

Chapter 4 – Research methodology

Outline

This chapter covers the research design (Section 4.1), including concepts of inductive and deductive (4.1.1), quantitative and qualitative (Section 4.1.2), and mixed-methods (Section 4.1.3). The research methods covered in this study are set out in this Chapter. Specifically, the Phases involve the scoping study (Section 4.2.2), questionnaire survey (Section 4.2.3), multiple case studies (Section 4.2. 4) and qualitative studies (focus group discussion and in-depth expert interview) (Section 4.2.5). The distinct four phases correspond with the four guiding research objectives and eight research questions (see Table 1.1). The outputs (results) are presented in Chapter 5 (the combination of scoping study and questionnaire survey), Chapter 6 (multiple case study), and Chapter 7 (focus group discussion and in-depth expert interview).

4.1 Research design

Research design represents the framework of techniques and methods utilised in a particular research undertaken as presented below:

4.1.1 Inductive and deductive research techniques

An inductive research approach refers to research undertaken, analysed, and generalised, based on the availability of data. On the other hand, deductive takes off from generalised principles or theories that are known to be true to a specific conclusion (Glaser and Strauss, 1967). It is believed that the inductive technique examines a research problem in its natural state (a posteriori), which often leads to theory building.

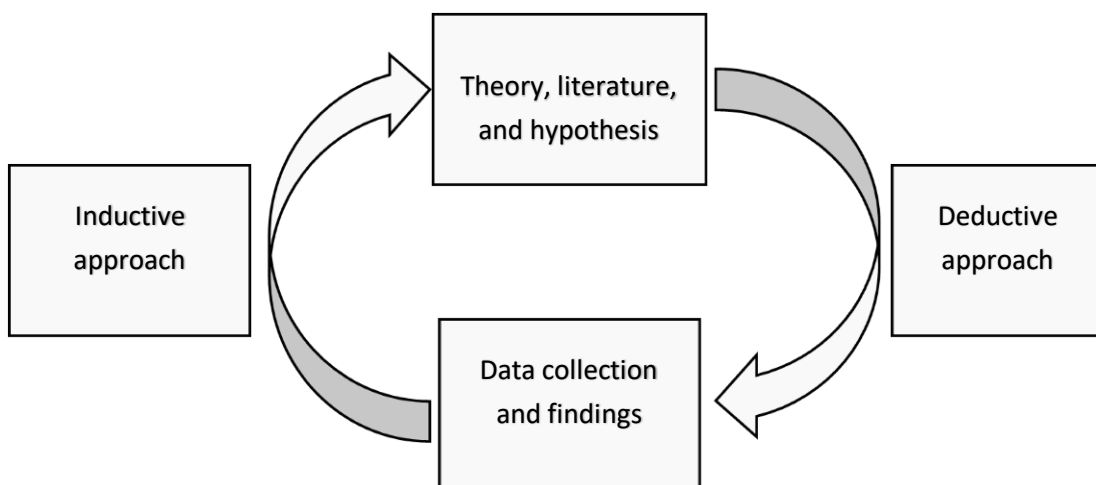


Figure 4-1: Inductive and deductive research techniques (Adapted, Evangelista, 2011 p 167)

Alternatively, deductive relies on an established theory (a priori) as a guide for data collection and analysis (see Figure 4.1). Based on the exploratory nature of the present study, both inductive and deductive research approaches are adopted to guide the research investigation.

4. 1.2 Quantitative and qualitative research approaches

Quantitative and qualitative research approaches are two distinct and traditional research approaches (Martin, 1990, Hammersley, 1999, Denzin and Lincoln, 2000). The former concerns primarily collection and quantification of numeric data, while the latter conversely concentrates on word documents. The statistics analysis technique is most familiar with quantitative data (e.g., experiment, survey, and archival data), mainly to understand trends/patterns and cause and effect relationships (Martin, 1990). The following merits are attributed to the quantitative research technique, including limited researcher's influence on analyses outputs. The approach also enhances the potentials to generalise results due to the possible large volume of data (Dachler, 1997, Scandura and Williams, 2000). The demerits include the inability to quantify intangible data such as behavioural data, as it is also termed rigid (Bentz and Shapiro, 1998).

On the other hand, the qualitative approach is more flexible, with the potential to capture process and behavioural data (Denzin and Lincoln, 2000). The primary strength includes the ability to obtain data in its natural state, such as observation, interviews, conversation (Martin, 1990). The main drawback relates to human and financial intensity, low generalisability capacity, based on the inherent low sample size (Snow and Thomas, 1994).

4.1.3 Mixed-methods research approach

Varied approaches are used to achieve the research objectives, in the form of mixed methods. As the name implies, this specifically involves a combination of both quantitative and qualitative research methods in an integrative manner in a single research undertaking. This integrated approach can occur at specific or various phases of a particular research process: data collection, data analysis and interpretation. This definition brings us to distinguishing between mixed and multiple research methods. Unlike the mixed-method approach which connotes integration of research processes and outcomes, multiple research methods represent a mere combination of qualitative and quantitative research techniques, without integration (Creswell and Plano Clark, 2011).

The mixed-method approach is recently gaining prominence in the social science research domain, based on the complexity and dynamics of associated with social behaviour research (Bryman and Belle, 2003). Moreover, the approach helps to optimise the robustness of

research undertakings as it inherently taps into the strengths of both aspects of the research approaches (Hammersley, 1999, Bickman and Rog, 1998, Bartunek et al., 1993). It is also applied to support hypothesis outcomes with qualitative evidence (Buhaug, 2015, Thailer, 2012, Evangelista, 2011).

Based on the complex and dynamic nature of the research problems, a mixed-methods research approach in the form of triangulation is adopted for this study. There are other categories of mixed-method research such as convergent design (concurrent design) which involves the interactive application of various dimensions of research processes (data collection, analysis and interpretation) in a particular study (De Tremere, 2018). The triangulation approach is adopted in this study, based on the segmented, but linked four-phased studies explored (see Figure 4.2).

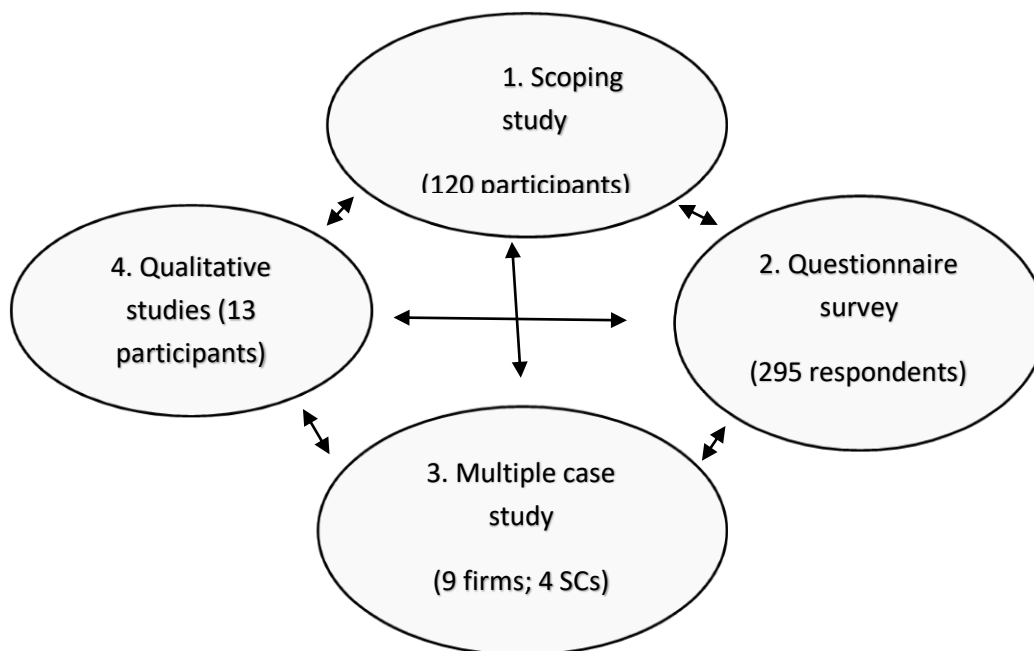


Figure 4-2: Triangulated research method for the study

Specifically, the triangulation research approach originates from multiple navigation strategies of the military (Jick, 1979). In the research domain, the approach suggests the application of multiple data sources to address specific research problem(s) (Jick, 1979). The chief merit of the approach is to ensure the internal and external validity of data, which may lead to obtaining robust research findings (Scandura and Williams, 2000, Harrigan, 1983). The main disadvantage relates to possible duplication of research findings, time, costs, over dependency on existing research frameworks (Martin, 1990). The details of the four research methods engaged in this study are presented in the next section.

4.2 Research methods

4.2.1 Overview

Research method can be briefly described as strategies used to implement a research design. Specifically, the research methods involved seven stages that comprise the four-phased study, including the research preparation (Leeds, 9 months), which involved desktop research - identification of the research problems and development of research questions/constructs; drafting of scoping study questions; data requirements; and selection of study locations (see Figure 4.3) and planning for the scoping study. It also involves scoping study trip planning, which concerns making contacts with relevant informants, travel permits, and financial grants. The second phase involves the first field trip to Abuja, Nigeria (1month) that constitutes the first phase of the study (scoping study). The first phase helps to have an overview of the research problems and reinterpretations, confirmation of the study location, and establishment of the relevant collaborations and other requirements (see Figure 4.4 for full details).



Figure 4-3: Map of Nigeria, highlighting three study locations (marked red star). Source: <https://www.worldatlas.com/img/areamap/d0f20052b0785b2c0dcafc464a47e09a.gif>

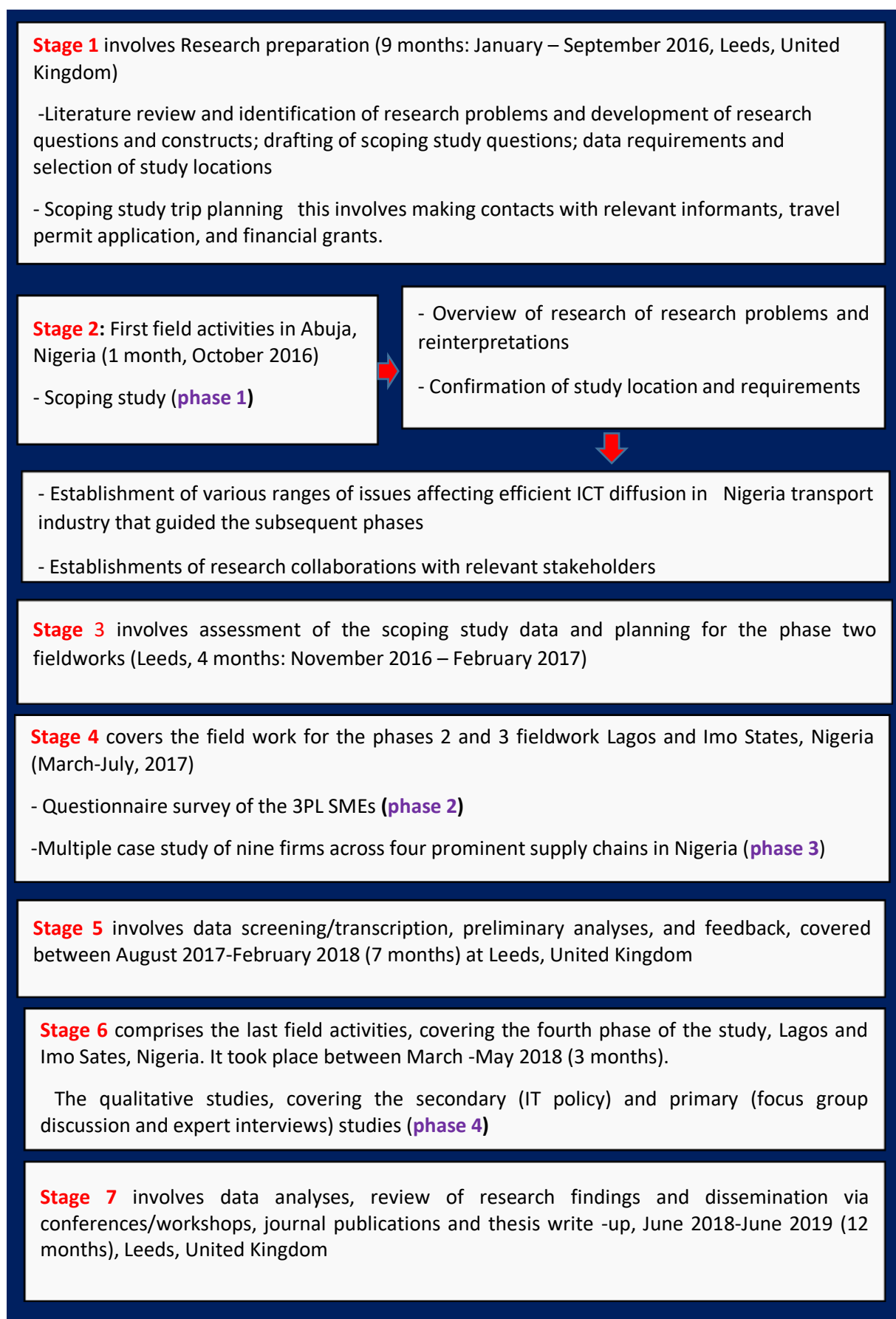


Figure 4-4 Integrated research design (Adapted, Okpara, 2016)

Another perspective of the overview relates to the data analyses. The combination of the multiple data analysis techniques corresponds to the mixed-methods research approach mentioned above, which is deemed suitable for the present research. The details are presented in Figure 4.5. The subsequent sections cover the specific research methods adopted in this research project.

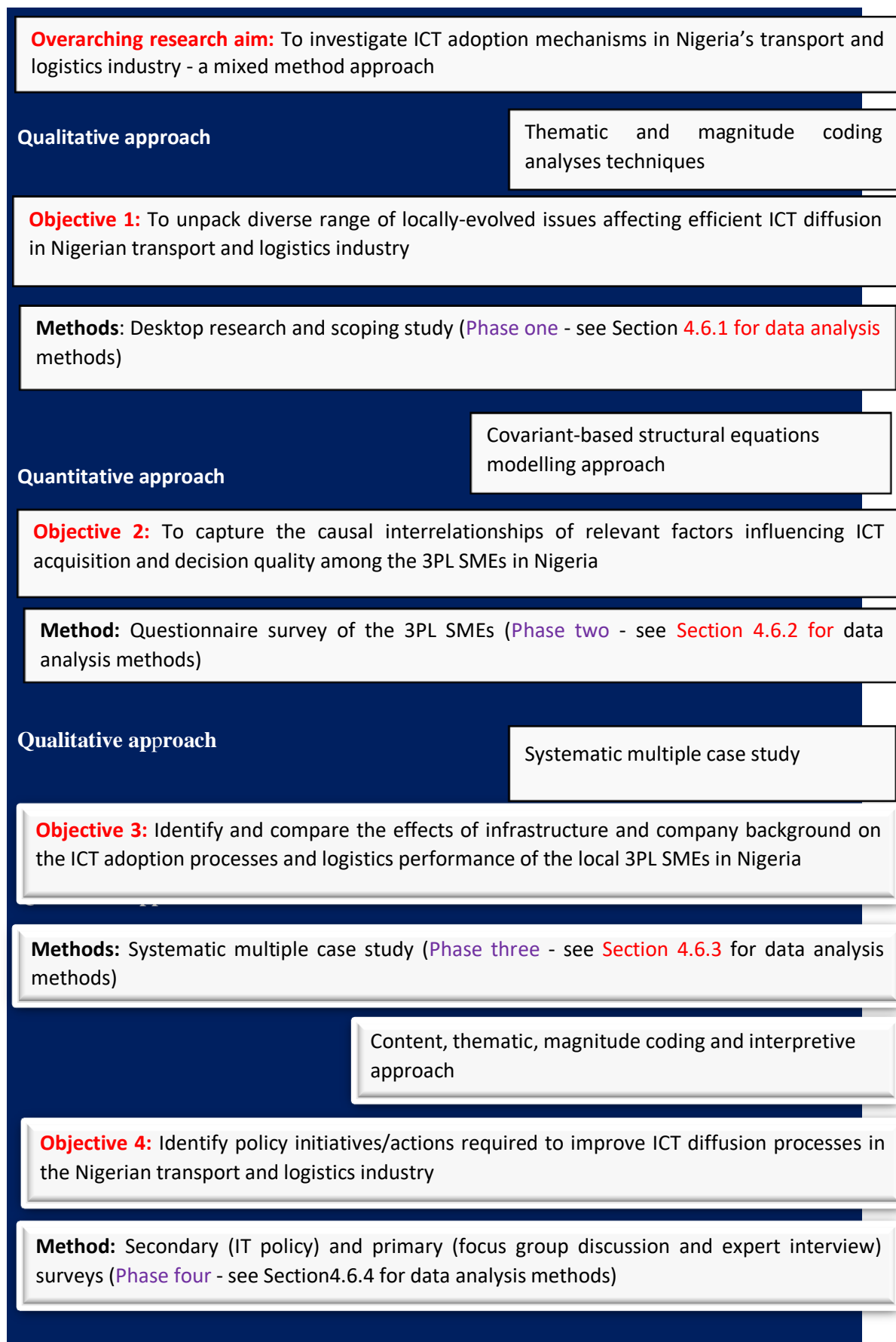


Figure 4-5 Linking research methods and objectives (Adapted, Okpara, 2016)

4.2.2 Scoping study (phase 1)

The scoping study (phase 1) was conducted in October 2016, which was initiated to gain preliminary insight concerning how varied range of locally-evolved issues are influencing ICT diffusion in Nigerian transport and logistics industry, using evidence from the local 3PL SMEs' activities. Also, the study provided a medium through which research collaborations were established that provided collaborative supports for the rest of the study. The rest of the section covers a brief description of the study location, study protocol and demographic characteristic of the participants, and data analysis techniques.

4.2.2.1 Description of the Study location

The study took place in Nigeria's Federal Capital Territory (FCT), Abuja, which became the nation's capital on 12th December 1991 after Lagos. The relocation was conceived in 1976, with the following reasons: to decongest Lagos and other environmental issues, as well as to centralise the nation's capital (Ayuba et al., 2013). The FCT consists of six council areas: AMAC, Bwari, Gwagwalada, Kuje, Kwali, and Abaji, as demonstrated in Figure 4.6.

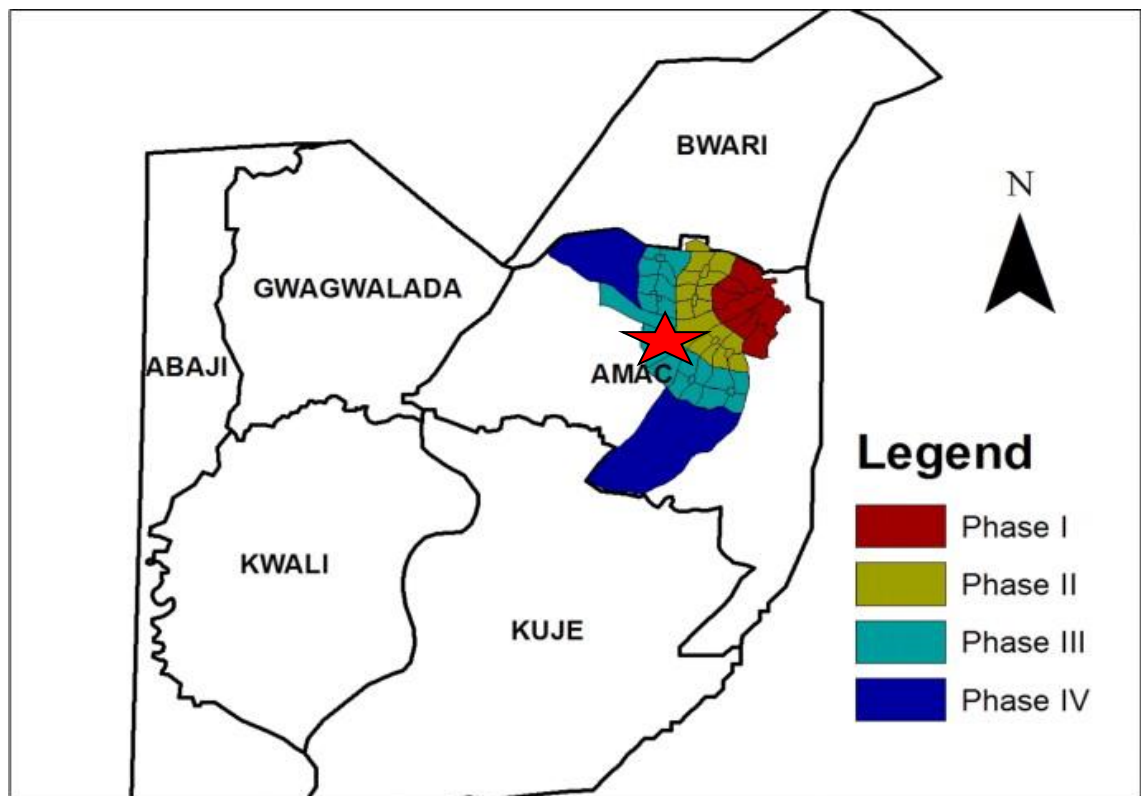


Figure 4-6 Map of FCT, Abuja showing the study site (marked red star) (Source: <https://ars.els-cdn.com/content/image/1-s2.0-S0264275114000699-gr2.jpg>)

The land area is 7,753.km/Sq. and population comprising 1, 406,239 (NPC, 2012). It is located within North of the confluence of Niger and Benue Rivers, bounded in the Northwest by Niger State, Northeast, Kaduna State; East, Nasarawa State, and Southwest, Kogi State. The serenity and environmental quality of the federal capital is reported to be deteriorating recently due to poor environmental management system (Imam et al., 2008).

The choice for the FCT as the study location for the phase 1 exploratory study was primarily influenced by its' hosting 2016 Annual Conference and General Meeting of Nigeria's branch of Chartered Institute of Logistics and Transport (CILT). The organisation is acknowledged as the leading transport and logistics professional body in the country with the mandate to promote knowledge of science/art of logistics/transport, as well as being the channel of communication for government, industry, and community at large for transport and logistics matters (www.ciltnigeria.org). The quality membership of the organisation cut-across various sectors of the local economy, which was the primary reason for its selection as the host for the exploratory study. Other reasons include relative security, and accessibility.

4.2.2.2 Protocol/procedure and demographic characteristics of the participants.

4.2.2.2.1 Protocol and procedure

The study protocol started in May 2016 by contacting the Public Relations Officer (PRO) of CILT. The positive outcome of the telephone conversation led to formal writing to the President for the inclusion of the exploratory study as one of the agenda items of the annual conference and general meeting, which was graciously approved (see Appendix 1c for the copy of the letter). Other protocols include dissemination of research documents such as consent forms, information sheets, and invitation letters to selected participants through the support of the PRO (see Appendices 1b-1e) for the copy of the research materials. The guiding questions were designed in such a way to help the panellists think about broad challenges of achieving logistics performance in Nigerian transport and logistics industry, followed by context-specific questions, and ended with questions that relate to potential strategies to address the identified problems.

The procedure occurred at the venue, including organising the participants (120) for the general presentation of the research objectives and the identified problems. Afterward, the participants were randomly subdivided into 15 Sub-groups, with a minimum of 8 members, where they reviewed the presentation, with the intention to match the desktop research outcomes with the on-the-ground realities. The approach is in line with the multiple focus groups (MFGD) discussion approach, with several moderators (Liamputtong, 2011, Berg, 2009). Due to the diversity of the participants' backgrounds, the moderations followed a constructive

approach, where the participants are allowed to express their views openly, based on their experiences, professionalism, and leadership. The participants reconvened after the subgroup discussions to review the inputs made at various subgroup levels and came up with consensus statements that summarise the scoping study. Note-taking and audio-recording of conversations were allowed.

The overall discussion period lasted about 120 minutes, until saturation was achieved. That is to say that further effort would have resulted diminishing returns (Lindlof, 1995). Apart from specific comments made about the research problems (see Section 5.2, Chapter 5 for results), they offered some specific recommendation for the future fieldwork of the study, including recruitment of field assistants with adequate knowledge of the field and can speak at least two out of three Nigeria's local dialects (Igbo, Yoruba, and Hausa). The recommendation is based on the notion that a basic understanding of the research field and engagement of field assistants who are conversant with the native languages would enable efficient and swift data gathering (Okpara, 2016). At the end, contacts were exchanged for follow-ups.

4.2.2.2.2 Demographic characteristics of the participants

The background of the 120 participants are covered in Table 4.1. The represented organisations spanned across transport and logistics practitioners, government agencies/ministries, professional bodies, leadership of various transport/logistics unions, security agencies, researchers, development actors (entrepreneurs), and student members of the organisation.

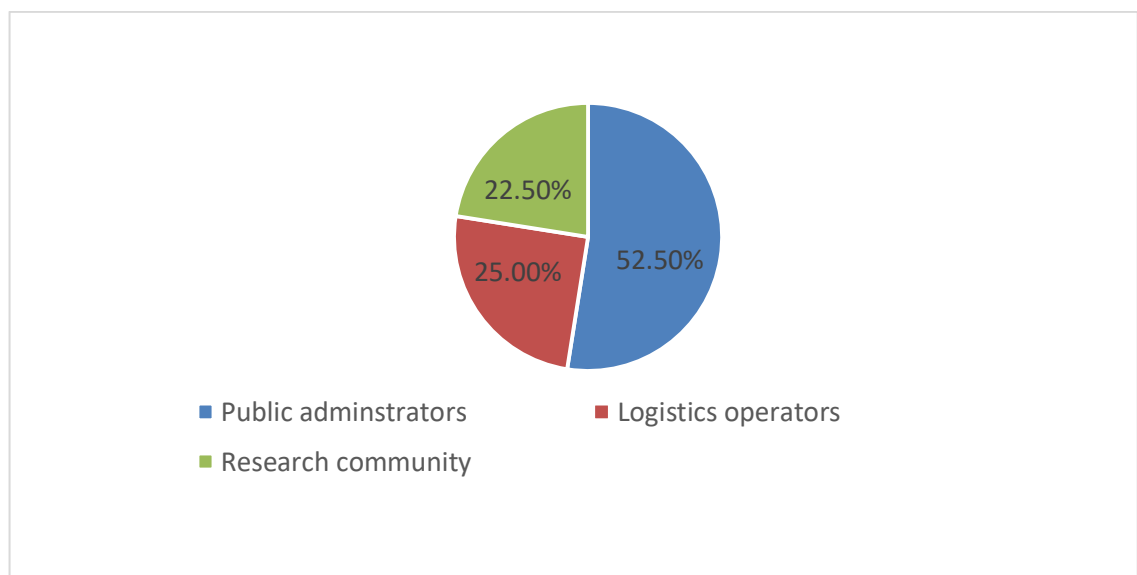


Figure 4-7: Thematic and magnitude categorisations of the participants

The participants appear to be more of senior staff members who have spent at least ten years in their current positions. The age bracket is between 19-65 years, with up to 85% male participants. The magnitude and thematic classifications of the participants are covered in Figure 4.7

Table 4-1: Background of the scoping study participants

Organizations	Other description
	Ranks
International Air Transport Association (IATA)	Senior staff (108, 90)
Shell Petroleum Development Company Nigeria (SPDC)	Junior staff (10, 8)
Nigeria Port Authority (NPA)	Students (2, 2)
Nigeria Maritime Administration and Safety Agency (NIMASA)	Years of experience
Federal Road Safety Commission (FRSC),	≤ 5 (51, 43)
Nigeria Defence Academy (NDA)	≤ 10(34, 28)
Nigeria Railway Corporation (NRC)	≤ 15 (17, 14)
Lagos Metropolitan Area Transport Authority (LAMATA),	≤ 25 (13, 11)
Federal Airport Authority of Nigeria (FAAN)	≤ 35 years (5, 4)
Nigeria Shippers Council (NSC),	Age (years)
Chartered Institute of Transport Administration (CIoTA),	≤ 25(13, 21)
Nigeria	≥26 ≤ 35 (25,
Federal and state ministries of transport	≥36 ≤ 45(40, 33)
Chartered Institute of Logistics and Transport (CILT), Nigeria	≥46 ≤ 55 (30,25
Leaders of various transport unions in Nigeria	≥55(10,8)
Nigerian Stock Exchange (NSC)	Gender
Relevant research institutions	Male (102, 85.0)
Logistics operators.	Female (18, 15.0)

*Values in brackets are the number of participants and corresponding percentage values

4.2.2.3 Data analysis techniques

The data analysis involves the transcription of the audio data and the review of notes. It was followed by rereading of manuscripts in several iterations to establish initial insights,

highlighting cross-thematic factors from inferences generated from the data (Katz and Postal, 1964, Blumenthal and Boakes, 1961, Rohrman, 1968). The Magnitude coding technique (Saldaña, 2016) is employed to generate frequencies of thoughts shared during the discussion (see Section 5.2, Chapter 5 for results).

4.2.3 Questionnaire survey (phase two)

The choice for the local 3PL SMEs for the embedded questionnaire survey in the present study corresponds to their critical roles in the industry (Mutula and Brakel, 2006, Metaxiotis, 2009, Federici, 2009, Ramdani et al., 2009), as well as their vulnerability in tapping relevant ICT resources to enhance their operations (Tob-Ogu et al., 2018). The lack of research in the field also informs the choice of the 3PL SMEs for the study (Evangelista, 2011, Gunasekaran and Ngai, 2003). The section covers the description of study location, demographic characteristics of the respondents and firms, the study protocol, research instrument, and data analysis.

4.2.3.1 Study location

The study location for the questionnaire survey is Lagos State, Nigeria. The selection is based on its socio-economic prominence in Nigeria and Sub-Saharan African (SSA), with the associated transport and logistics impacts (Adelekan, 2010, Merem and Twumasi, 2008). As previously mentioned, Lagos State used to be Nigeria's capital after Calabar. It is located in South-Western Nigeria, surrounded in North-East by Ogun State; West, Republic of Benin and South, Atlantic Ocean (Elias and Ademola, 2015).

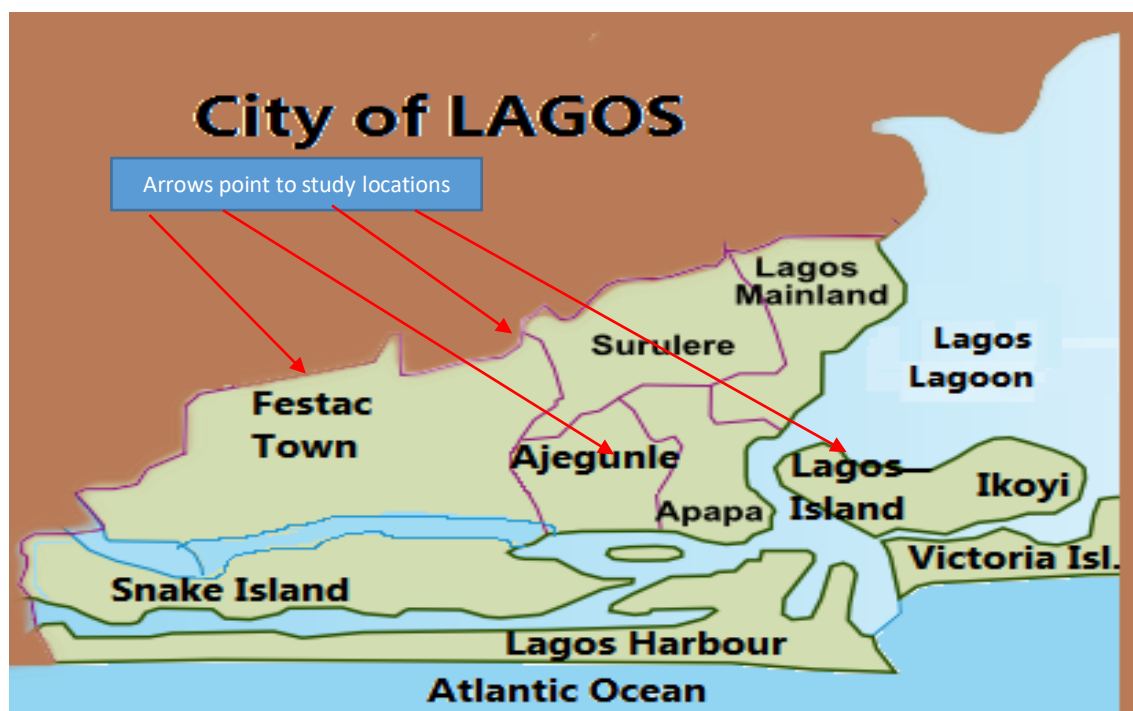


Figure 4-8: Map of Lagos city showing study locations
(https://upload.wikimedia.org/wikipedia/commons/9/98/Lagos_Map.PNG)

The state is geographically divided into three broad locations, including Lagos Mainland (Surulere, Festac Town, Ajagunle, and Apapa), Lagos Island (Ikoyi and Victoria Island) and Snake Island as demonstrated in Figure 4.8. The arrows in the Figure are pointing the path of travel during the field activities. The state is situated within latitudes 6°23'N and 6°41' and longitude 7°04'2'E, covering twenty Local Government Areas (LGA), landmass, 3345 square kilometres (22% coastal area) (Elias and Ademola, 2015, Wahab and Ayinde, 2010). The current population is about 18 million, with 25 million expected in 2025 (Lagos State Government, 2010).

Lagos State is recognised as one of the fastest-growing cities in the world (Elias and Ademola, 2015), with huge urban migration (6.0% annual population growth) (Elias and Ademola, 2015). Its huge economic activities yield about 36.5% of the national Gross Domestic Product (GDP), projected to achieve 63.30% of the national non-oil GDP in 2025 (about \$80.61 billion) (Elias and Ademola, 2015). The nation's transport and logistics industry revolve around the State, generating over 70% of national air traffic and 80% maritime. The security situation in the state is relatively stable (National Bureau of Statistics, 2013). All these combined to influence the siting of the study site in the area. The demographic characteristics of the respondents and firms are covered next.

4.2.3.2 Background of the firms and respondents

The demographic characteristics of the firms encompass employment status, location, designation, duration of existence, and affiliated supply chains (see Table 4.2).

Table 4-2: Demographic characteristics of the firms

Employment status	Company site	Company status	Year of existence	Industry
≤ 10 (50, 17)	Lagos Island (48, 17)	Private (142, 48)	≤10 (97, 33)	Apapa Port Complex (173, 59)
11-50 (171, 58)	Lagos Mainland (155, 53)	Limited liability (129, 44)	11-20 (62, 21)	Health care (34, 12)
51-199 (71, 24)	Others (91, 301)	Public liability (24, 8)	21-30 (89, 30)	Food/beverage (58, 20)
			31-40 (47, 16)	Auto-parts/accs. (30, 10)

*Values in brackets are the number of participants and corresponding percentage values

Table 4-3: Demographic characteristics of the respondents

Items	Description				
Ranks	1 (25, 8)	2 (32, 11)	3 (32, 11)	4 (193, 69)	5 (13, 5)
Gender	Male (261, 89)		Female (31, 11)		Undisclosed (2, 1)
ICT Experience	Nil (20, 7)	Low (60, 23)	Moderate (130, 44)		Advanced (85, 29)
Age (years)	≤ 24 (65, 22)	≤35 (80, 27)	≤45 (85, 29)	≤55 (54, 18)	≥ 56 (11, 4)
Education status	< High school (44, 15)		≥ High school (86, 3)	≥ Graduate (162, 55)	
Frequency of use of ICT	Nil (20, 7)	≤3 (80, 27)	≤5 (120, 41)	≤7 (50, 17)	Undecided (25, 85)

* Key: 1 = Owner-managers; 2 = Assistant general managers; 3 = Operations managers; 4 = other management staff; 5 =Undisclosed participants; numbers in brackets are percentage values; Values in brackets are the number of participants and corresponding percentage values.

For the respondents, the data covers that management staff of the sampled firms, including owner-managers (Managing Directors), Assistant General Managers, Operations Managers, other management staff. The demographic information covered also includes gender; ICT experience, education status, and frequency of use of ICT tools (see Table 4.3).

4.2.3.3. Protocol and procedure

The fieldwork took place between March-July 2017, involving a random sampling technique to avoid compromising the quality of data (Mangione, 1998). The data collection was achieved with the help of three Field Assistants (see Figure 4.9). In order to obtain the population of the local 3PL SMEs investigated in the study, the database of the Nigerian Chapter of Chartered Institute of Logistics and Transport (CILT), Chartered Institute of Transport Administrators, Lagos State Chamber of Commerce, Corporate Affairs Commission (CAC), relevant transport unions, Nigerian Port Authority (NPA) and other relevant agencies/organisations were consulted. The outcomes of the search indicate about 4500 registered local logistics providers in Lagos State. The categorisation of the registered firms includes freight/haulage operators, warehousing service operators, clearing and forward agents/consultants, and parcel delivery firms (Table 4.4).

Table 4-4: Categories of logistics service providers in Lagos State, Nigeria

Categories	Quantity	Percentage (%)
Parcel delivery firms	25	0.6
Freight/haulage firms	3900	86.7
Third-party logistics providers	400	8.9
Clearing and forwarding/consultant firms	175	3.9
Total	4500	~100



Figure 4-9: The Field Assistants during the questionnaire survey in Lagos State, Nigeria, May, 2017

Specifically, the parcel delivery firms are mostly multinational firms that reside their regional offices in Lagos State, Nigeria. The 3PLs category reflects those firms that provide specialised (outsourced) logistics services, including transportation to organisations. The road freight/haulage firms are those firms that provide full haulage services in the region. Last, the clearing and forwarding/consultancy firms are mostly engaged in international shipments/goods clearing activities, brokerage, warehousing/inventory, and consultancy services. There is no evidence for the activities of the fourth-party logistics (4PLs) services in the region.

Considering the definition of the 3PLs and the segmentations of 3PL SMEs in Section 3.4, Chapter 3, the above categorisations are captured in the questionnaire mailing list except for the parcel delivery firms due to their inherent large size. The procedure for setting up the questionnaire data collection was guided through the recommendations of the research collaborators, whose backgrounds cut across relevant professional bodies and unions as represented in Table 4.1, Section 4.2.2.2.2. At the end, 2000 questionnaires were randomly

selected from the relevant data bases consulted for the survey and distributed through four major channels as represented in Table 4.5. The random data collection approach was adopted to minimize bias and to ensure that the intended population of the study are truly represented in the sample (Mangione, 1998).

Table 4-5: Questionnaire data collection channels

Organisations	Quantity	Percentage (%)
Chartered Institute for Logistics and TRANSPORT (CILT)	620	31
Chartered Institute of Transport Administrators (CloTA)	480	24
Relevant Transport Unions	580	29
Nigerian Port Authority (NPA)	320	16
Total	2000	100

The segmentation of the data collection channels is required to direct path of travel, as well as to reduce potential duplication of data. The data collection involves both email (800, 40%) and manual (1200, 60%) procedures. The representatives of the sample cover major supply chains in the region: food/beverages (23%), health (20%), automotive (18%), and Lagos (Apapa) Wharf (35%). The specialities of the sampled firms cover freight/haulage, third-party logistics, clearing and forwarding, and consultancy (see Table 4.4), indicating that the actual population of the study has been captured in the sample.

Table 4-6: Data screening procedure

Description	Quantity (%)	Quantity (%)
Empty cases	50 (7.7)	
Out of scope (e.g., large firms)	60 (9.2)	
Duplicates	45 (6.9)	
Incomplete data	80 (12.3)	
Unengaged response (outliers)	120 (18.5)	
Unusable		355 (54.6)
Useable		295 (45.4)
Total		650 (100)

Out of 2000 randomly distributed questionnaires, 650 questionnaires (33%) were completed and returned. SMEs After data screening, 295 questionnaires (45.4%) were realised for the final data analysis. The usable sample size was adequate for structural equation modelling (Karadag, E. 2012) (see 4.2.3.6.2 for details). The data screening procedures are represented in Table 4.6. Further, to ensure the reliability of the data, other statistical tests were conducted before data analysis (See Section 4.2.3.6.2 for detail). The next section covers the description of the research instrument.

4.2.3.4 Research instrument

The study adopts a five-point Likert scaled questionnaire, ranging from strongly disagree-strongly agree (Larson, 2005) (see Appendix 3), covering the seven constructs represented in the causal model (Figure 4.10). The constructs were developed from the literature review (see Section 2.2.1, Chapter 2), comprising between 4-6 items. To recount, the constructs involve three exogenous (predictors) constructs, including consumer readiness (CR), scope of business (SB), and facilitating conditions (FC). The mediator constructs involve perceived usefulness (PU) and perceived ease of use (PEOU). The moderating variables include ICT experience and education status. The controlled variables include gender, age, and frequency of use. The dependent constructs comprise the ICT acquisition (IA) and decision quality (DQ), as demonstrated in the causal model (Figure 4.10). The questionnaire also contains the demographic information of the respondents and their firms (see Appendix 3). Importantly, the questionnaire was modified severally to suit the context of the study, including amendment of the wordings, removal of similar items. The amendments were based on the inputs of the supervisory team and the collaborators from the industry. Finally, the questionnaire was piloted using 50 samples using the contacts developed from the scoping study.

4.2.3.5 The causal model

4.2.3.5.1 Background

There is a lack of theoretical frameworks for ICT adoption among the local 3PL SMEs (see Chapter 2, Section 2.2.1). Similarly, little work has been advanced to underpin the causal interrelationships of factors influencing ICT adoption among the local 3PL SMEs (see Chapter 3, Section 3.4). The absence of the common narrative that explains the intermediate characteristics of the local 3PL SMEs evidently influences how ICT adoption challenges among the local 3PL SMEs is understood and interpreted. Existing empirical literature seeking to explain factors influencing ICT acquisition and decision quality have produced divergent views, particularly concerning the reluctance and innovativeness of the local 3PL SMEs (Pokharel, 2005, Kilpala et al., 2005). Conversations in this field typically draw upon factors influencing ICT acquisition and decision quality amongst the local 3PL SMEs and impacts without underpinning the possible causal interrelationships of contextual factors (see Chapter 3, Section 3.4). Perceive usefulness (PU) and perceived ease of use (PEOU) of ICT have remained key elements in literature that mediate the effect of the external variables and actual ICT acquisition particularly at individual levels (Davis, 1989).

On the other hand, there is a rich literature concerning factors influencing ICT acquisition at firm levels (Tornatzky and Fleischer, 1990). Some of the identified factors fall within the technological, organisational, and environmental factors (see Chapter 4, section 2.2.1 for details). Little is known where intermediate characteristics of the SMEs fit in ICT adoption discourse (Awa et al. 2015). Moreover, the concept of the intermediate characteristics of the local 3PL SMEs is less evident in the logistics and SC studies, compared to larger organisations (see Chapter 3, Section 3.4). Awa et al. (2015) propose an integrated framework that suggests a path to establish the intermediate characteristics of the local SMEs. Yet literature remains vague regarding the operationalisation of the integrated framework, particularly as it concerns local 3PL SMEs (Evangelista, 2011).

The causal model (Figure 4.10) is developed to fill these gaps. It is based on the premise that to anticipate solutions to improve ICT diffusion in the specialised sector as transport and logistics require the involvement of the relevant stakeholders (see Chapter 4, Section 4.2.2). Accordingly, they recommended important aspects to include in the causal model such as consumer readiness (CR), scope of business (SB) and facilitating conditions (FC) (see Chapter 3, Section 2.2.1). Giving the focus on the intermediate characteristics of the local 3PL SMEs and knowing the contextual conditions of the 3PL SMEs in Nigeria, the causal model is developed.

4.2.3.5.2 The causal framework

ICT acquisition and decision quality of the local 3PL SMEs were assessed based on the broader theoretical grounding discourse (Chapter 2, Section 2.2) which emphasise the importance of integrating various ICT models, frameworks, and theories to find common ground for intermediate characteristics of the local 3PL SMEs (see Chapter 3, Section 3.4). The framework (Figure 4.10) accounts for the underlying causal interrelationships of factors influencing ICT acquisition and decision quality of the local 3PL SMEs. The PU and PEOU are conceived as the mediator constructs, while CR, SB, and FC were adopted as the set of external factors (see Chapter 2, Section 2.2.1 for details).

The past studies in the field lack such an integrated approach. Instead, ICT adoption challenges among the local 3PL SMEs are framed as individual influencing factors and impacts. This encompasses the situation where the local 3PL SMEs are constrained or stimulated by a set of contextual factors. Assessment of ICT acquisition challenges in this context opens considerations for mapping the causal interrelationships of the contextual factors influencing ICT acquisition and decision quality among the local 3PL SMEs (see Chapter 3, Section 3.4).

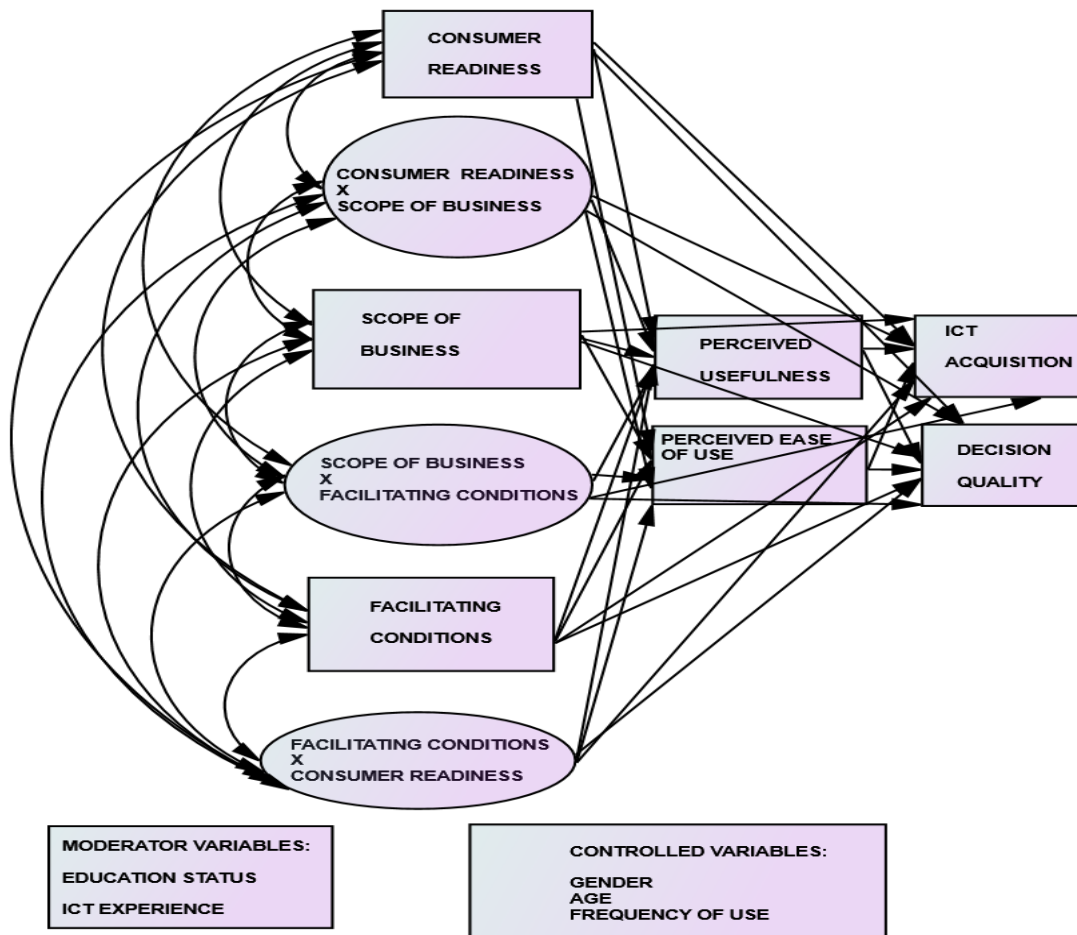


Figure 4-10: The causal model (Adapted, Lowry and Gaskin, 2014)

4.2.3.5.3 The causal model computation

This study adopts the process model in the form of mediation, two-way interaction, and multiple group moderation models to compute the causal model. The details are presented below:

Mediation model:

The mediation process model is usually used to understand how underlying mechanisms or processes influence a known relationship in the form of mediator variables. Mediator variables can also be referred to as the carriers or transporters of information along chains of causal relationships (Little et al., 2007). The approach has a long history in the behavioural and social science research (Hyman, 1955, MacCorquodale and Meehl, 1948, Wright, 1934), which can lead to three types of effects; no mediation, mediated and indirect effects. No mediation occurs when an existing causal relationship experiences negligible or no effect after the introduction of a mediator variable. The mediated effects are subdivided into partial and full effects, denoting the degree of effects generated after the introduction of mediator variables.

The partial mediation effect occurs when the strength of an existing causal relationship significantly drops (> 0) after the introduction of a mediator variable. On the other hand, full mediation occurs when the introduction of a mediator variable removes the causal effects ($= 0$) of an existing relationship. Moreover, the indirect effect of mediation model accounts for the sum of the mediated and direct effects. Others include mediation effects include total and inconsistent effects. The former is represented by the sum of the direct and indirect effects, while the latter denotes when the strength of a causal relationship turns non-significant after the introduction of a mediator variable (Kenny, 2018).

According to Baron and Kenny (1986), the following assumption should be met before conducting mediation analysis: (i) there should be an existing positive relationship between the variables to be mediated, and (ii) The mediator variables should also exhibit positive relationships between both ends of the mediated variables. Moreover, Kenny (2018) argues that the strength of the causal relationships should be guided by zero and non-zero coefficients rather than statistical significance, as proposed by Baron and Kenny (1986).

The argument is based on the possibility that a trivial coefficient can yield exhibit statistical significance when large data is use and vice versa. The author also raises the multicollinearity issue, which could induce false statistical significance. The author further argues that the indirect effect metrics represent the accurate measurement of mediation effects as it accounts for both mediated and indirect effects. It based on this that this study adopts indirect effect metrics within the context of bootstrapping (Hayes, 2013, Sobel, 1982, Bollen and Stine, 1990) to accept or reject the study hypotheses. However, the study also adopts the Baron and Kenny approach for the interpretations of the results to account for the possible effects of the relatively low sample size of the study.

With this understanding, the following equations are crafted to highlight what the proposed hypotheses under the mediation concept represent (see causal model - Figure 4.10 for details).

$$IA/DQ = b_0 + b_1CR + b_2SB + b_3FC + b_4PU + e_1$$

$$IA/DQ = b_0 + b_1CR + b_2SB + b_3FC + b_4PEOU + e_2$$

Where: IA = ICT Acquisition; CR = Consumer Readiness; SB = Scope of Business; FC = Facilitating Conditions; PU = Perceived usefulness; DQ = Decision Quality; PEOU = Perceived Ease of Use

Two-way Interaction model:

The two-way interaction model suggests that the strength of the proposed causal relationship between an exogenous construct (CR, SB, and FC) and the endogenous mediator constructs (PU and PEOU) depends on the interaction effects (high or low) amongst the exogenous

construct. As such, this study wants to know how the causal relationships between CR and PU/PEOU are influenced by their interactions with SB and FC (high or low). Likewise, the study wants to understand how the interactions between SB and PU/PEOU are affected by SB's interactions with FC (high or low) as expressed by the following equations:

$$PU = (CR + SB) + (CR * SB)$$

$$PEOU = (CR + SB) + (CR * SB)$$

$$PU = (CR + FC) + (CR * FC)$$

$$PEOU = (CR + FC) + (CR * FC)$$

$$PU = (SB + FC) + (SB * FC)$$

$$PEOU = (SB + FC) + (SB * FC)$$

These are based on the notion that exogenous constructs are not standalone in nature, but interact amongst themselves to predict the endogenous constructs (PU and PEOU). For example, CR can be influenced by a number of contextual factors such as status of trading partners/customer (SB), institutional/regional policies (FC), and firm size (Ezenwa, 2019, Ezenwa et al., 2018, Mehmman and Teuteberg 2016, Scupola, 2009, Al-Qirim, 2006, Jeyaraj et al., 2006, Wagner and Fillis, 2005, Boyes and Irani, 2004, Zhu et al., 2003, Zhu et al., 2002, Mehrtens et al., 2001, Martin and Matlay, 2001). Likewise, SB is inherently influenced by characteristics of the business/services, diversity of the stakeholders' interest, and the individual difference factors of the owner-managers (Ezenwa (2019, Xie and Breen, 2018, Chu et al. (2018, Evangelista, 2011, Jeyaraj et al., 2006, Windrum and De Berranger, 2002, Tornatzky and Fleischer, 1990). Lastly, literature indicates that regions that lack favourable FC potentially hinder efficient ICT diffusion (Ezenwa et al., In press, Ezenwa et al., 2018, Abou-Shouk et al., 2016, Carter et al. 2015, Meyer and Rowan, 1977).

The concept behind the developed hypotheses relates to TAM (Davis, 1989), which postulates that PU and PEOU are influenced by characteristics of surrounding external factors, which in turn determines the actual adoption of an information system. The last set of the developed hypotheses concern the multiple-group moderation model as presented next.

Multiple-group moderation model:

This can be referred to as a potential changer to a known causal relationships (Little et al., 2007). In this study, two moderation variables are created to underpin their moderation effects on the causal model. Specific emphasis is laid on the possible moderation effects of ICT experience and education status on the causal positive relationships between SB and PU; CR and PU, respectively, as demonstrated by the equations below:

$$PU = b_0 + b_1 + b_1SB + b_2_{ICT_exp} + b_3SB * ICT_exp + e_1$$

$$IA = b_0 + b_1 + b_{1CR} + b_{2Edu_stat} + b_{3CR} * Edu_stat + e_2$$

The idea here is to explore how the individual difference factors (IDF) in the form of ICT experience and education status of the local owner-managers (Agarwal and Prasad, 1999, Chau, 1996, Rogers 1995, Dabholkar, 1992, Hambrick and Mason, 1984, Zmud, 1979, Bass, 1969) can influence the established causal relationships, expressed in the causal model. These align with the notion that firms utilise their internal resources in terms of expertise and skills (intangible assets) as a means of achieving a competitive advantage. Literature also shows that such intangible internal resources are difficult to imitate and make them critical for firms' competitive strategies.

4.2.3.5.4 Summary

The process model, involving mediation, two-way interaction, and multiple moderation models are introduced in this study to help underpin how contextual issues around the local 3PL SMEs interact to influence ICT diffusion in the broader industry. These involve the effects of technological development regarding the mediation effects of the PU and PEOU constructs. Second, the interaction effects help to highlight the possible effects of the industry environment, scope of businesses, and the readiness of the individual firms on the mediator factors.

Next, are the likelihood of the moderation effects of internal resources of the firms such as ICT experience and education status of their owner-managers in this case on the proposed causal model. Apart from mapping the underlying mechanisms influencing ICT diffusion in the Nigerian transport and logistics industry, the approach also helps to operationalise the proposed integrated model by Awa et al. (2015). The limitation of the process model relates to the application of both Baron and Kenny Approach and Bootstrapping to account for the mediation analysis results. This was adopted to achieve optimal implications of the research findings.

Finally, the study envisages that the potential insights to be gained from the processes analyses could be useful to practitioners, policymakers, and entrepreneurs in mapping ICT acquisition/implementation strategies, enactment of regulations and policies, as well as improvement of technology innovations, respectively. The next section concentrates on data analysis operations.

4.2.3.6 Research hypotheses

Following the theoretical literature explored in Chapter 2 (see Section 2.2) and the causal model (Section 4.2.3.5), this section proposes the following hypotheses: First, PU and PEOU

often mediate (indirectly influence) the causal relationships between external factors and actual ICT acquisition and decision quality (Davis et al., 1989, Davis, 1989, Triandis, 1980). As such, this study proposes that the propensity of the set of external factors such as CR, SB, and FC to predict IA and DQ of the local 3PL SMEs depends on the mediating effects of the PU and PEOU. Accordingly, this informs the proposal of the following four null hypotheses:

H1a-c: PU does not significantly mediate the positive causal relationships between:

(i) CR/IA; (ii) SB /IA; (iii) FC /IA.

H2a-c: PU does not significantly mediate the positive causal relationships between:

(iv) CR/DQ; (v) SB/DQ; (vi) FC /DQ.

H3a-c: PEOU does not significantly mediate the positive causal relationships between:

(vii) CR/IA; (viii) SB/IA; (ix) FC/ IA

H4a-c: PEOU does not significantly mediate the positive causal relationships between:

(x) CR /DQ; (xi) SB /DQ; and ((xii) FC /DQ

Second, the theoretical literature advances the interaction effects of the set of external contextual factors (CR, SB, and FC) on the mediator constructs (PU and PEOU) (see Chapter 2, Section 2.2 for details). A large segment of the technological, organisational, and environmental sources of factors influencing ICT adoption at firm level suggests that the interactive effects of CR, SB, and FC predict the extent of PU and PEOU of ICT resources. For example, CR is influenced by a number of contextual factors such as trading partners/consumers (SB) as well as other institutional and regional specific issues (FC).

Likewise, SB can be influenced by the characteristics of the business/service, stakeholders' diversity and interest, and individual difference factors of the owner-managers (Agarwal and Prasad, 1999, Chau, 1996, Rogers 1995, Dabholkar, 1992, Hambrick and Mason, 1984, Zmud, 1979, Bass, 1969). FCs are somewhat related to the external factors that either dampen or strengthen the likelihood of ICT adoption in specific settings. The literature shows that region facing severe diffusion of innovation (DoI) challenges are likely lacking the necessary FCs that can enable individuals and firms to perceive innovation as a matter of necessity. This has combined to influence lack of awareness and motivation in those regions (e.g., developing countries).

These combine to suggest that whether the status of the set of external factors (CR, SB, and FC) can lead to improved PU and PEOU depend on their interactive effects (high/low) (see Section 4.2.3.5.3). Therefore, the study proposes that the extent any of the external factors can strengthen or dampen PU or PEOU of ICT will depend on the interactive impacts (high/low) of other contextual factors. Based on this argument, this study proposes the following six null hypotheses:

H5a-b: SB does not significantly strengthen the positive causal relationship between CR and PU

H6a-b: SB does not significantly strengthen the positive causal relationship between CR and PEOU

H7a-b: FC does not significantly strengthen the positive causal relationships between CR and PU

H8a-b: FC does not significantly strengthen the positive causal relationship between CR and PEOU

H9a-b: FC does not significantly strengthen the positive causal relationship between SB and PEOU, and

H10a-b: FC does not significantly strengthen the positive causal relationship between SB and PU

Third, the multiple moderation model proposes that if ICT experience and education status of the 3PL SMEs' owner-managers can change the status of the existing causal interrelationships, then they can be considered as moderating variables (Little et al., 2007). This suggests that improved ICT experience and education status of the owner-managers can redirect the existing causal interrelation in the positive directions. In contrast, they can also hinder existing positive causal interrelationships amongst the causal variables if the owner-managers lack the requisite ICT experience and education (business knowledge), making the moderating variables a rallying point for determining the rate of ICT adoption amongst the local 3PL SMEs (see details in Chapter 2, Section 2.2).

Accordingly, the interest of the empirical analysis here is to ascertain the moderating impact of the ICT experience and education status of the sampled owner-managers on the pre-existing mediated and interacting causal interrelationships. This implies that when there is low mediation and interacting effects, it is likely that high ICT experience and education can turn the situation around. For example, perceived dampened causal relationships between SB and PU can be spurred by the improved ICT experience of the owner-managers (Agarwal and Prasad, 1999, Chau, 1996, Rogers 1995, Dabholkar, 1992). Likewise, perceived low mediated relationship between CR and IA can be strengthen by enhanced education status of the owner-managers. On this basis, the following two null hypotheses are proposed:

H11a-b: ICT experience does not significantly strengthen the positive causal relationship between SB and PU

H12a-c: Education status does not significantly strengthen the positive causal relationship between CR and IA

4.2.3.7 Data analysis

4.2.3.7.1 Preliminary data analysis procedure

This section involves preliminary data screening, which involves checking data for error(s). The order of operations encompasses deleting empty cases, unengaged responses, outliers, and duplicated data (See Section 4.2.3.3 for details). Missing data were imputed by calculating the median values of the non-continuous data and the mean scores for continuous variables. The data screening also connotes tests of skewness⁷ and kurtosis⁸ using Microsoft Office Excel software to ascertain the symmetric conditions of the data. Since nearly all research variables were based on Likert-scale, the study has no reason to exclude variables based on skewness except if they exhibit no variance. Also, kurtosis scores that are greater or less than +/-2 can be problematic. The questionnaire data achieved all these conditions. The next section covers the techniques applied in the of the sampled data.

4.2.3.7.2 Structural Equation Modelling (SEM) and procedure

Why Structural Equation Modelling (SEM)?

SEM is a somewhat advanced regression statistical analysis technique. It is also referred to traditional modelling method, grounded in theoretical constructs and widely used in the behavioural science research. The increasing popularity of SEM relates to its accurate explanatory power of defining causal relationships, in terms of underpinning direct, indirect, and interacting relationships, simultaneously (Karadag, E. 2012). Also, SEM helps to understand the relationships between observed (measured) and latent variables, which is deemed adequate for management theory hypothesis testing, particularly within the context of information system management domain (Michael A. Merz and Alden 2008; Christian M. Ringle, Marko Sarstedt and Straub 2012).

Moreover, one of the key arguments for adopting SEM in this study is based on its capacity to combine formative (latent variables) and reflective (observed variables) models in a given set of data (Lohmoller 1989; World 1982), which is lacking other similar statistical models such as General Linear Model (GLM) and logit models (Cohen, 1998). Finally, SEM helps to establish relationships between structural and theoretical models, using path analysis.

⁷ Test of skewness is a measure of the symmetry of data

⁸ Kurtosis measures whether the data is heavy or light -tailed.

SEM procedure

The preliminary analyses that set the foundation for SEM include Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). Correctly, EFA is applied in this study to uncover the underlying structure of the developed constructs, as well as identifying their relationships. Its main objective is to establish the content validity of a given data. Some descriptions of the specific tests conducted for the study include factor correlation matrix describes the correlation between the variables and factors/variables. The correlations between variables are not expected to be high to avoid multicollinearity (see Table 4.7 for outputs).

Table 4-7: Factor correlation matrix

Factors	SB	PU	FC	PEOU	CR	DQ	IA
SB	1.000	.279	.507	.526	.341	.556	.303
PU	.279	1.000	.249	.241	.368	.299	.411
FC	.507	.249	1.000	.350	.505	.484	.346
PEOU	.526	.241	.350	1.000	.257	.660	.156
CR	.341	.368	.505	.257	1.000	.429	.429
DQ	.556	.299	.484	.660	.429	1.000	.327
IA	.303	.411	.346	.156	.429	.327	1.000

Pattern matrix loading represents the regression coefficients of the extracted factor, with ≥ 0.5 as the acceptable range for EFA. Similarly, Kaiser-Mayer- Olkin (KMO) is one of the measures used to establish goodness of fit, with ≥ 0.5 as acceptable ranges. Bartlett's test of sphericity is used to confirm the goodness of fit EFA, using p-value as an indicator. Also, the cumulative variance score represents the total variance explained.

Table 4-8: Exploratory factor analysis (EFA): items/scores

Items	Scores
Pattern matrix loading	0.496 - 0.945
Kaiser-Mayer- Olkin (KMO)	0.914
Bartlett's Test of Sphericity	7092.45, $p < 0.001$
Cumulative variance score	0.65
Non-redundant residual	0.20
Goodness of fit	$p < 0.001$
Cronbach Alpha	≥ 0.80

Non-redundant residual accounts for the difference between the observed and reproduced correlation, with ≥ 0.05 score, considered as an acceptable range. The goodness of fit establishes that the extracted factors are adequate to explain the covariance amongst the observed variables. Cronbach Alpha is used to measure the internal consistency of the extracted factors, which helps to establish the reliability of EFA; ≥ 0.60 scores are considered reliable. All these tests are conducted in this study, using SPSS (16.0) software (see Table 4.8 and Appendix 4 for outputs).

Further, CFA is a statistical technique employed to test the construct validity of sets of observed variables, to underpin the relationships between observed variables and their underlying latent counterparts. In order to achieve this, the following tests are undertaken in this study, using SPSS (16.0) and AMOS software (Arbuckle, 1997): Validation index procedure is employed to determine the factor structure of the observed variable after EFA (Table 4.9).

Table 4-9: Validation index table

Items	CR	AVE	SB	PU	FC	PEOU	CR	DQ	IA
SB	0.805	0.508	0.713						
PU	0.935	0.708	0.330	0.841					
FC	0.932	0.733	0.418	0.289	0.856				
PEOU	0.914	0.682	0.368	0.527	0.259	0.826			
CR	0.883	0.602	0.441	0.361	0.370	0.513	0.776		
DQ	0.898	0.687	0.167	0.568	0.245	0.375	0.242	0.829	
IA	0.839	0.567	0.345	0.598	0.317	0.506	0.424	0.678	0.753

* Extraction Method - Maximum Likelihood; Rotation Method - Promax with Kaiser Normalization

Table 4-9 Confirmatory factor analysis (CFA) - items/scores

Items	Scores
RMSEA	0.037
PCLOSE	1.00
CFI	0.971
CMIN(χ^2)/DF	1.412
Curve estimation	$p < 0.001$
VIF	≤ 3.00

Root mean square error of approximation (RMSEA) represents the absolute measure of model fit, with ≤ 0.05 considered as a good fit. P of Close Fit (PCLOSE) helps for testing specification (sampling) error (≥ 0.10 scores are considered good fit). Likewise, comparative fit index (CFI)

helps to analyse the model fit by examining the discrepancy between data and the hypothesised model (≥ 0.5 is an acceptable range). Variance inflation factor (VIF) is conducted to detect multicollinearity in the CFA model, with ≤ 5 as an acceptable range. CMIF (X^2) is somewhat regarded as the chi-square in CFA – AMOS (≥ 0.05 is the acceptable range). Also, the comparative fit index (CFI), helps to detect any discrepancy between data and the hypothesised model (≥ 0.05 is the acceptable range) (see Table 4.10 and Appendix 4 for outputs).

Table 4-11: Structural validity for the SEM: items/scores

Items	Scores
CMIN(X^2)/DF	1.196
CFI	0.978
PCLOSE	0.298
RMSEA	0.057

Last, the structural validity is achieved, based on the outcomes presented in Table 4.11. It is based on the outcomes of these tests that the study proceeded to the hypotheses tests, using covariant-based structural equation modelling (SEM) with AMOS software (Arbuckle, 1997). The results of the hypotheses are presented in Chapter 5. The next section covers the multiple case study method. The multiple group moderation model is achieved with invariant tests. The results of the three-process model covered in this phase of the study are covered in Chapter 5.

4.2.4 Multiple case studies (phase 3)

This section covers the multiple case method aspect of the research investigation. It is adopted to respond to the third broad research objective of the study, which is to map and compare the effects of both the internal and external factors on the ICT adoption process and logistics performance of the local 3PL SMEs in Nigeria. The internal factors relate to the internal infrastructure and logistics competence, while the external factors refer to the possible influence of their affiliated SCs and other locally-evolved issues. It is conceived to consolidate our understanding of contextual issues affecting efficient ICT adoption and assimilation amongst the local 3PL SMEs in Nigeria after the phase two study.

The case study research method in the field is beginning to draw research interest in recent years (Seuring, 2005, Chow et al., 1994b), regarding its capability to respond to ‘how and why’ research questions. Likewise, other qualitative methods such as focus group discussion and expert interviews help in boosting practical interpretations and understanding of the research problems (see Section 4.1.2, Chapter 4). It is argued that a combination of case study and

survey techniques in the field of transport and logistics encourages state-of-the-art research, with practical implications (New and Payne, 1995). The application of mixed-methods, mainly with the case study, is further supported in the field, based on robust research undertakings (Maloni and Carter, 2006, Ellram, 1996).

Moreover, it is advised that case studies in the field should be based on a theoretical framework to bridge the gap between theories and practice (Gammelgaard, 2003, Juga, 2003). Also, lack of research both in context of the local 3PL SMEs (Evangelista, 2011, Gunasekaran and Ngai, 2003) and developing logistics market as Nigeria (Tob et al., 2018) make it critical to adopt case study approach to boost the exploratory nature of the research investigation. The case study is grounded in an established theory - structure-process-model (Adapted, Donabedian, 1988), considered appropriate to enhance the robustness of case study research undertakings (Yin, 2014). In light of these, the multiple case study adoption in this study would help advance the following: (i) improves the understanding of issues affecting ICT diffusion in the Nigerian transport and logistics industry; (ii) consolidates the theory-building nature of the present study; and (iii) strengthens the overall reliability of the study. The subsequent sections cover brief descriptions of the study location, research framework, protocol, and description of the various SCs sampled in the study.

4.2.4.1 Brief description of the study location and theoretical framework

The study location is still Lagos State, Nigeria (see details in Section 4.3.1.1). Its choice is linked with the questionnaire survey in Chapter 2 as they formed part of the multiple case study. This aspect of the study concerns teasing out some of the issues raised in the phase 2 study, which is linked to the adaptation of the structure-process-outcome framework (see Figure 4.11).

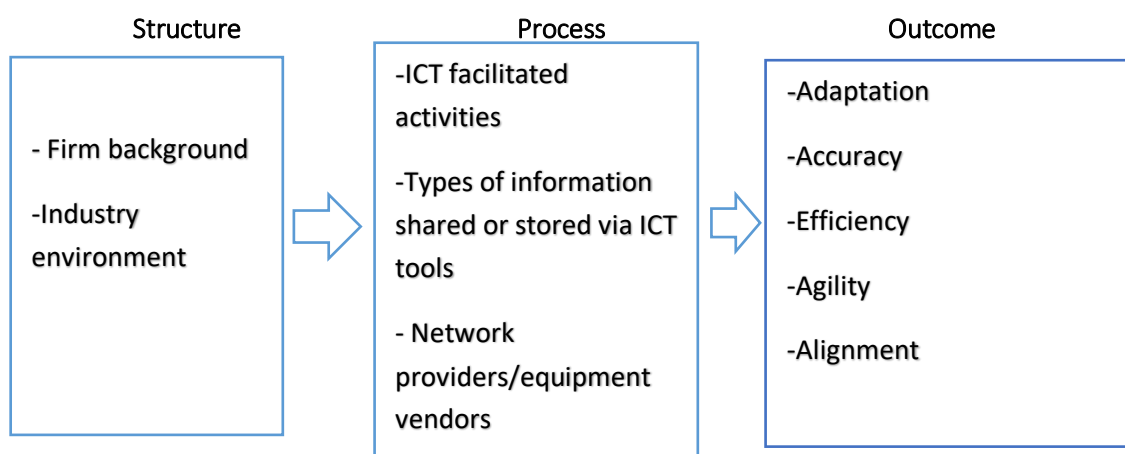


Figure 4-11: Research framework (Adapted, Donabedian, 1988)

Specifically, the structure concerns the immediate and the affiliated SC background, which involves the available infrastructure, human resources, and other locally-evolved issues affecting SC collaborations. The process aspect entails those activities that spur ICT adoption; types of information shared or stored with ICT resources; and the sources of information systems.

The outcome refers to the predetermined logistics performance, expected to achieve, including adaptation, accuracy, efficiency, agility, and alignment. Precisely, adaptation concerns the role the available ICT resources play towards adjusting SC activities, in relation to an equivalent change in the market demand. Accuracy refers to the accurate recording keeping achieved from adopting ICT resources, particularly for inventory management. Efficiency on its own comprises how much the application of ICT resources have improved cost savings while rendering superior service. Agility implies how far the implementation of ICT resources help in achieving swift adjustment required accommodating sudden changes in the original delivery or supplying demands. The developed framework guides data collection (Yin, 2014). The next section covers the data collection protocol.

4.2.4 2 Protocol

The research protocol refers to the background, rationale, and procedures observed while conducting the study. Importantly, the selection of the 3PL SMEs and their affiliated industries are guided by the outcome of the questionnaire survey. They include Apapa Port Complex, food/beverage, health care, and auto-parts/accessories, as presented below.

4.2.4 2.1 Apapa port complex

It is also known as the Lagos port complex is the largest and busiest port complex in Nigeria, consisting of Apapa quays, Third Apapa Wharf Extension, Apapa Dockyard, Apapa petroleum Wharf, and bulk vegetable oil Wharf. Other activities covered in the complex include Ijora Wharf, Kirikiri light terminal, and Lilypond inland. The port is built and funded by the Nigerian government and is the main channel for international shipments in the region. The port management was outsourced to private operators in 2005, with Nigerian Port Authority (NPA) acting as Landlord and Regulator (Eniola et al., 2014). Lack of coordination of port activities is named as one of the main causes of the fragmented 3PL SMEs' services in the region, which in turn hinders the provision of ICT-facilitated customised services. However, the author reveals that the situation is improving after the port concession. The bulk of the logistics activities in the port complex may have stimulated their huge participation in the questionnaire survey. Their scope of business covers freight (delivery of containerised consignments), warehousing, and consultancy services (clearing and forwarding).

4.2.4.2.2 Food/beverages

This is another industry that attracts the services of the local 3PL SMEs in the region, which, may be related to the strategic relevance of agri-food in the resourced-based economy (Bryceson and Yaseen, 2018). Moreover, the redefinition of the global sourcing of agricultural products and materials makes the services of the local 3PL SMEs lucrative. Most of them are engaged as local contractors, charged with local distribution and supply (Riley and Srivastava, 2016). The author asserts that these emerging roles of local 3PL SMEs have required them to acquire the relevant ICT resources to be able to retain their local and international collaborators.

4.2.4.2.3 Healthcare

IT also represents another attracting sector for the services of the local 3PL SMEs in the region. They are engaged in various forms of outsourced services, including the freighting of pharmaceutical and hospital products and equipment. Some of them are also involved in consultancy services, such as inventory management services and other internal coordination services. These may align with the notion that the sector is under pressure to meet national targets. For example, the sustainability and transformation partnership (STP) in England has required a pragmatic framework for efficient coordination of the sector, relating to integrating primary and secondary health services (Department of Health, 2019). Confidentiality in the handling of personal data has been named the primary inhibitor of efficient information sharing in the industry (Kierkegaard, 2013, Pflieger et al., 2015, Medlin et al., 2011), and active involvement of the local 3PLs, in particular (Xie and Breen, 2018). Some of these salient issues represent what the present study wants to find out in the context of developing countries.

4.2.4.2.4 Auto-parts/accessories and services

The industry is unusually attracting increasing international collaborations with the local 3PLs. It may be linked with the emerging globalisation of products and services, with the auto-parts supplies and services taking the lead, particularly in reaching developing markets (Wright, 2006, Katiyar et al., 2015). Apart from consolidated last-mile deliveries, inventory management is another aspect of logistics service that attracts the attention of the local 3PLs (Harland et al., 2007). The rationale for the selection of the respective industries relates to their frequencies in the questionnaire survey. The full detail is presented below.

4.2.4.3 Rationale and selection processes

First, the study envisages that further investigation concerning how different categories of the local 3PL SMEs are responding to the ICT adoption challenges in the industry would help

deepen understanding of the research problems. Second, the identification of the specific industries followed their magnitude in the questionnaire survey. Third, the selection of the specific firms coincides with their distinctiveness, in terms of affiliated SCs, individual difference factors (IDF) of the respondents, scope of businesses, locations of company sites, firm status, and internal infrastructure. Importantly, the expression of interest by the sampled firms for inclusion for the case study led to the selection of the initial 60 firms (20.3% of the questionnaire survey). The distribution includes Apapa port complex = 25; food/beverage = 15; healthcare = 10; and auto-parts and accessories = 10. After further considerations, based on the initial criteria, 9 firms were finally selected, comprising Apapa port complex = 3, and the rest, two each. Overall, the steps taken are to build robustness of the comparative multiple case studies (Yin, 2014).

4.2.4.4 Procedure

The procedure focuses on the development of the guiding questions for the study (see Appendix 5), data collection planning, and data collection. The planning is to ensure smooth conduct of the study, which involves agreements on the interview date, procedure to disseminate research documents (e.g., information sheets and consent forms), and venue. It was agreed that at least two management personnel would be involved in the interview to boost the veracity of data.



Figure 4-12:: The Researcher (2nd from right) and a company management team during a field tour, July 2017



Figure 4-13: The Researcher and his Field Assistants during a field tour, July 2017

The nine interviews took place at the company sites, which lasted approximately 120 minutes for each session. The field assistants were retained for the study. At the end of every session, company tours were conducted for company observations, with due approval (see Figures 4.12-4.13). Consents were also obtained for audio-recording of conversations and picture capturing. The next section covers description of the selected case firms.

4.2.4.5 Case firms' descriptions

This section covers the descriptions of the nine selected firms: Apapa Port Complex – three firms; Health sector – two firms; food and beverage – two firms; and auto-parts/accessories – two firms.

4.2.4.5.1 Apapa Port Complex

Case firm one

It is a limited liability firm, established in 1976. Its main company site is located in Lagos Mainland. The circumstances that led to firm's establishment were not available. The firm started operations with five employees (administrative and field staff), with one truck. The current staff strength is about 55, with 45 fleet (mainly HCV⁹ and HCV²¹⁰). The firm is

⁹ Heavy commercial vehicle, up to 12t

currently engaged in warehousing, clearing, and forwarding, freight, and consultancy services. Major business contracts are achieved through random on-the-spot market demand as well as referral. Their freight activities spread across neighbouring countries.

The current ICT profile comprises telephone services, emails, interactive website services, global positioning systems (GPS), and internet services. They have plans to acquire automatic warehouse systems (AWS), enterprise resource planning (ERP), customer relationship management (CRM), electronic data interchange (EDI), radio frequency identification (RFID), and E-routing. On the other hand, they have no plans to acquire land area network (LAN) (see Table 6.1, Section 6.3). The top management staff has moderate education (at least first degree), while their field workers (e.g., drivers and mobile mechanics/technicians) are less educated, with little or no ICT experience. However, there is an internal ICT training arrangement and other staff training activities, based on a third-party service.

ICT-facilitated activities include simple electronic communication (mobile and emails), tracking of fleet activities, online transactions, website services, mainly for conducting clearing and forwarding services. Types of information shared/stored include GPS signals, video/voice calls, text/graphical messages, and storage of personal information of employees and business documents. Their network providers are locally sourced, mainly for global systems of mobile communication (GSM). They use public email services (Gmail). The website hosting is also locally sourced, together with computer and software vendors (Table 6.7, Section 6.3). The immediate and targeted logistics performance includes adaptation¹¹, accuracy, cost reduction/efficiency, agility¹², and alignment¹³.

Case firm two

The second case firm belongs to the Apapa-Wharf Complex category. It is also a limited liability company, which began operations in 2010. The company site is located in Lagos Mainland. The revelation of the financial status was declined. The firm was reported to start as owner-driver but has risen to 25 employees, mainly field staff and secretarial team. Their activities cover mainly freight transport, with about 22 fleets (HCV1 and HCV2).

The management staff members lack basic ICT experience and education. They use mainly telephone services to conduct their business. They have plans to adopt other relevant ICT

¹⁰ Heavy commercial vehicle, above 12t ANDERSON, R. 2006. LCV scoping study 1: Review of published literature. In: VALLINT, J. (ed.) *Report to DfT Logistics Policy Division ED06135 Issue 1*.

¹¹ Adaptation here refers to the ability to adjust supply chain activities to accommodate market changes

¹² Agility depicts short-term changes in the deliveries of demand or supply

¹³ Alignment is somewhat incentives for the supply chain partners to improve the performance of the chain LEE, H. 2004. The triple – a supply chain. *Harvard Business Review*, October, 102-112. The selection of the performance indicators is related to the need to explain the research phenomena links

resources in the future, such as emails, websites, GPS, internet services, ERP, CRM, EDI, and E-routing. There are no existing plans to AWS and RFID, and undecided about adopting LAN (see Table 6.1, Section 6.3). ICT-facilitated services include simple communication with mobile phones. They also use simple mobile communication devices to monitor the activities of their drivers.

The type of information shared includes voice/video calls and texts/graphical messages/chats. Their primary internet network provider covers mainly mobile telephone communication services (see Table 6.7). The predetermined logistics performance relates to cost reduction for coordination. Their main reason for differing the adoption of other relevant ICT resources relates to lack of enabling environment and limited scope of business.

Case firm three

The last case firm sampled from this category is established in 2004. The surrounding circumstance that led to its establishment is related to the increasing logistics opportunities in the region. The firm foundation staff strength was three, including the owner. The current staff number is fifteen. The firm is a limited liability company, whose main scope of business encompasses clearing/forwarding, warehousing, and consultancy services. They sub-contract haulage services to sister companies. The top management is educated and has relevant ICT skills.

The current ICT profile covers telephone, emails, websites, and desktop/laptops. They intend to adopt the following in future WMS, RFID, ERP, CRM, and EDI. They revealed that they do not have future intention to uptake GPS and E-routing, and undecided about installing LAN (see Table 6.1, Section 6.3). The ICT facilitated activities include electronic communication, data storage, online booking/transactions, website services for digital port operations, and online presence.

The type of information shared involves voice/video calls, text/graphical messages, and exchange business information, mainly with international collaborators. Personal computers are used for storing personal information and company data. They source their computers and software through local procurement firms. They patronise local network providers for their internet and GSM services. They use corporate email services, and website hosted and maintained by indigenous firms. The anticipated logistics performance with the use of the ICT resources includes accuracy, alignment, cost reduction, adaptation, and agility.

4.2.4.5.2 Health sector

Two case firms (4 and 5) are selected from this sector (see Section 4.2.4.3) for the selection process. The background details include:

Case firm four

The firm was established on October 5, 1974. It is a non-limited liability firm, which is located in Lagos Mainland, Lagos State. Its main outsourcing organisations include pharmaceutical companies and hospitals. The firm commenced operation with only one light commercial vehicle, operated by the owner. The current fleet size is 30, mainly LCV1¹⁴ and LCV2¹⁵, with some refrigerated fleet for the conveyance of temperature-controlled freight. The current staff strength is 35. Lack of adequate road network and security on the highways are the major operational challenges.

The current ICT profile comprises GSM, email, desktop computers/laptops, internet services, and GPS. They intend to acquire interactive websites, ERP, CRM, EDI, and E-routing in the future. There are no plans for AWMS and RFID, and undecided about implementing LAN. The management team has an average ICT experience and education. ICT-facilitated activities comprise tracking, electronic communication, and storage of personal information.

The type of information shared encompasses GPS signals, voice/video calls, text/graphical messages, and electronic data. Stored data includes personal data and business/contract documents. The firm depends mainly on third-party operators for their internet and GSM services. They also rely on local procurement firms for their ICT resources and equipment (Table 6.7, Section 6.3). The anticipated ICT-facilitated logistics performance comprises agility, accuracy, adaptation, cost reduction, and agility.

Case firm five

It is the second case firm within the health sector, established in the early 1980s and currently a limited liability company. The increasing outsourcing logistics services in the sector inform the need for its establishment. The firm started as an agent for sourcing transport and logistics services for the logistics outsourcing organisations in the sector. The foundation staff members were four, and currently twenty-five. They now offer warehousing, training, consultancy, and parcel deliveries. The management staff has adequate ICT experience and at least first degrees. They lack commercial fleet as they are not involved in haulage activities. The parcel

¹⁴ Light commercial vehicle, weight range between 1.8t -2.6t

¹⁵ Light commercial vehicle, weight between 2.6t – 3.5t ANDERSON, R. 2006. LCV scoping study 1: Review of published literature. In: VALLINT, J. (ed.) *Report to DfT Logistics Policy Division ED06135 Issue 1*.

delivery activities are usually subcontracted to sister organisations. Their financial information was declined. The main reasons for not involving in freight include lack of adequate road network, insecurity, and extortions.

The ICT profile involves mobile/land telephone, emails, interactive websites, desktop/laptop, and computers. Others include internet AWS, LAN, and EDI services. There are plans to uptake RFID, ERP, and CRM in the future; there are no current intentions for obtaining GPS and E-routing. The ICT-facilitated activities include electronic communication, online financial transactions, digitalised warehousing system, and storage of personal and business information. The types of information shared encompassed voice/video calls, text/graphical text messages, and exchange of business documents and financial transactions. They engage third-party providers for their mobile phone and internet services. The website hosted and managed locally. The acquisition and maintenance of ICT resources are achieved through a third-party provider. The anticipated logistics performance includes cost reduction, adaptation, and alignments.

4.2.4.5.3 Food and beverage

Case firm 6

The firm was acquired from the original owner in 2000 - limited liability full haulage company, headquarter located in Lagos Mainland. The vehicle fleet constitutes mainly of containerized HCV1 and HCV2 due to the nature of their services – food and beverage distribution. The current fleet size is 110, with 75 (69%) functional. The staff strength is about 125. The information concerning their financial status was declined. The management team has low ICT literacy and education. Their business contracts are usually on short-term and require no formal processes (based on a gentle man's agreement). The primary source of contracts is through referrals on the spot demand arrangement. There is no regularised arrangement to become a 3PL operator in the industry. The major operational challenges are lack of adequate road network, security, and other basic amenities, as well as irregular policies and extortions.

The current ICT resources involve telephone, emails and internet services. They have plans to acquire the following in future: AWS, RFID, LAN, ERP, CRM and EDI. The ICT-facilitated functions involve electronic communication, tracking, and online transitions. The type of information shared includes voice/video calls, text/graphical messages, and business transaction documents. They source their telecommunication services on a third-basis. The predetermined logistics performance to achieve through ICT uptake is efficiency (cost reduction).

Case firm 7

This case firm was established in 1979, with the owner being a sole operator. The location of the firm is Lagos Mainland as a limited liability firm. The company fleet has increased 80, while only about 40 fleets are functional, operating. The situation was blamed on the lack of adequate road networks in Nigeria, which is responsible for frequent vehicle breakdowns. The fleets are mainly open-bodied HCV1 and HCV2 for the conveyance of containerised products. Their services are not restricted to food/beverage distribution. They have plans to diversify into warehousing services, clearing/forwarding and other consultancy services.

The ICT literacy of the management staff is low, as well as their educational status. The operational challenges include irregular policies, lack of human resources, lack of willingness to pay higher for customised services, high cost of business capital, lack of functional insurance systems, as well as the mentioned infrastructural challenges in the region. The current ICT profile includes telephone, emails, desktop computer/laptops, and internet services. The limited ICT uptake was blamed on the operational challenges highlighted above. They have the intention to uptake ICT skills, resources, and business knowledge as the situation improves.

The current ICT-facilitated services involve electronic communication, tracking, data storage, website services, and online transactions. The types of information stored comprise personal information and business documents, while the share information includes voice/video and text/graphical messages, and business documents. The internet and GSM services are outsourced, as well as engaging local procurement outfits for their ICT resources and software. The targeted logistics performance includes cost reduction and coordination (alignment).

4.2.4.5.4 Auto-parts /accessories

Case firm 8

The firm was established on 20th April 1993. The initial fleet was six, with ten employees, but currently, 150 fleet (LCV2, HCV1, and HCV2) and 180 staff, respectively. The circumstance behind the establishment of the firm was to advance logistics services in the region. The location of the company headquarters is currently in Owerri, Imo State. They are primarily involved in auto-part/accessories distribution, as well as other building materials. They are also involved in warehousing, clearing/forwarding, and consultancy services. The information concerning their financial status was not granted.

The firm has in-house ICT Department, supported by third-party network providers. They have implemented most of the enlisted ICT resources, except RFID and ERP they intend to acquire in future. ICT-facilitated services include electronic communication, tracking/tracing, data storage, online transactions and web services. The type of information shared corresponds to

GPS signals, voice/video calls, text/graphical messages, exchange of business documents, and company newsletters. They engage the local procurement companies for ICT resources and software. The primary operational challenges encompass lack of infrastructure, lack of trust to share data, high cost of business capital, and lack of trained human resources. The persistent infrastructural deficit in the region was tipped as the main cause of frequent vehicle breakdowns and associated high running cost. The predetermined logistics performance comprise efficiency, adaptation, accuracy, cost reduction, agility, and alignment.

Case firm 9

The last case firm was selected from the auto-parts/accessories, established in 1998, with two foundation staff (the founder and a secretary). They started operations with zero fleet, but currently have up to 110 functional fleets, comprising LCV1, LCV2, HCV1, and HCV2. The current staff strength is 120, covering warehousing, freight, and consultancy services. The main company site is located in Lagos Mainland, with the management team having advanced ICT skills and enhanced quality education. The financial information was not available as the time of the interview. They collaborate with international logistics organisation such as FedEx and DHL, as a local contract with the indigenous e-commerce outfits (Jumia and Konga). They also engage in general goods deliveries, in addition to auto-parts/accessories. The main operational challenges include lack of enabling environment and skilled manpower.

The current ICT profile involves telephone, emails, interactive websites, computers/laptops, GPS, AWS, RFID, LAN, CRM, EDI, and E-routing, and internet services. They have plans to acquire ERP in future. The facilitated ICT activities comprise electronic information, tracking, data storage, website services, online transactions and advertisements. The type of information shared and stored encompass GPS signals, voice/video calls, text/graphical messages, exchange of business documents, dissemination of company newsletter, and storage of personal information and business documents (e.g., bill of lading and business contracts). The web services are sourced through third-party operators, as well as ICT resources sourced through local procurement companies. The predetermined logistics performance includes efficiency (cost reduction), adaptation, accuracy, alignment, and agility.

4.2.4.6 Data analysis

The data analysis is guided by the adapted theoretical framework (Figure 4.11). It primarily involves comparing the activities of the firms, both intra and inter of the sampled industries, with the intention to unveil deeper insights concerning the research problems (Bryman and Belle, 2003). Based on the nature of the study, the deductive research approach is applied, using the outcomes from the questionnaire as a point of reference (see details of inductive and

deductive research approaches in Section 4.1.1). The data analysis commenced with the transcription of the audio-recorded data, followed by several iterations of rereading to develop deep insight into the data content. The case firms were contacted for rectification of information where the need arose. The supplementary documents from the World Bank (2013, 2018) are used to support the analysis and explanation of the research findings. The details of the research outputs and discussion are presented in Chapter 6. The next section covers the method for the last phase of the study.

4.2.5 Institutional perspective (phase 4)

The section covers the last qualitative studies in the form of focus group discussion (FGD) and expert interview (EI), deemed necessary to help identify the policy initiatives/actions that may be relevant in improving ICT diffusion among the local 3PL SMEs and the broader industry. The negative consequences of lack of relevant infrastructure in the Nigerian transport and logistics industry are highlighted, including lack of logistics performance (World Bank, 2018) and lack of ICT diffusion in the local economy (Tob-Ogu et al., 2018, Apulu, 2012). The problems are partly traced to the huge institutional voids on the part of the government (Ezenwa et al., In press) (see chapter 3, Section 3.5 for details).

Several developmental programmes and policies have been initiated in the region to boost the sectoral application of ICT resources, but have yet to fulfil their mandates. For example, the Federal Government of Nigeria (FGN) created the National IT policy with the intention to make the nation an information driven-society (NITDA, 2001). However, the implementation of the policy is yet to materialise and overdue for a review (Adedoyin et al., 2008). Also, the IT policy lacks adequate consideration for the transport and logistics sector and lacking proper developmental procedures (NITDA, 2001). It is in light of these that the fourth phase of the study is conceived to identify policy initiatives that may stimulate ICT diffusion in the industry. The objective is achieved by the review of the relevant policy documents and supported by two qualitative studies. The research method includes the conceptual framework development, a brief description of the study site, research protocol/procedures, and data analysis techniques.

4.2.5.1 *Development of conceptual framework*

The conceptual framework development (Figure 4.14) is linked with the institutional theory application in Chapter 2 (Section 2.2.3). The concept is backed by the Gerstetter et al. (2011) revelation that a step towards bridging a digital gap in a local economy requires formulation of action plans, regulations, and advisory council as a steering mechanism until achieving a designated developmental project. Besides, the conceptual framework builds on the notion

that the provision of public infrastructure and relevant regulations is the primary responsibility of the government in charge. Hence, the conceptual framework is designed to map the interactions between the government institutional framework, structural problems (industry - related), and operational challenges (firm-specific) in the Nigerian transport and logistics industry, with a specific focus on ICT diffusion challenges. Moreover, the concept aligns with the interactive functionality of a logistics system, comprising the institutional framework, infrastructure, shippers/consignees, and service providers are (Banomyong, 2017, Mondragon et al., 2017, Kayisire and Wei, 2016, Banomyong et al., 2008).

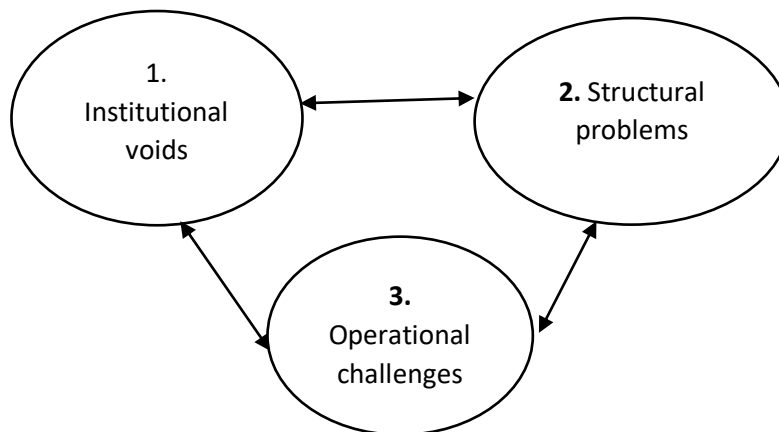


Figure 4-14: The conceptual framework

However, it is evident that Nigeria's logistics system is not functioning optimally, hence its lack of performance (World Bank, 2018), and increasing vulnerability of the local logistics operators, regarding ICT implementations (Tob-Ogu et al., 2018). Therefore, the conceptual framework is developed to shed light on the salient issues behind the matters raised above. The priority areas include reviewing relevant policies and functionality of the institutional framework, stakeholders' perception, and developing an ICT diffusion framework from the study to guide addressing the problems. The next section covers the study location, research protocol/procedures, and data analysis techniques.

4.2.5.2 The description of the study site

The study sites comprise Lagos and Imo States, Nigeria. The description of Lagos States is already done (see Section 4.2.3.1, Chapter 4). Imo State is located in South-Eastern Nigeria, lies within Latitude 5'10 and 5'67N; Longitude 6'36 and 7'28E. It is bounded in the North-West by Anambra State, South-West, River State, and East by Abia State (Njoku-Tony, 2011). The State was created on 3 February 1976, covers about 5,530 km² (2, 1140 sq. mi), and population size of about 3,927,563 (PHC Priority Tables, 2006). It comprises 27 Local Government Areas (LGAs), including Owerri Municipal (the state capital), where the study is conducted (Figure 4.15). Owerri city is informally referred to as the entertainment capital of Nigeria, regarding its

popularity for hosting several hospitality outfits. Also located in the city is the Sam Mbakwe Cargo International Airport and several higher institutions.

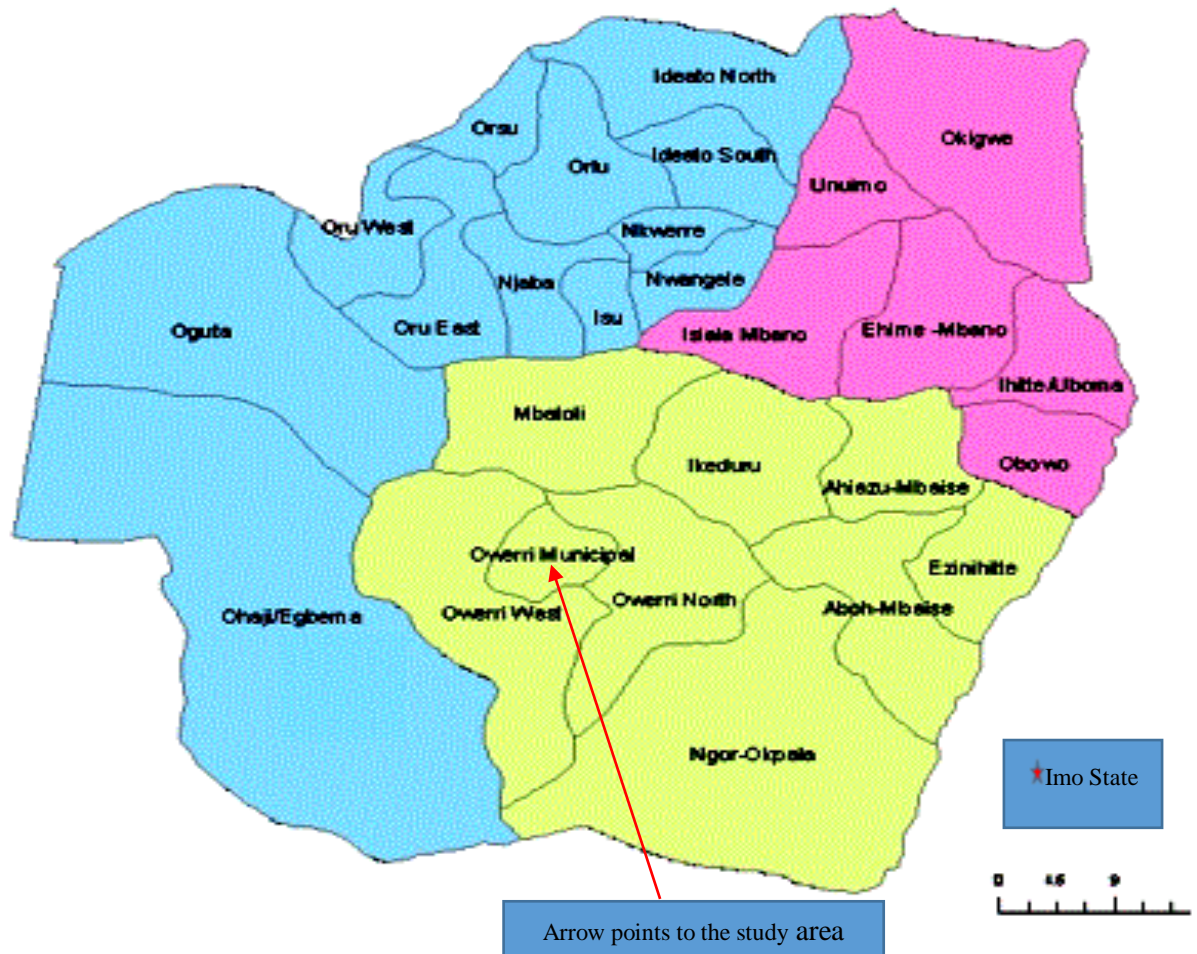


Figure 4-15: Map of Imo State, showing the study location (Map of Imo State)

4.2.5.3 Background of the respondents and rationale

The selection of the participants coincides with their in-depth understanding of the research problems, relating to work experience and practice, leadership, and research. Moreover, several of them participated in the scoping study and have been following the research development. Overall, 13 participants were involved, comprising 8 for the focus group discussion (FGD) and 5 for expert interviews (EIs). The FGD panellists are denoted as P1, P2..., and the EI interviewees as I1, I2 ... (Table 4.12)

Table 4-12: Demographic characteristics of the participants

Codes	Represented organizations	Designations	Years of experience	Education status
Focus group discussion panellists (P)				
P1	Nigeria Shippers Council (NSC)	Senior shipping officer	12	Graduate
P2	Nigeria Shippers Council (NSC)	Shipping officers	8	Graduate
P3	Chartered Institute of Logistics and Transport (CILT)	Chartered member	20	Postgraduate
P4	High Institution	Senior lecturer	17	Postgraduate
P5	Logistics firm	Senior analyst	18	Graduate
P6	Logistics firm	Manager	15	Postgraduate
P7	National Maritime Administration and Safety Agency (NIMASA)	Senior officer	14	Graduate
P8	University lecturer	Professor	25	Postgraduate
Expert interviewees (I)				
I1	Nigeria Port Authority (NPA)	Management staff	25	Postgraduate
I2	Flour mills company	Manager	7	Postgraduate
I3	Transport union	President	12	Postgraduate
I4	Transition park	Manager	18	Graduate
I5	Logistics company	Senior ICT personnel	26	Graduate

4.2.5.4 Protocol

The contacts of the participants were sourced from their professional organisations, including Chartered Institute for Logistics and Transport (CILT) and Chartered Institute of Transport Administrators (CIoTA), Nigeria. Some of them were contacted directly, following the initial exchange of contacts during the phase one study. The dissemination of the research materials (e.g., information sheets, consent forms, and notification letter) were also achieved through their contacts. The scheduling of the meeting times and venues were concluded through telephone conversations. The data collection took place sequentially between August and November 2017, with FGD coming first. Before the commencement of each exercise, the consents of the participants were sought through signing the consent forms. The FGD took

place in Lagos city and lasted about 3 hours, 20 minutes. On the other hand, the venues for the 5EIs covered Lagos city and Owerri Municipal, with each session consuming 90 minutes, average. The discussion and interview sessions reached saturation stages as all the participants exhausted their views to the best of their ability and knowledge. Audio-recording of discussions and interview sessions were granted. The guiding questions are appended in Appendix 6.

4.2.5.5 Data analysis technique

The data analysis techniques cover the following: First, qualitative document analysis (QDA) for the IT policy; content, thematic, magnitude coding techniques (Saldaña, 2016), and interpretative phenomenal analysis (IPA) technique (Elliott, 2000) for the FGD and EI data. Specifically, QDA entails interpreting the IT policy to give meaning and voice around its analysis, which involves developing themes, cross themes, and magnitude coding. The IPA technique refers to offering insight into a given context using pieces of phenomenal evidence. Similarly, thematic analysis entails development of patterns from a given qualitative data. Magnitude coding represents frequency counts of salient information contained in a qualitative data.

The procedure followed the traditional process, including transcriptions of audio data, and rereading in several iterations until in-depth meanings are achieved from each data set. Unclear details were resolved by contacting the concerned participants for rectifications. In the end, the research supervisors and the participants were contacted to review the data to ensure that the different data sets represent the accurate information intended by the informants. The study adopts Nvivo 11 software for the content analysis (text query search technique), which guided the development of patterns for the FGD data (Appendix 7). Others were conducted manually. The next section comprises the conclusion of the chapter.

4.3 Conclusion of chapter 4

This chapter focuses on the research methodology, covering the research design and several methods that constitute the four phases of the study. Specific issues, such as strengths and weaknesses of qualitative and quantitative research methods, are highlighted. Deductive and inductive research approaches are also presented. The mixed-methods research and the triangulation technique are also highlighted. Around these presentations, rationales for making specific choices for the research methods adopted in this study are justified. Importantly, the dynamics and complexities of the research problems deemed it necessary to adopt mixed-methods research techniques for this study. The idea is to explore various dimensions affecting efficient ICT diffusion in the Nigerian transport and logistics industry.

Though advantages abound for the adoption of the mixed-methods research approach, such as tapping from both sides of broad methods to boost the research robustness, there are also limitations, including time-consumption, capital, and resource-intensity. The resource aspect entails the researchers undergoing training to be able to handle both aspects of broad methods, both in data collection and analysis. Apart from that, there is also the tendency of duplicating results.

Results and discussions

The subsequent chapters – 5, 6, and 7 cover the results and discussions of the four-phased study. Chapter 5 covers the scoping study and questionnaire survey; chapter 6, multiple case studies; and chapter 7, IT policy, and the last two empirical qualitative studies (focus group discussion and expert interviews).

Chapter 5 –Results and discussions of phases 1 and 2 studies

Outline

This chapter covers the results and discussions of the first and second phases of the study, which correspond to the following research objectives: (i) To unpack diverse ranges of contextual factors influencing ICT adoption among the local 3PL SMEs. (ii) To empirically capture the interrelationships of the contextual factors (scope of business, consumer readiness, facilitating condition, perceived usefulness, perceived ease of use of ICT, and individual difference factors) on ICT acquisition and decision of the local 3PL SMEs. The Chapter contains four sections, covering the overview (5.1), scoping study results (5.2), questionnaire results (5.3), and discussion and conclusion (5.4).

5.1 Introduction

The importance of local SMEs is universal regarding their contributions to economic growth (Scupola, 2009). In the context of transport and logistics industry, their activities are crucial in relation to enhancing SC integrations/processes, agility, adaptation, and alignment (Lee, 2004). However, issues relating to ICT uptake amongst the local 3PL SMEs are under-researched (Evangelista, 2011, Gunasekaran and Ngai, 2003), with few studies linking their limited ICT adoptions to several contextual issues: limited scope of business, firm size, financial and human capital constraints (Irina et al., 2015, Harindranath et al., 2008, Rantapuska and Ihanainen, 2008, Zeimpekis and Giaglis, 2006, Pokharel, 2005, Hollenstein, 2004, Stefansson, 2002, Kuan and Chau, 2001 Kuan and Chau, 2001). Others found lack of ICT training centres (Kuan and Chau, 2001) and reluctance to accept change (Perego et al., 2011b, Huckridge et al., 2010, Kilpala et al., 2005), as part of the barriers. Against this background, it is recommended that mapping the causal interrelationships of locally-evolved factors would help to accurately underpin underlying issues involved (Banomyong, 2017, Evangelista, 2011, Evangelista and Sweeney, 2006).

The above research gap is attended, using the phases' one and two of this study, as demonstrated in this Chapter. The research methods are covered in Sections 4.2.2 and 4.2.3, Chapter 4, respectively. Briefly, the phase one involves an exploratory scoping study with 120 relevant stakeholders in the industry, used to build the ground for the phase two study.

Phase two involves 12 broad hypotheses tests, covering mediation, two-interaction, and multiple-group moderation models, using covariant-based structural equation modelling, with AMOS software. The questionnaire data covered 295 3PL SMEs in Nigeria. The mediation tests

are decided and interpreted by both Barron and Kenny and Bootstrapping techniques to ensure the robustness of the research findings. Likewise, the two-way interaction analyses are interpreted by the graphical outputs.

The outcomes of both phases of the study are presented below, using their respective research questions to guide the presentation

5.2 What are the diverse range of contextual factors influencing ICT adoption among the 3PL SMEs in Nigeria? (RQ i).

The diverse ranges of factors influencing affecting efficient ICT adoption amongst the local 3PL SMEs are summarised in Table 5.1. The thematic factors are divided according to barriers and drivers and estimated using their magnitude scores. The magnitude outcomes led to the categorisation of the thematic factor as the top, intermediate, and low barriers and drivers, accordingly. Precisely, nine ICT adoption barriers are identified, including the top barriers, relating to lack of adequate public infrastructure, lack of capital, lack of trust to share data, high-cost ICT acquisition and maintenance, and irregular policies. The intermediate barriers involve extortions, lack of patronage for customised services, and lack of intelligent transport networks. The lower barrier involves the lack of willingness to accept technology innovations by the collaborating partners.

On the other hand, the drivers encompass flexibility of services and innovativeness, local and international collaboration opportunities, enhanced accessibility to the local logistics markets, and technology adaptive skill. The intermediate driver coincides with their better understanding of the local routes, increasing outsourced logistics services, and online freight exchange platforms.

Table 5-1: Diverse ranges of factors influencing ICT adoption amongst the local 3PL SMEs

S/N	Thematic factors	Magnitude scores	Remarks
Barriers			
i	Lack of adequate public infrastructure	15 (100)	Top barrier
ii	High cost of business capital	15 (100)	Top barrier
iii	Lack of integration and trust to share data amongst collaborating partners	13 (87)	Top barrier
iv	High cost of ICT acquisition and maintenance	13 (87)	Top barrier
v	Irregular policies	12 (80)	Top barrier
vi	Extortions	10 (67)	Intermediate barrier
vii	Lack of patronage for customised services	9 (60)	Intermediate barrier
viii	Lack of adequate (intelligent) transport network	8 (53)	Intermediate barrier
ix	Lack of collaborators' willingness to accept technology innovation	5(33)	Low barriers
Drivers			
x	Flexibility of services and innovativeness	14 (93)	Top driver
xi	International and local collaborations	14 (93)	Top driver
xii	Easy accessibility to the local logistics markets	13 (87)	Top driver
xiii	Technology adaptive skills	12 (80)	Top driver
xiv	Better understanding of the local routes	11 (73)	Intermediate driver
xv	Increasing logistics outsourcing services	10 (67)	Intermediate driver
xvi	Online freight exchange opportunities	8 (53)	Intermediate driver

*Numbers in brackets are % values of the magnitude scores. Decision rules for ranking: ≥ 70 = Top barrier/driver; $\leq 50 - \leq 69$ = Intermediate barrier/driver; <50 = Low barrier/driver

5.3 Are the contextual factors influencing ICT acquisition and decision quality among the local 3PL SMEs interrelated? (RQ ii).

The tests for content and construct validity of the structural equation model are presented in Section 4. 2.3.6.2, Chapter 4.

5.3.1 The mediation test results

The mediation tests are summarised in Table 5.2. The outcomes using indirect effect (bootstrapping) results fail to reject null hypotheses. However, with Baron and Kenny's approach, some of the results suggest otherwise. Therefore, to optimise the outcomes of both methods, indirect effects results are used to test the hypotheses, while the Baron and Kenny's outputs are considered in the discussion of the research findings, with the following decision rules:

- Full mediation = Reduction in the regression weight after the introduction of the mediator variables with non-significant statistical result after mediation
- Partial mediation = Reduction in the regression weight after the introduction of the mediator variables with significant statistical results
- No mediation = Non-significant causal relationship, before and after the introduction of the mediation constructs.

Specifically, the model helps to highlight the underlying effects of perceived usefulness and ease of use of ICT resources in the pre-existing causal relationships between the sets of selected predicting variables (FC, SB, and CR) and the response variables (IA and DQ).

Table 5-2 Mediation model results

S/N	Relationships	Direct without mediation	Direct with mediation	Remarks
H1a -c	(i) CR/PU/IA	0.357 (***)	0.128 (***)	Partial mediation, indirect effect not significant - null hypothesis not rejected
	(ii) SB/PU/IA	0.194 (***)	0.069 (ns)	Full mediation, indirect effect not significant - null hypothesis not rejected
	(iii) FC/PU/IA	0.119 (ns)	0.042 (ns)	No mediation, null hypothesis not rejected
H2a -c	(iv) CR/PU/DQ	0.224 (***)	0.059 (ns)	Full mediation, indirect effect not significant - null hypothesis not rejected
	(v) SB/PU/DQ	0.053 (ns)	-0.086 (ns)	No mediation - null hypothesis not rejected
	(vi) FC/PU/DQ	0.119 (ns)	0.255 (ns)	No mediation - null hypothesis not rejected
H3a -c	(vii) CR/PEOU/IA	0.350 (***)	0.148 (**)	Partial mediation, indirect effect not significant- null hypothesis not rejected
	(viii) SB/PEOU/IA	0.194 (***)	0.070 (ns)	Full mediation, indirect effect not significant- null hypothesis not rejected
	(ix) FC/PEOU/IA	0.119 (ns)	0.038 (ns)	No mediation, null hypothesis not rejected
H4a -c	(x) CR/PEOU/DQ	0.224 (***)	-0.017 ()	Full mediation, indirect effect not significant - null hypothesis not rejected
	(xi) SB/PEOU/DQ	0.053 (ns)	-0.086 (ns)	No mediation- null hypothesis not rejected
	(xii) FC/PEOU/DQ	0.119 (ns)	0.059 (ns)	No mediation- null hypothesis not rejected

R^2 : CR = 0.57, SB = 0.41, FC = 0.51; Indirect effects = ns; ** $\approx p \leq 0.05$, *** $\approx p \leq 0.01$, ns $\approx \geq 0.05$

As described in the introductory part of the section, the outcomes Baron and Kenny approach (Baron and Kenny 1986) are used for the discussion of the results to bolster the intuitive understanding of the research findings. In particular, following, Baron and Kenny approach, there are some elements of mediating effects of PU and PEOU in the causal relationships between CR /SB and IA/DQ. These highlight the importance of the mediating variables in determining the rate of ICT uptake in the local logistics industry. The full details of the study implications are presented in Section 5.4.

5.3.2 The two-way interaction test results

The two-way interaction analysis outputs are covered within H5a-b - H10a-b, as indicated in Figures 5.1-5.6. Here, the outcome of the study fails to reject the null hypothesis, except for H10a-b.

H5a-b: SB dampens the positive causal relationship between CR and PU of ICT, null hypothesis not rejected (Figure 5.1)

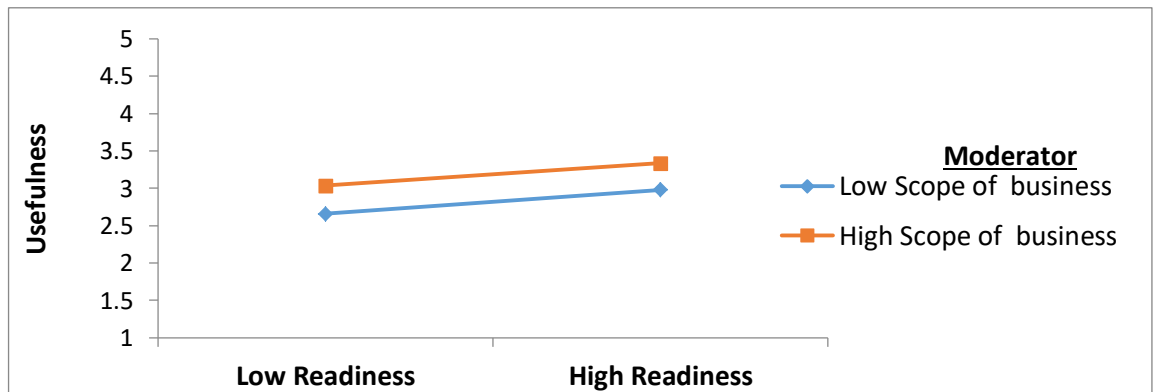


Figure 5-1: SB dampens the positive causal relationship between CR and PU of ICT.

H6a-b: SB dampens the positive relationship between CR and PEOU of ICT, null hypothesis not rejected (Figure 5.2).

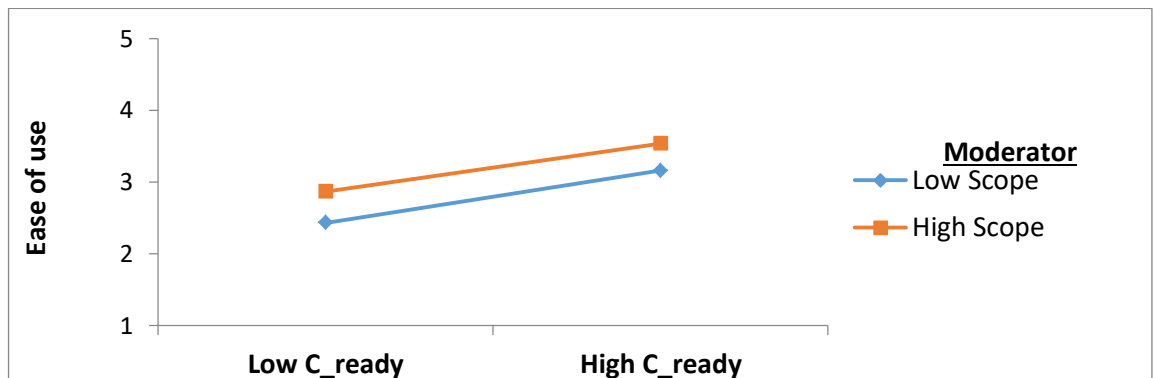


Figure 5-2: SB dampens the positive relationship between CR and PEOU of ICT.

H7a-b: FC dampens the positive causal relationship between CR and PEOU of ICT, null hypothesis not rejected (Figure 5.3)

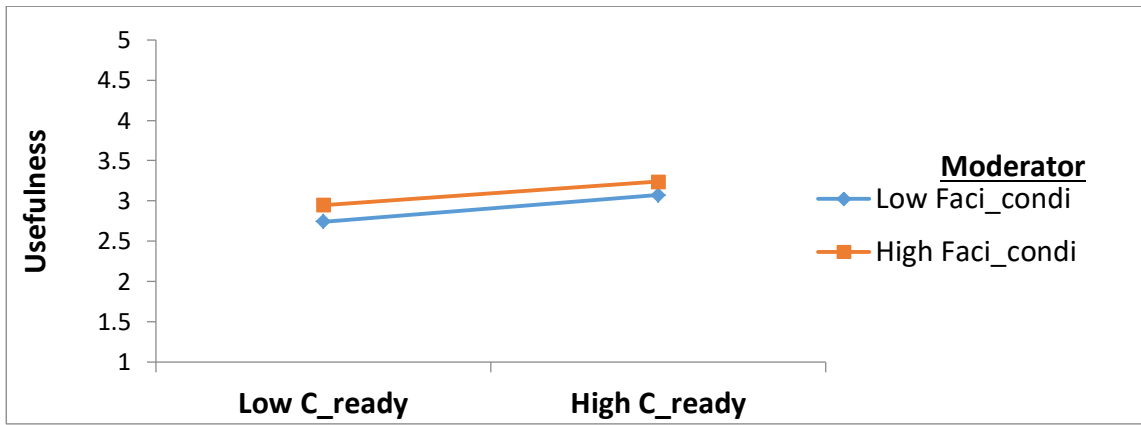


Figure 5-3: FC dampens the positive causal relationship between CR and PU of ICT.

H8a-b: FC dampens the positive causal relationship between CR and PEOU ICT, null hypothesis not rejected (Figure 5.4)

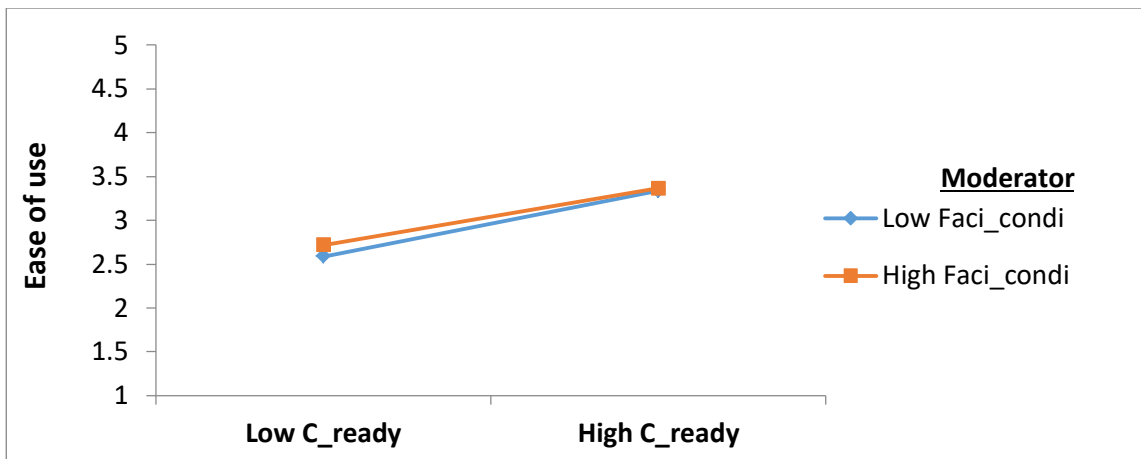


Figure 5-4: FC dampens the positive causal relationship between CR and PEOU of ICT.

H9a-b: FC dampens the positive causal relationship between SB and PU of ICT, null hypothesis not rejected (Figure 5.5).

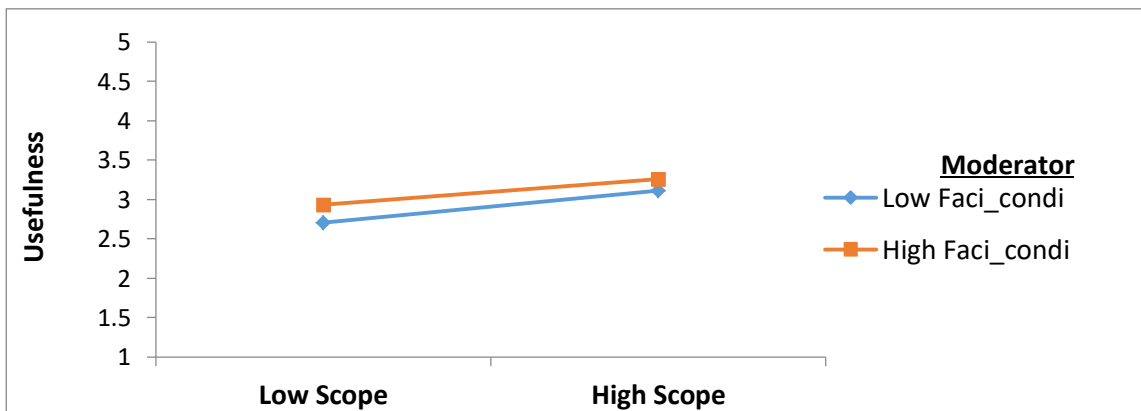


Figure 5-5: FC dampens the positive causal relationship between SB PU of ICT.

H10a-b: FC strengthens the causal positive relationship between CR and PEOU of ICT, null hypothesis rejected (see Figure 5.6)

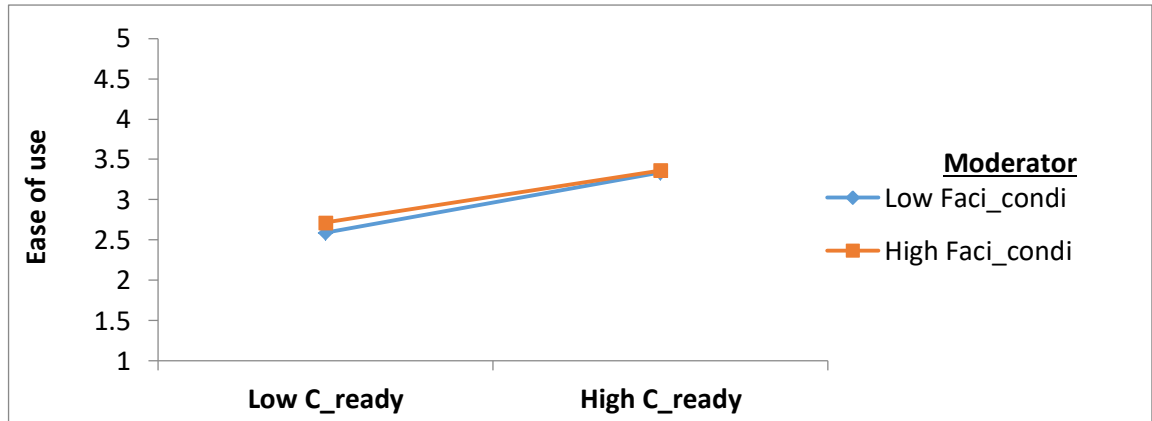


Figure 5-6: FC strengthens the causal positive relationship between CR and PEOU of ICT.

In summary, while some of the interaction effects are not very high, the model makes intuitive sense. A lower facilitating conditions (FC) and scope of business (SB) will leave the local logistics operators with less usefulness and ease of use of ICT resources, irrespective of their high zealotness (consumer readiness) to adopt relevant ICT resources. The detailed implications of the study are presented in Section 5.4.

5.3.3. Multi-group moderation test results

This section covers the multiple group moderation analysis results as indicated in Table 5.3. The objective is to pin down where the internal resources such as the ICT experience and education resources of the owner-manager fit in to the model. Both outcomes of the hypotheses rejected the null hypothesis.

Table 5-3: Multiple-group moderation model results

Hypotheses	Effects (β)		z-score	p value	Remarks
	Low	High			
H11a-b: SB/ICT experience / PU	0.178	0.387	1.706	***	Null hypothesis rejected
H12a-c: CR / Education status / IA	0.012	0.143	2.383	***	Null hypothesis rejected

*** $\approx p \leq 0.01$

H11a-b: ICT experience significantly moderates the positive causal relationships between scope of business and perceived usefulness of ICT, null hypothesis rejected. The decision is based on the shift in regression weight, 0.178 to 0.378 ($p < 0.001$).

H12a-c: Education status also significantly moderates the positive causal relationship between consumer readiness and ICT acquisition, null hypothesis rejected. The increase in the regression weight also supports the decision, 0.012 - 0.143 ($p < 0.001$).

The outcome of the multi-group moderation analysis suggests the potential high impact of innovative local logistics operators in improving levels of ICT uptake in the local logistics industry. However, the significant differences in the levels of ICT experience and education status of the sampled owner-managers as indicated by the respective p - values (< 0.01) make the development of ICT and logistics training centres critical in the region. We believe that the approach will raise the innovative skills of the local 3PL SMEs, and, in turn, improve their optimal application of relevant ICT resources. The details of the implications of the study are presented in the next section.

5.4 Discussions, implication and conclusion of Chapter 5

This section integrates the findings from the phases' one and two studies (Sections 5.2 and 5.3). Specifically, phase one study concentrated on mapping the diverse ranges of factors influencing ICT adoption among the local 3PL SMEs, while phase's two concerned with mapping the causal interrelationships of the relevant context-specific factors. The outcomes of both studies converged, highlighting the dampening effects of lack of facilitating condition (FC) and limited scope of business (SB) on the propensity of the local 3PL SMEs to adopt relevant ICT resources to boost their logistics activities. The details are as follows:

5.4.1 Factors influencing ICT adoption among the local 3PL SMEs

The preliminary phase one study reveals nine contextual factors influencing ICT adoption and amongst the local 3PL SMEs (see Table 5.1). The table shows notable potential barriers, covering lack of adequate public infrastructure, lack of capital, lack of trust to share data, high-cost of ICT acquisition and maintenance, and irregular policies. Others include extortions, lack of patronage for customised services, lack of intelligent transport networks, and lack of willingness to accept technology innovations by the collaborating partners. On the other hand, the driving factors encompass flexibility and innovativeness of the local 3PL SMEs, local and international collaboration opportunities, enhanced accessibility to the local logistics markets, and technology adaptive skills. Also, a better understanding of the local routes and increasing outsourcing of logistics services represent some of the identified drivers.

The above outcomes show that the local 3PL SMEs in Nigeria are relatively motivated to adopt relevant ICT resources to boost their logistics operations (Tob-Ogu et al., 2018). However, this advantage is yet to translate into improved logistics performance in the region (World Bank, 2018) as the local 3PL SMEs are burdened by poor FC and limited SB (Ezenwa, 2019, Xie and

Breen, 2018, Chu et al. 2018, Evangelista, 2011, Jeyaraj et al., 2006, Windrum and De Berranger, 2002, Tornatzky and Fleischer, 1990 Abou-Shouk et al., 2016, Carter et al. 2015, Meyer and Rowan, 1977). Opportunities for flexibility of services, innovativeness, easy access to the local logistics markets and technology adaptive skills exploited by the local 3PL SMEs have been often hindered by the unfavourable business enabling environment in the local logistics market (Oledinma, 2015, Iheanacho, 2014, Ezeife and Bolade, 1984). Likewise, the local 3PL SMEs are yet to optimise the increasing outsourced logistics services in the region as well as the local and international collaborating opportunities. The estimations of the causal interrelationships of some of the identified factors are covered in the phase two study to help consolidate the revelations achieved in the preliminary (phase one) study. This aligns with the notion that research problems can be efficiently addressed if the reasons they exist are well understood (Buhaug, 2015). Therefore, the main objective of the phase two study relates to understanding the remote and direct causes of reduced ICT diffusion among the local 3PL SMEs and the regional transport and logistics industry (World Bank, 2018).

In summary, the above outcomes align with the negative impacts of the recurrent infrastructural challenges, corruption, and lack of logistics competence on logistics performance in Nigeria (World Bank, 2018, Oledinma, A., 2015, Iheanacho, 2014, Ezeife and Bolade, 1984). They often combine to retard logistics activities in the local logistics market, with its multiplier effects on the entire logistics system in the region (Ezenwa et al., In Press, Banomyong, 2017, Mondragon et al., 2017, Kayisire and Wei, 2016, Banomyong et al., 2008). In contrast to related literature which suggests similar locally-evolved challenges, there is a perception about the potential vulnerability of the local 3PL SMEs, as evidenced by the majority of barriers emanating from the industry environment (Tob-Ogu et al., 2018, Abou-Shouk et al., 2016, Awa et al., 2015, Venkatesh & Bala, 2008, Melville et al., 2004). While on the other hand, the driving factors appear to be linked to the resilience, innovativeness, and flexibility of the local logistics operators (Ezenwa et al., In Press Pokharel, 2005). Yet, it is reported that the lack of logistics competence in the region is one of the major banes for low logistics performance in Nigeria (World Bank, 2018). With the outcomes from phase one study, it can be established that the efforts of the local 3PL SMEs to acquire relevant ICT resources are undermined by the unfavourable industry environment in the region (Ezenwa et al., Gillwald et al., 2018, Iheanacho, 2014, Ejimudo, 2013, Ologbenla, 2007, Onah, 2006, Obi, 2006, Oladapo, 2004 Ezeife and Bolade, 1984). The next section covers the discussions of the phase two study.

5.4.2 The effects of causal interrelationships of locally evolved factors on the ICT acquisition and decision quality of the local 3PL SMEs

5.4.2.1 PU and PEOU mediation effects

The empirical evaluation of the hypotheses H1a-c-H4a-c were based on the mediation effects of the PU and PEOU on the proposed causal relationships between a set of external (exogenous) variables (CR, SB, and FC) and response (endogenous) variables (IA and DQ) (Table 5.2). These were achieved by the mediation process model (Chapter 4, Section 4.2.3.5.3). As highlighted earlier, the outcome of the hypotheses was interpreted with Baron and Kenny procedure (Baron and Kenny 1986) which lends support for partial/full mediation effects of PU/PEOU on the positive causal relationships between CR and IA/DQ; SB and IA (through PEOU). In contrast, the results indicate insignificant mediation effects between FC and IA/DQ, as well as between SB and IA/DQ (through PU). The outcomes are significant for this study, for example, the significant effects of the mediation effects on the positive causal relationships between CR and IA/DQ suggest the importance of PU/PEOU in boosting the propensity of the local 3PL SMEs and their collaborating partners to acquire relevant ICT resources and enhancing their decision quality. On the other hand, the insignificant mediation outcomes are relevant in explaining the consequences of poor FC and limited SB on PU/PEOU, which in turn retard IA/DQ. These outcomes are supported by the decrease in regression weights ($p \leq 0.05$) as the mediator variables are introduced (partial mediation). Similarly, full mediation occurs when the introduction of the mediation constructs decreases the magnitude of the regression weights ($p \geq 0.05$ after mediation). For the no mediation effects, the magnitudes of the affected causal relationships fail to decrease between 'before and after' the introduction of the mediation variables, as well as statistically insignificant ($p \geq 0.05$).

The results are consistent with the phase one study, where the local 3PL SMEs were found strongly motivated to adopt the relevant ICT resources, based on their perceived understanding of the positive impacts of relevant ICT resources on their businesses (PU) and their perceived adaptive capacities (PEOU) (Tob-Ogu et al., 2018). On the other hand, the lack of significant mediation effects between FC and IA/DQ suggests weak causal connections between sets of causal variables, even in the presence of PU/PEOU. Likewise, SB exhibits poor causal effects on DQ, which the mediator variables (PU/PEO) could not amplify. The results also show that there is a full mediation between SB and IA through PU/PEOU, suggesting that some of the local 3PL SMEs are engaged with logistics services where the application of ICT resources are optimised. These scenarios provide convincing evidence that characteristic of both PU and PEOU depend on the corresponding status of the external (exogenous) to predict actual IA and DQ among the local 3PL SMEs. The research findings align with TAM, which

asserts that PU and PEOU combine to influence the impact of external contextual factors on actual application of a new system (Davis 1989) (see Chapter 2, Section 2.2.1 for details). These revelations are consistent with strategic decision challenges the local 3PL SMEs face to ensure that relevant ICT resources are acquired to boost their logistics operation and services (Kilpala et al., 2005, Pokharel, 2005).

Moreover, the research outcomes suggest that the probability of ICT diffusion increasing under the present situation may not be fully supported, considering the perceived shortcomings from the key variables such as FC and SB. This aligns with the notion that the perceived enhanced status of the CR cannot singularly boost ICT diffusion among the local 3PL SMEs. The study outcomes reflect how lack of FC and relatively constrained SB (external factors) underlie the reasons for the low ICT adoption among the local 3PL SMEs (Ezenwa et al., In Press). This revelation is believed to have crucial implications for the discussion regarding the lack of logistics performance in Nigeria (World Bank, 2018). Based on the model results, Table 5.2 implicitly support claims in the recent works within a geographical focus in Nigeria that PU and PEOU of ICT cannot alone improve ICT diffusion in the local economy without supporting FC and enhance SB (Tob-Ogu et al., 2018, Apulu, 2012). The absence of clear understanding of the impact of the external factors on the mediating characteristics of the PU and PEOU prompted the development of the two-way interaction model.

Taken together, the study argues that human ingenuity, which relates to the capacity to cope or contain in an unfavourable condition often triggers the development of inadequate adaptive capacities to ensure that they remain in business (Tob-Ogu et al., 2018). As such, (as revealed in the phase one study), most of the local 3PL SMEs in Nigeria have transited from coping to adapting to the prevailing situation, particularly amongst the local 3PL SMEs who are engaged with advanced logistics services (Evangelista, 2011). It is based on this notion that the multiple moderation model is developed in this study to underpin how different categories of the local 3PL SMEs are responding to the perceived ICT adoption challenges. The study envisages that despite the perceived poor FC in the region, the 3PL SMEs are likely to focus on their intangible resources (e.g., ICT experience and education status) (Awa et al. (2015), and other external forces (e.g. logistics outsourcing organisation and collaborators) to boost their competitive strategies (Guo et al., 2016).

In light of these, it is believed that the results presented in Table 5.1 reflect the realistic nature of the complexity and dynamics of ICT diffusion challenges amongst the local 3PL SMEs and the broader industry. The take away from the mediation model is that the perceived negative impact of poor FC is huge on the IA/DQ and cannot be significantly mediated by PU and PEOU. In contrast, CR and SB (to some extent) can be reasonably mediated to improve IA/DQ. These

combine to suggest that the mediator variables (PU/PEOU) are at best when the surrounding external (exogenous) variables are at best. That is to say that placing PU/PEOU under the spotlight, without consideration for other contextual factors can yield a misleading signal of the cause-effect process under investigation. The results point towards the need to look beyond the mediation model by shifting focus to how the contextual factors interact to predict their causal relationships with the mediator variables. Some of these issues represent what the outcomes of the two-way interaction model represent as discussed next.

5.4.2.2 Two-way interaction effects

Given that the status of the contextual factors (high and low) can predict the characteristics of the mediation variables (PU/PEOU), hypotheses 5-10 (a-b) were developed to complement the mediation effects discussed above. The outcome of the hypotheses' tests indicate that FC and SB dampen the positive causal relationships between CR and PU/PEOU (see Section 5.3.2), supporting the elicited negative consequences of poor FC and limited SB on the propensity of the local 3PL SMEs to optimise ICT uptake. This again confirms the notion that FC and SB account for the limited mediation effects of PU and PEOU. Specifically, hypotheses 5a-b proposes that the causal relationship between CR and PU depends on the interactive effects of the SB (high or low). This aligns with the notion that status of the SB is critical in determining the extent of the causal relationship between CR and PU (Chatterjee, Grewal, & Sambamurthy, 2002), emphasising the 'context conditionality' of the contextual issues investigated in this study (see Chapter 4, Section 4.2.3.5). Similarly, the result satisfies the intuition behind the conditional hypothesis, which relates to the possible dependency of the perceived positive causal relationships between CR and PU/PEOU on the status of the third variable (SB). The same applies to the related hypotheses, for example, 7a-b also reveals similar result, suggesting that the positive causal relationships between CR and PU/PEOU; SU and PU all depend on the interactive effect of the third variable (FC).

The two-way interaction model outputs combine to show that both SB and FC are relevant in modifying the mediation effects of the PU/PEOU as discussed in the previous section. Hence, the effects are expected, which suggest that the perceived positive relationships between CR and PU/PEOU retard in the presence of low SB and unfavourable FC. Likewise, the positive causal relationship between SB and PU can be reduced by the unfavourable FC in the study site. On the other hand, the strengthening effect of FC on the positive causal relationship between CR and PEOU is unexpected. One reason for this might be linked to industry-specific forces other than public infrastructure and policies.

These hypotheses depict the peculiarities of regional-specific issues influencing ICT adoption among the 3PL SMEs across (see Chapter 3, Section 3.4). In the context of the study site, SB and FC seem to constitute major barriers to ICT adoption among the local 3PL SMEs, while the CR appears the main enabling factor. When the two-way interaction model outputs are compared with the mediation model results, they converge, based on the causal links between the mediator and the external (exogenous) variables. These suggest that the likelihood of improving ICT diffusion in the local transport and logistics industry may be achieved sufficiently when the FC and SB are enhanced (see Chapter 2, Section 2.2.1).

The above assertion comes as no surprise since lack of infrastructural development is historically a characteristic feature of the Nigerian transport and logistics industry (see Chapter 3, Section 3.5). Of course, this is the reality in the current-day transport and logistics industry (Ezenwa et al., In Press, World Bank, 2018), making FC the rallying point to address ICT diffusion challenges in Nigerian transport and logistics industry (see Chapter 3, Section 3.5.1). Indeed, the evidence that the lack of necessary infrastructure and irregular policies increase the challenges of efficient ICT adoption in Nigerian is consistent with the previous studies (see Chapter 3, Section 3.5).

Finally, while these findings may be the case for several developing logistics markets, the results presented here indicate an unprecedented divergent view, relating to the huge technological gaps between developing and developed logistics markets (see Chapter 3, Section 3.4). While the concerns in this study may not relate to reconciling literature, the fundamental issue may be the case pertaining to differential (underlying) locally-evolved issues that affect efficient applications of ICT tools in the industry. These combine to show that different contexts reflect different evidence and may, in turn, require different approaches to tackle the contextual issues. The next section covers the discussion of multi-group moderation hypotheses outputs.

5.4.2.3 Multi-group moderation effects

Hypotheses H11a-b and H12a-c hold that enhanced ICT experience and education status of the owner-managers can stimulate the established causal interrelationships in a positive direction. These were assumed critical base on the critical stance of intangible resources such as ICT experience and education in boosting ICT uptake at firm levels (Awa et al., 2015). With this understanding, ICT and education status of the owner-managers are adopted in this study as moderating variables, and the results of the associated hypotheses are presented here. The corresponding null hypotheses are rejected as the impacts of the ICT experience and education status of the owner-manager significantly moderate the positive causal relationships between

SB and PU; CR and IA, respectively. These outcomes are supported by the increase in the magnitude of the regression weight, indicating low-high effects of ICT experience and education status and statistically significant p-values (<0.01). The results also indicate significant differences in the ICT experience and education status of the owner-managers. These are expected as it has been earlier reported that the local 3PL SMEs are strongly motivated towards the adoption of the intelligent transport and logistics systems. However, the significant differences in their levels of ICT experience and education status are somewhat 'puzzling' which suggests the need for further investigation (e.g., multiple case studies of selected firms) to understand the reasons for the divergent responses to ICT adoption challenges among the local 3PL SMEs. We envisage that the approach may help highlight the effects of industry/firm-specific issues affecting ICT diffusion and decision quality in the local logistics industry (Ezenwa et al., In Press, World Bank, 2018). This revelation is consistent with the phase of this study, as presented in Chapter 6.

Although the multiple group moderation analyses did not consider the entire causal interactions, the results presented here, nonetheless, are consistent with the previous studies. For example, ICT experience and education status have been found intangible resources that stimulate efficient ICT utilization at firm levels (see Chapter 2, Section 2.2.1). These revelations combine to suggest that the contextual issues affecting ICT diffusion process in the local logistics industry are not exhaustive. Because quantitative analyses do not often tell the full story, the study found it necessary to back these results with qualitative evidence as demonstrated in the next phases (multiple case studies, focus group discussion, and expert interviews) of this research investigation. These culminate to a four-phased study that explores diverse ranges of mechanisms influencing ICT diffusion within the context of Nigeria's transport and logistics industry (see Table 1.1). The next section covers the implications of the present research findings.

5.4.3 Study Implications

While the local 3PL SMEs suffer from the conventional limitations such as size, capital, human resources, and market share (Tob-Ogu et al., 2018, Evangelista, 2011, Pokharel, 2005, Kilpala et al., 2005, Gunasekaran and Ngai, 2003), the study shows that they also struggle to cope with regional-specific issues such as dilapidated road networks, unstable electricity, irregular policies, extortion (Ezenwa et al., In Press, Obiorah, 2016, Oledinma, A., 2015, Iheanacho, 2014, Ejimudo, 2013, Ologbenla, 2007, Onah, 2006, Obi, 2006, Oladapo, 2004, Ezeife and Bolade, 1984). These depict the level of vulnerable status of the local 3PL SMEs in the study site (Tob-Ogu et al., 2018, Melville et al., 2004). Developing feasible strategies to address the institutional voids in the local logistics industry, regarding some of the issues identified above

might constitute an appropriate intervention for the local 3PL SMEs and the broader industry (Ezenwa et al., In Press). It aligns with the notion that when an intervention is locally defined and centrally enforced, the regional-specific challenges can be addressed, which would, in turn, improve logistics performance in the region (Ezenwa et al., In Press, World Bank, 2018).

However, the significant moderating effects of the ICT experience and education status on the causal relationships between SB and PU; CR and IA suggest that owner-managers with requisite skills/experiences and education/knowledge are more likely to survive the dampening effects of the unfavourable industry environment in the region. The evidence is consistent with literature that people with relevant experience are more disposed to exploit the benefits of technology innovation than their counterparts with low or no experience (Dabholkar, 1999, Zmud, 1979). Likewise, it is discovered that educated people are aggressive seekers of innovation, based on their potential abilities to manage uncertainties (Agarwal and Prasad, 1999, Rogers, 1995, Hambrick & Mason, 1984, Becker, 1970). The significant differences in the results of the multiple-group moderation analyses show that there is a noticeable gap between some of the owner-mangers of the local 3PL SMEs who have the requisite skills and knowledge and those who lack them. This revelation may be useful in explaining the conflict reports in the literature concerning the innovativeness and reluctance of the local 3PL SMEs (Pokharel, 2005, Kilpala et al., 2005).

In order to better understand the realistic positions of the local 3PL SMEs regarding their responses to the prevailing ICT adoption challenges among the local 3PL SMEs, multiple case studies have been conducted in this research. It is envisaged that development actors (e.g., entrepreneurs and original equipment manufacturers) and policymakers would tap relevant information in the study in developing realistic policies, regulation, and awareness that may help steer transport and logistics operations in Nigeria to the path of achieving logistics performance, within the context of global best practice. The development actors may seize the research findings as developmental opportunities in the form of technological inventions and innovation, suitable for filling the digital gap in the local logistics environment. These align with the cloud and web-based resources that are less dependent on the traditional infrastructure (Gartner, 2017, Neaga et al., 2015, O'Sullivan, 2007). Besides, the new dimensions of the technological developments help to reduce cost as demands are placed based on need, unlike the traditional outright purchases of ICT resources and equipment. Also, new technologies such as blockchain are starting to strengthen the security and safety of SC integration and processes through its distributed ledger technology (DLT) (Leymann et al., 2012, Bourklakis et al., 2011). These issues indicate the need for the local 3PL SMEs to update skills and resources appropriately.

Moreover, while there are many measures for assessing factors influencing ICT adoption in the literature (Venkatesh & Davis, 2000, Rogers 1995, Ajzen, 1991, Tornatzky and Fleischer, 1990, Davis, 1989, Davis, 1993 Fischbein & Ajzen, 1975) (see Section 2.2.1, Chapter 2), the integration of the relevant theories as operationalised in this study helps to tease out the peculiar characteristic of the local SMEs (Awa et al., 2015). According to the author, this aspect has been rarely captured in the related literature. Still on the theoretical implications of the study, it also contributes to extending TAM within the context of 3PL SMEs and developing logistics markets, where research is still at an infant stage. Particularly, TAM is extended in this study by fitting the relevant external factors in the field to PU and PEOU, and, in turn, ICT acquisition and decision quality of the local 3PL SMEs. Methodologically, the study contributes by adopting mixed-methods research, considered effective in engaging complex behavioural research (Bryman and Belle, 2003), and for explaining hypothetical research investigation (Hammersley, 1999, Bickman and Rog, 1998, Bartunek et al., 1993). Moreover, the approach is highly recommended in the field, based on the lack of theoretical backgrounds (Evangelista, 2011).

5.4.4 Conclusion

Few works concerning factors influencing ICT adopting amongst the local 3PLS SMEs pay insufficient attention to regional-specific determinants, in particular, the fundamental factors that shape the rate of ICT diffusion among the local 3PL SMEs and the broader industry. This study envisages that the research findings would help to put issues concerning lack of logistics performance in the region in proper perspective. Although the contested nature of the vulnerability of the local 3PL SMEs is widely acknowledged in the first phase of the study, the causal interrelationships estimations in the phase two help to consolidate the claim, especially highlighting where efforts should be directed. Before now, there has been no consensus concerning the degree of factors militating against efficient ICT diffusion in the Nigerian transport and logistics industry, as well as their causal interrelationships, which are covered in this study.

Also, in response to the recent call to predict accurately factors influencing ICT adoption among the local 3PL SME (Awa et al., 2015), this study presents the causal model as a tested tool to accurately predict ICT adoption among the local SMEs. In a similar vein, Evangelista and Sweeney (2006) are of the view that mapping the causal interrelationships of factors influencing ICT adoption among the local 3PL SMEs would be useful in explaining underlying issues affecting efficient adoption among the local 3PL SMEs. The causal model resonates with the integrated model, tipped for accurate prediction of ICT adoption among the local SMEs. The causal constructs are selected, based on the recommendations of the local stakeholders,

which makes the causal model consistent with the scope of the study, which can be replicated across similar environments and scopes.

The deep-rooted issues identified through the causal model raise concerns about the inability of the resource users amongst the local logistics operators to exploit the increasing logistics opportunities, given the persistent unfavourable business environment in the region. With these, it can be concluded that the causal model communicates local-appropriate insights about what may contribute to new forms of interventions and reforms for improving logistics performance in the region. This study envisages that the replications of the causal model in the same or similar field of study over time might communicate useful information about how the local 3PL SMEs can cope with the dynamics and complexities associated with the continued technological advancements in the field. The basic requirements may coalesce around updating the causal constructs, expanding its features, and increase population and sample of studies. As much as applied in this study, caution must be applied in interpreting the results to ensure that research outputs are not misinterpreted. It is based on this notion that mixed-methods research is recommended to improve the robustness of research findings. The model can be replicated beyond the context of the study as far as relevant constructs are applied.

This study recognises the following shortcomings, which the future study can fulfil, including (i) limited sample of the study, which reflected in the inconsistencies of the hypothesis's tests and interpretations. (ii) Lack of exploring the customers' perspective of the study. (iii) Lack of assessment of the technological development trends, using longitudinal data, and (iv) lack of comparative study with other similar and diverse nations. In doing these, scenarios of factors influencing ICT adoption among the local 3PL SMEs in the region can be captured systematically to unveil both remote and direct issues after ICT diffusion amongst the local 3PL SMEs. Finally, it is believed that the outcomes from the present study have set the foundation upon which the future can be consolidated to better explain interactions between the industry environment and logistics competence in a way that it is easy to understand without complications concerning issues affecting logistics performance in the region and potential solutions.

Chapter 6 – Results and discussion of phase 3 study

Outline

This chapter covers the results and discussions of phase 3 part of the study. The aim is to map and compare the effects of company and industry backgrounds on the ICT adoption process, and in turn, the logistics performance of the local 3PL SMEs. This aspect of the study was conceived to provide clearer and deep insights into the dynamics of issues influencing ICT uptake amongst the local logistics operators. It also aligns with responding to the 'how and why' related research questions. Specifically, the chapter comprises overview (6.1), results (6.2) and discussion of the research findings and concluding remarks (6.3).

6.1 Introduction

The study is built on the structure-process-outcome model (Donabedian, 1988) (see Section 4.2.4, Chapter 4), based on the need to enrich the research investigation with practical and industry-specific insights, with a view to improve the strategic understanding of the research problems (Harris et al., 2015, Lee, 2004), as well as defining practical pathways to improve logistics performance in the region (World Bank, 2018, 2013). The guiding research questions include:

- How do the company background and industry environment feature in the ICT adoption process of the selected local 3PL SMEs?
- How do the company background and industry environment influence the prioritisation of ICT tools of the selected local 3PL SMEs?
- How do the combinations of the company/industry backgrounds and the extent of ICT uptake influence the logistics performance of the selected local 3PL SMEs?

As previously presented in the research method chapter (Section 4.2.4, Chapter 4), this study covers nine case firm, selected across four distinct industries: Apapa-Wharf Port Complex, agriculture, health, and auto-parts/accessories. The outcomes of the multiple case study are presented next.

6.2 Results (RQs III, IV, and V)

6.2.1 Intra industry comparisons - ICT profile and background

Apapa Wharf Port Complex (case firms 1, 2, and 3)

The intra industry comparisons for the Apapa-Wharf Port Complex are presented in Table 6.1. Concerning the ICT profile, case firms' 1, 2, and 3 use (46 %), (8%), and (38%) of the enlisted ICT tools. The plan to use category includes (46%), (69%), and (38%). The no plans option encompasses 8%, 15%, and 15%. The undecided theme encompasses (0%), (8%), and (8%), respectively. Other compared attributes include staff strengths (55, 25, 15), fleet sizes (45, 22, 15), years of establishments (1976, 2010, 2004), ICT experience and education status of the respondents (high, medium, high), and scope of business (basic, full haulage, basic). There is no restriction for entry or exit of the local logistics operations in the industry. The case firms are all limited liability companies (LLC), with ICT profile, ranking medium, low, and low. Last, the case firms confirmed lack of basic infrastructure as the major inhibitor of ICT adoption.

Table 6-1: Intra industry comparisons - Apapa-Wharf Port Complex

Firms	1				2				3			
	U1	P	N	U2	U1	P	N	U2	U1	P	N	U2
ICT tools												
Telephone	*				*				*			
Email	*					*			*			
Website	*					*			*			
Computers	*					*			*			
GPS	*					*					*	
Internet	*					*			*			
AWS		*					*			*		
RFID		*					*			*		
LAN			*					*				*
ERP		*				*				*		
CRM		*				*				*		
EDI		*				*				*		
E-routing		*				*					*	
ICT profile	6	6	1	0	1	9	2	1	5	5	2	1
score												
% score	46	46	8	0	8	69	15	8	38	38	15	8
Staffing	55				25				15			
Fleet size	45 (HGV1 and HGV2)				22 (HGV1 and HGV2)				Nil			
Year of est.	1976				2010				2004			
Fin. record	N/A				N/A				N/A			
ICT exp./ed.	High				Medium				High			
Coy sites	Lagos Island				Lagos mainland				Lagos Island			
Scope of bus.	Basic logistics				Full haulage				Basic logistics			
Restr.SC	No				No				No			
Coy status	LLC				LLC				LLC			
ICT profile	Medium				Low				Low			
Trans infra.	Poor				Poor				Poor			
Security chal	Yes				Yes				Yes			

* U1 = use, P = plan to use, N = no plans, U2 = undecided; LLC = Limited Liability Company; N/A = not available; Decision rule for the ICT profile: ≤40% = Low, ≤59 = medium, ≥ 60% = High

Health sector (case firms 4 and 5)

The comparisons of the firms' background correspond to their staff strengths (35 and 25), fleet sizes (30 and nil), and the years of establishments (1974 and 1980). Both firms have ICT experience and educated owner-managers. Their company sites are both located in Lagos Mainland, with scopes of businesses categorised as basic and full haulage operators. The industry is highly regulated. The ICT profiles of are mixed, as follows: use (32%, 62%); plan to use (46%; 23%); no plans (15%, 0%); undecided (8%, 15%). Both rated the industry environment as poor (see Table 6.2 for details).

Table 6-2: Intra sector comparisons - Health sector

Firms	4				5			
Ranks	U1	P	N	U2	U1	P	N	U2
Telephone	*				*			
Email	*				*			
Website		*			*			
Computers	*				*			
GPS		*						*
Internet	*				*			
AWS			*		*			
RFID			*			*		
LAN				*	*			
ERP		*				*		
CRM		*				*		
EDI		*			*			
E-routing		*						*
ICT profile score	4	6	2	1	8	3	0	2
% value	31	46	15	8	62	23	0	15
Staffing	35				25			
Fleet size	30 (LCV1/LVC2)				Nil			
Year of est.	1974				1980			
Fin. record	N/A				N/A			
ICT exp./ed.	High				High			
Coy sites	Lagos Mainland				Lagos mainland			
Scope of bus.	Full haulage				Basic logistics			
Restr. SC	Yes				Yes			
Coy status	Non-LLC				LLC			
ICT profile	Low				High			
Transport infra.	Poor				Poor			
SC risk	Yes				Yes			

* U1 = use, P = plan to use, N = no plans, U2 = undecided; LLC = Limited Liability Company; N/A = not available; Decision rule for the ICT profile: $\leq 40\%$ = Low, ≤ 59 = medium, $\geq 60\%$ = High

Food and beverage industry (case firms 6 and 7)

The comparisons include staff strength (125 and 90) and fleet sizes (110 and 80). Both firms exhibited low ICT profile. Also, the owner-managers were found to have low in ICT experience and education status. They also declined to reveal their financial records. The company sites are located in the Lagos Mainland. The scopes of business are both full haulage operators, with no restrictions on entries and exist. They are also limited liability companies. The primary operational challenges include lack of security in the highways and dilapidated transport infrastructure. The details of the ICT profile comprise: use (23%, 31%), plan to use (31%, 69%), no plans (0% and 0%), and undecided (46% and 0%) (See details in Table 6.3).

Table 6-3: Intra industry comparisons - food/beverage

Firms	6				7			
	U1	P	N	U2	U1	P	N	U2
ICT tools								
Telephone	*				*			
Email	*				*			
Website		*				*		
Computers		*			*			
GPS		*				*		
Internet	*				*	*		
AWS				*		*		
RFID				*		*		
LAN				*		*		
ERP				*		*		
CRM				*		*		
EDI				*		*		
E-routing		*				*		
ICT profile score	3	4	0	6	4	9	0	0
% score	23	31	0	46	31	69	0	0
Staffing	125				90			
Fleet size	110 (HCVI/HCV2)				80 (HCV1/HV2)			
Year of est.	2000				1980			
Fin. record	N/A				N/A			
ICT exp./ed.	Low				Low			
Coy sites	Lagos Mainland				Lagos Mainland			
Scope of bus.	Fall haulage				Full haulage			
Restr. SC	No				No			
Coy status	LLC				LLC			
ICT profile	Low				Low			
Transport infra.	Poor				Poor			
SC risks	Yes				Yes			

* U1 = use, P = plan to use, N = no plans, U2 = undecided; LLC = Limited Liability Company; N/A = not available; Decision rule for the ICT profile: $\leq 40\%$ = Low, ≤ 59 = medium, $\geq 60\%$ = High

Auto-parts and accessories (case firms 8 and 9)

The staff strengths are 180 and 190, with fleet sizes, 150 and 110, and established, 1993 and 1980, respectively. The financial statuses were not given. The company headquarters are Lagos Island. Their scopes of businesses are classified as advanced logistics providers. There are partial regulations for their entry and exit procedures in the industry. Both are limited liability firms, with their top management having adequate ICT experience and enhanced education status. Both firms reported poor industry enabling environments. Last, their ICT profile are ranked high as follows: use (85%, 92%), plan to use (15%, 8%), no plans (0%, 0%), and undecided (8%, 0) (see Table 6.4).

Table 6-4: Intra industry comparisons - auto-parts/accessories

Firms	8				9			
	U1	P	N	U2	U1	P	N	U2
ICT tools								
Telephone	*				*			
Email	*				*			
Website	*				*			
Computers	*				*			
GPS	*				*			
Internet	*				*			
AWS	*				*			
RFID		*			*			
LAN	*				*			
ERP		*				*		
CRM	*				*			
EDI	*				*			
E-routing	*				*			
ICT profile score	11	2	0	1	12	1	0	0
% score	85	15	0	8	92	8	0	0
Staffing	180				120			
Fleet size	150 (LCV2, HCVI, HCV2)				110 (All categories)			
Year of est.	2000				1980			
Fin. record	N/A				N/A			
ICT exp./ed.	High				High			
Coy sites	Lagos Mainland				Owerri			
Scope of bus.	Advanced				Advanced			
Restr. SC	Partial				Partial			
Coy status	LLC				LLC			
ICT profile	Advance				Advance			
Transport infra.	Poor				Poor			
SC risks	Yes				Yes			

* U1 = use, P = plan to use, N = no plans, U2 = undecided; LLC = Limited Liability Company; N/A = not available; Decision rule for the ICT profile: $\leq 40\%$ = Low, ≤ 59 = medium, $\geq 60\%$ = High

6.2.2 Inter industry comparisons – ICT profile

The inter-industry comparisons for the ICT profile are presented in Table 6.5. The two case firms (9 and 8) from the auto-parts/accessories emerged top, having scored 92% and 85% respectively, followed by case firm 5 from the health sector (62%), and case firm 1 (Apapa-Wharf), (46%). Others recorded low ICT profile, having adopted less than 40% of the enlisted ICT tools. For the 'plan to use' category, case firm 9 (Apapa-Wharf) and case firm 7 (food and beverage) had the highest scores (69%), followed by the case firm 1 (Apapa-Wharf) and case firm 4 (health sector) that scored 46%, respectively. Others like case firm 3 (Apapa-Wharf), case firm 6 (food and beverage), and case firm 5 (health sector) had lesser plans to adopt the enlisted ICT tools, with 38%, 31%, and 23% rankings. The least in this category include the case firms from the auto-parts/accessories (8 and 9) that scored 15% and 8%, respectively. The case firms that had no plans to use at least 15% of the enlisted ICT tools emerged from Apapa-Wharf Complex (case firms' 2 and 3) and Health sector (case firm 4). The 'undecided to adopt' group are as follows: The case firm 6 (food/beverage) made the highest score (46%), followed by the case firm 5 (Apapa-Wharf), (15%) and the three case firms from the Apapa-Wharf that score 8%, respectively. The proportionate scores of each of the categories are: use (30.50%); plan to use (25.42%); no plans (3.39%), and undecided (6.77%).

Table 6-5: Summary of ICT profile

Firms/items	Firm 9	Firm 8	Firm 5	Firm 1	Firm 3	Firm 4	Firm 7	Firm 6	Firm 2	Mean (%)
Industries	Auto-parts	Auto-parts	Health sector	Apapa Wharf	Apapa Wharf	Health care	Food/beverages	Food/beverages	Apapa Wharf	
Use	12(92)	11(85)	8(62)	6(46)	5(38)	4(31)	4(31)	3(23)	1 (8)	30.50
Plan to use	1 (8)	2 (15)	3 (23)	6(46)	5(38)	6 (46)	9 (69)	4(31)	9 (69)	25.42
No plans	-	-	-	-	2(15)	2 (15)	-	-	2 (15)	3.39
Undecided	-	-	2 (15)	1(8)	1(8)	1 (8)	-	6(46)	1(8)	6.77
Remark	High	High	High	Medium	Low	Low	Low	Low	Low	

*Decision rule, use: $\leq 40\%$ = Low, ≤ 59 = medium, $\geq 60\%$ = High; values in bracket are percentage scores; total number of ICT tools = 13.

The inter-industry comparisons also involve other background information, as presented in Table 6.6. The results indicate that the case firms from the food/beverage and auto-parts/accessories have higher staff strength than their counterparts from the Apapa-Port Complex and Health sector. The same applies to their fleet sizes. The data for their years of establishments indicates that the Apapa-Wharf Complex and Health sector have firms that started operations earlier than their counterparts in the food/beverage and auto-parts/accessories. The oldest is the case firm 4 (Health sector) that was established in 1974, followed by the case firm 1 (Apapa-Wharf Port Complex). Others spread across from 1980 – 2010. All the case firms declined to release their financial records. The ICT experience and education status of the owner-managers emerged high across the industries, except for the food and beverage.

Most of the firm's locations are in Lagos State, except case firm 9 (auto-parts/accessories) that has its main company site in Owerri, Imo State, Nigeria. The firms' specialities are mixed (ranging from full haulage, basic and advanced logistics), except the case firms' 6 and 7 (food/beverage) that concentrate primarily on full haulage.

Table 6-6: Summary of inter industry comparisons

Background	Apapa-Wharf	Health sector	Food/beverages	Auto-parts/accessories
Staffing	Small	Small	Medium	medium
Fleet size	Small	Small	Medium	Medium
Year of est.	1976/2004/2010	1974/1980	1980/2000	2000/1980
Fin. record	N/A	N/A	N/A	N/A
ICT exp./ed.	High	High	Low	High
Coy sites	Lagos	Lagos	Lagos	Lagos/Owerri
Scope of bus	Mixed	Mixed	Full haulage	Advance
Restr.SC	No	Yes	No	Partial
Coy status	LLC	Mixed	LLC	LLC
Trans infra.	Poor	Poor	Poor	Poor
SC risks	Yes	Yes	Yes	Yes

*LLC = Limited Liability Company; N/A = not available

Moreover, the results indicate that there is less or no restriction of entry or exit of the local 3PL SMEs into Apapa-Wharf Complex and food/beverage, whereas there are full and partial entry restrictions for the local 3PL SMEs in the health and auto-parts/accessories sectors, respectively. Most of the case firms have limited liability status, except the case firm 4 (health sector). Last, all the firms reveal that their primary operational challenges are related to the lack of transport and ICT infrastructure, coupled with insecurity across Nigeria's highways.

6.2.3 Intra and inter industry comparisons - ICT adoptive capacities/prioritisation

The results are summarised in Table 6.7, using three thematic areas as reference points: ICT-facilitated activities; types of information shared /stored, and outsourced ICT – related services. The results indicate that almost all the case firms, irrespective of their industry backgrounds utilise ICT resources for communication purposes. The same applies to track services and online transactions, except case firm 5 (health sector) and case firm 2 (Apapa-Wharf) who are were found not to be using any of the enlisted ICT devices for tracking purpose and for online transactions, respectively. Also, case firm 2 (Apapa Wharf) and case firm 6 (food

and beverage) do not have or use the computer for data storage. Likewise, case firm 2 (Apapa-Wharf), case firm 4 (Health sector), and case firm 6 (food/beverage) lack website services.

For the information shared, almost all the firm use voice/video and text messages to share information. The majority also utilise some of the enlisted ICT resources for exchange of business documents and storage of personal information, except the case firm 2 (Apapa Wharf). The case firm 6 (food/beverage) does not also store personal information, using computer devices. Another form of information shared, using ICT devices is the company newsletter, which is also widely applied, except case firm 2 (Apapa Wharf), and the two case firms (6 and 7) from the food/beverages, respectively. The GPS services are also applied by 56% of the case firms. Specifically, the case firms 1 and 3 (Apapa- Wharf), case firm 4 (Health sector), and two case firms (8 and 9) from Auto-parts and accessories share information through GPS devices. Also, the international shipments documents such as the bills of lading are shared, especially by case firm 3 (Apapa Wharf), and the two case firms each from the health sector (4 and 5) and auto-parts (8 and 9), respectively.

Moreover, the analysis shows that there are divergences within and across industries for all the enlisted activities that make up the ICT adoption process. For example, case firms 1(Apapa Port Complex), 3(Apapa Port Complex), 8(Auto-parts/accessories), and 9 (Auto-parts/accessories) score 100% in all the enlisted activities. Others in list include Health sector (88%, 77%), food and beverages (71%, 47%), and Apapa Port Complex (18%). Finally, auto-parts accessories score the highest (100%) in all the enlisted activities, followed by Health sector (82.4%), Apapa Port Complex (72.5%), and last food beverage (58.9%).

Table 6-7: Summary of ICT uptake

Themes	Items	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6	Firm 7	Firm 8	Firm 9	Mean score
Industries		Apapa Port Compl.			Health sector		Food/beverages		Auto-parts		
ICT facilitated activities	Electronic communication	✓	✓	✓	✓	✓	✓	✓	✓	✓	100
	Tracking	✓	✓	✓	✓		✓	✓	✓	✓	80
	Data storage	✓		✓	✓	✓		✓	✓	✓	78
	Online transactions	✓		✓	✓	✓	✓	✓	✓	✓	80
	Websites services	✓		✓		✓		✓	✓	✓	67
Types of information shared/stored	GPS services	✓		✓	✓				✓	✓	56
	Voice/video calls & text messages	✓	✓	✓	✓	✓	✓	✓	✓	✓	100
	Business documents	✓		✓	✓	✓	✓	✓	✓	✓	80
	Personal information	✓		✓	✓	✓		✓	✓	✓	78
	Company newsletter	✓		✓	✓	✓			✓	✓	67
	Bill of lading and related documents			✓	✓	✓			✓	✓	56

Table 6.7 Continued (2/2)

Service providers/ equipment vendors	GSM network providers	✓		✓	✓	✓	✓	✓	✓	✓	80
	Email service providers	✓		✓	✓	✓	✓	✓	✓	✓	80
	Internet network providers	✓		✓	✓	✓	✓	✓	✓	✓	80
	EDI & RFDI service providers	✓		✓	✓	✓			✓	✓	56
	Computer/ accessories vendors	✓		✓	✓	✓		✓	✓	✓	78
	Website hosting companies	✓		✓		✓			✓	✓	56
Mean score - Case firms		100	17.6	100	76.5	88.2	47.1	70.6	100	100	-
Mean score – Industries			72.5		82.4		58.9		100		

6.2.4 Intra and inter industry comparisons - Pre-determined logistics performance

The summary of the predetermined logistics performance index is presented in Table 6.8. The ranking is guided by the World Banks (2018) report concerning the interactive effects of the industry environment (infrastructure, e.g., road networks and telecommunication systems) and the logistics competence (internal resources, ICT experience and business knowledge) on the logistics performance of the local logistics operators, as demonstrated the hypothetical expressions below:

- Adequate public infrastructure + High internal resources = High logistic performance
- Less public infrastructure + High internal resources = Moderate logistic performance
- Less public infrastructure + Medium internal resources = Low logistic performance.
- Less public infrastructure + Low internal resources = Very Low logistic performance

The classification aligns with Chow and Henrisksson (1993) definition of logistics performance indicators as a systematic and objective search for and analysis of a set of information that represents the identification and solution of any related problems in the field. The internal resources referred here include the combination of ICT resources, requisite skills, and education (knowledge). The lack of public infrastructure unstable electricity, dilapidated road network, lack of data management system, lack of adequate telecommunication platforms, irregular polices (Ezenwa et al., In Press). The identified logistics performance comprises efficiency, accuracy, alignment, agility, and adaptation. Specifically, logistics efficiency relates to how effectively logistics operations and services are conducted, particularly, concerning resource input and output ratio. Accuracy relates to accurate record-keeping of personal information and business transactions. Alignment entails readiness of the SC partners to collaboratively improve a specific performance. Agility depicts how responsive a logistics system is, in terms of short-term changes in deliveries of logistics demand. Last, adaptation involves the ability to adjust supply chain activities concerning market changes (Lee 2004).

Therefore, the results indicate as follows: None of the firms achieved high logistics performance, based on the generic lack of enabling environment (public infrastructure and adequate policies/regulations) across the selected industries. Most of the case firms achieved moderate logistics performance across industries, except food/beverage case firms 6 and 7 that score very low logistics performance. Similarly, case firm two scores low logistics performance (Apapa Port Complex). All the case firms in both Auto-part/accessories and Health sector 3PL SMEs recorded moderate logistics performance (see Table 6.8). To facilitate ICT uptake across industries, which would, in turn, improve logistics performance, the outcomes from the multiple case analyses suggest the need to improve the business enabling

environment in the region as the primary strategy. The secondary strategies rely on improving integrations between the local logistics operator and the logistics outsourcing organisations.

Table 6-8: Logistics performance index

Industry/item	Apapa Port Complex			Healthcare sector		Food/beverages		Auto-parts/access.	
Case firms	1	2	3	4	5	6	7	8	9
Logistics performance	+++	++	+++	+++	+++	+	+	+++	+++
Indicators	++++ High logistics performance		+++ Moderate logistics performance		++ Low logistics performance		+ Very low logistics performance		

Decision rules: Improves infrastructure + enhance logistics competence = High logistics performance; Less infrastructure + enhance logistics competence = Moderate logistics performance; and Less infrastructure + Less logistics competence = Low logistics performance

6.3 Discussion and conclusion of Chapter 6

The main objective of this phase of the study is to compare the firm/industry backgrounds of the selected case firms, in relation to their ICT uptake and logistics performance. This proposal is guided by the need to provide practical and industry-specific insights concerning ICT uptake challenges amongst the local 3PL SMEs. The outcome of the study is expected to have critical implications, particularly for its potential replicability for international comparisons and opportunities for the local logistics operators to compare their strategic competences. With these, other policy-related actions and development opportunities may ensue. The full discussions of the chapter are guided by their respective research questions as follows.

6.3.1 Influence of company and industry background on ICT adoption amongst the local 3PL SMEs.

Literature indicates that factors influencing ICT uptake at firm levels are complex and dynamic, regarding the interactive effects of the industry environment, organisation, and technological factors (Tornatzky and Fleischer, 1990), with more significant consequences in the developing logistics markets as a result of inadequate institutional framework (Dayan and Ndubisi, In Press, Ezenwa et al., 2018). Here in this study, the systematic multiple case study analysis shows that the selected case firms vary in their backgrounds, as well as their responses to ICT uptake. Precisely, the selected case firm from the auto-parts/accessories and their counterparts in the health sector exhibited considerable logistics competence in terms of the high levels of ICT profile and updated ICT skills and business knowledge, which manifested positively on the quality of ICT uptake and engagements. However, there is evidence that the majority of other categories of the selected case firms with fewer ICT resources and skills have plans to update their ICT resources and skills in future as the lack of facilitating conditions in the industry improve. These converged with the phase two study, regarding the overriding dampening effects of lack of facilitating conditions over potential positive causal relationships between consumer readiness/scope of business and perceived useful/perceived ease of use of ICT resources (Ezenwa et al., 2018).

Further, as the local 3PL SMEs are the receiving ends of both institutional and industry-specific challenges in the Nigerian transport and logistics industry (Ezenwa et al., In Press), most of the local 3PL SMEs across the identified industries are found to concentrate on the applications of simple ICT resources such as mobile phones and emails for mainly electronic communications. Others have also adapted mobile telecommunication devices as tracking devices for the safety and security of their consignments and field staff. The use of ICT resources is also widely applied for transactional purposes, indicating their acceptance of technology innovation in the

field. The industry-specific influences are also evident, considering the auto-parts/accessories local logistics providers, emerging as the top motivated operators, followed by those in the health sector, Apapa Port Complex, and last, food/beverage. Levels of fragmented logistics activities (Evangelista, 2011) appear different across industries, in line with the found differences in their intra industry comparisons, particularly in the Apapa-port Complex. The results also show that local 3PL SMEs are engaging third-party services for their ICT acquisition, which is a step in the right direction as most technology innovations are currently transforming into web and cloud resources (Neaga et al., 2015, Zage et al., 2013). As expected, this would go a long way to address infrastructure-related challenges among the local 3PL SMEs, as the web and cloud resources are less dependent on the traditional infrastructure (Harris et al., 2015, Perego et al., 2011a, ENABLE, 2010, O'Sullivan, 2007). Besides, the development would help to address technology compatibility, and trialability, challenges, found critical for the diffusion of innovation (Rogers, 1995).

As Table 6.7 indicates the provision of advanced ICT resources such as EDI and RFID on third-party bases are still at infant phases, compared to the primary ICT resources such as GSM, email, and website/internet services. This suggests the need to increase awareness of the benefits of web and cloud-based resources amongst the local logistics providers, which are found to be less dependent on the traditional infrastructure. This can be achieved in the form of regulation/policies or creation of ICT training centres by the local authorities (Symesa and Phillipson, 2019, Castka and Balzarova, 2008, OECD, 2000, John and Storey, 1998). It may also involve development of collaborative framework between the local logistics operators and the ICT innovators and development actors to enhance skill acquisition, as well as adoptive capacities of the local logistics operators (Tob et al., 2018, Neaga et al., 2015, Zage et al., 2013, Evangelista, 2011, Pokharel, 2005, Gunasekaran and Ngai, 2003). Similarly, the outcome of the study may be useful in providing additional insights into how to improve sectoral applications of relevant ICT resources as in the case of food/beverage and Apapa Port Complex, who were found low in ICT uptake, in comparison to their auto-parts and health sector counterparts. These revelations may be also critical for both local and international collaboration conversations as the study sheds light on the current realities on the ground, especially the strengths and weaknesses of the local 3PL SMEs across the selected industries.

Above all, the research outcomes are able to achieve one of the objectives of the research, which is to understand how different categories of the local 3PL SMEs are responding to the ICT diffusion challenges in the Nigerian transport and logistics industry. This is believed to have a critical role in addressing lack of logistics performance in the region, and in turn, global SC integration and processes. Because the local 3PL SMEs are found to have different competency

levels from the phase two study of this research project, it was found critical to map how internal and external factors (Tidd, 2001, Metcalfe, 1981, Majan and Peterson, 1979, Rogers and Shoemaker, 1971) are influencing the divergent characteristics among the local 3PL SMEs. This approach is in line with the earlier assertion in the study regarding the use of the local 3PL SMEs as a test-bed over issues affecting the entire industry. The selection of the represented industries was informed from the outputs from the phase 2 study and the recommendation of the local stakeholders, which combined to show their prominence in the local logistics market. As such, it is believed that the findings of the study are consistent with current realities in the local logistics market, with relevant implications, as highlighted above. This section of the discussion concerns how the firm background and industry environment influence their ICT prioritisations.

6.3.2 Influence of company and industry background on ICT prioritization of the local 3PL SMEs

The outcome of the study demonstrates that one of the significant pathways by which logistics industry/outsourcing organisation influences the characteristics of their contacted local 3PLs is through its impacts on their ICT prioritisations (Tiwari et al., 2018, Harris et al., 2015). These align with the notion that industry environment, together with logistics outsourcing organisations combine to influence the characteristics and quality of ICT uptake of the local 3PL SMEs (Evangelista, 2014, Berglund et al., 1999). There is also a substantial diverse range of ICT resources applicable in different industries (Tiwari et al., 2018, Harris et al., 2015). How ICT uptakes differ across different industries in the local logistics market represents one of the research objectives of this study. While literature offers useful insights concerning the application of ICT resources in different industries (Tiwari et al., 2018), it is yet to be expanded to how that influence their relations with their contracted 3PL SMEs. This corresponds to understanding how external factors such as industry environment/logistics outsourcing organisations feed ICT prioritisation and characteristics of the local 3PL SMEs (Ezenwa et al., 2019).

Further, within the context of developing the logistics market, an in-depth investigation is needed of the causal links between industry environment/logistics outsourcing organisations and ICT prioritisation amongst the local 3PL SMEs. These relate to improving the understanding of the dynamics of the locally-evolved issues influencing ICT adoption among the local 3PL SMEs and the broader industry. In this study, it is evident that lack of an enabling business environment is the same across the selected industries, while on the other hand, the impacts of the outsourcing logistics services differ. It is within this context that the next phase of the study is conceived to map the effects of the institutional framework on the industry

environment, and in turn, the local logistics operators. Specifically, the study shows that there is general interest for communication devices for safety and security purposes, while on the other hand, prioritisations of advanced ICT resources differs according to industry-specific needs, for example, the adoption of ICT resources, in relation to warehousing, inventory, and freight management activities. As expectedly, the revelations would help the logistics operators to understand the need to integrate their plans for ICT acquisition with the broader long-term strategic plans of the organisations. This aligns with the notion of having random plans for future ICT acquisition found in this study. For example, firm 2 (Apapa Port Complex) that adopts only one item (8%) of the ICT resource but has plans to acquire 9 (69%) of the enlisted ICT resources. With this approach, the firms could be adequately prepared, both in the tangible and intangible resources to boost optimisation of their future ICT uptake.

The study argues that every industry may have its own specific ICT uptake requirements and objective, for example, health sector and other business ventures that have different motives, in terms of achieving quality care deliveries and business competitiveness, respectively (Xie and Breen, 2018). Likewise, findings from the agricultural SC suggest that confidentiality of data is more profound, particularly for subsistence farmers who feel vulnerable to share data for fear of losing business to their rivals. In practical terms, the main objectives of this aspect of the study relate to pointing attention to why the understanding of the dynamics of specific industries is necessary in boosting ICT diffusion in the broader logistics market in the study site. It is also consistent with the argument that over-concentration on the external factors can lead to misguided policy suggestions.

Therefore, situating ICT diffusion challenges in the field within the context of industry-specific challenges, where the emphasis is on how the characteristics of logistics outsourcing organisations influence the influence of the quality of ICT uptake of the local 3PL SMEs, has become critical research focus in this field. To allow for a close assessment, this study also considers how the company backgrounds and the industry environment combine to influence the performance of the local 3PL SMEs through their ICT adoptive capacities (Tob et al., 2018, Evangelista, 2011, Gunasekaran and Ngai, 2003, Pokharel, 2005). This aspect of the study is presented next.

6.3.3 Influence of company background and quality of ICT uptake on the logistics performance of the local logistics firms

The outcome of the multiple case study posits that the logistics performance of the local 3PL SMEs is influenced by the causal interactions between the firms/industry backgrounds and quality of ICT uptake. This is consistent with the causal model-induced hypotheses tests, where

the PU/PEOU of the available ICT resources were applied as mediators on the proposed causal relationships between sets of external factors and the ICT acquisition and decision quality of the local logistics operators. Both studies converged, concerning the established dampening effects of the unfavourable industry environment on the ICT adoptive capacities of the local 3PL SMEs, and in turn their logistics performance. The unfavourable industry environments correspond to unstable electricity, dilapidated road network, lack of data management system, lack of adequate telecommunication platforms, irregular polices (Ezenwa et al., In Press). The logistics performance highlighted in this study includes logistics efficiency, adaptations, agility, alignment, and accuracy of record keeping.

Specifically, the results indicate that none of the firms was able to achieve high logistics performance, based on the persistent lack of business enabling environment in the region (Ezenwa et al., In Press, Obiorah, 2016, Oledinma, A., 2015, Iheanacho, 2014, Ejimudo, 2013, Ologbenla, 2007, Onah, 2006, Obi, 2006, Oladapo, 2004, Ezeife and Bolade, 1984). Nonetheless, most of the case firms across the various sectors achieved moderate logistics performance due to adequate internal resources, in terms of ICT resources and skills they have obtained. In particular, all the case firms around the auto-parts/accessories and health sectors achieved moderate logistics performance, followed by their counterparts in Apapa Port Complex who achieved a similar fit, except case firm 2 in the group that achieved low logistics performance. On the other hand, food/beverage case firms came last with very low logistics performances, associated with their low internal resources.

These imply that logistics performance in the region is mainly driven by the individual efforts of the local logistics operators, irrespective the prevalent lack of an enabling environment in the region. This revelation has remained consistent from the inception of the research findings in this study. Literature indicates that the trend has persisted in the region due to profound institutional voids (Ezenwa et al., In Press). The authors assert that the dominant thematic factors include irregular intervention schemes and political corruption, which combine to stall the development of the local logistics environment, mainly infrastructural deficit. The cumulative effects on the local logistics operators include limited scope of business and lack of motivation.

Research has shown that lack of infrastructure is the main inhibiting factor for efficient ICT uptake amongst local SMEs in Nigeria (Apulu, 2012). Others are of the view that lack of long-term planning, corruption, irregular policies, nepotism and lack of continuity plans for infrastructural development are locally-specific issues hindering infrastructural development in Nigeria (Ezenwa et al., In Press, Obiorah, 2016, Oledinma, A., 2015, Iheanacho, 2014, Ejimudo, 2013, Ologbenla, 2007, Onah, 2006, Obi, 2006, Oladapo, 2004 Ezeife and Bolade, 1984). In

trying to achieve logistics performance in the region, the revelations made through the case firms show that the local logistics operators often engage on the inappropriate adaptation of ICT resources, indicating the degree of their vulnerability (Tob-Ogu et al., 2018, Melville et al., 2004). One particular instance is the recurrent use of mobile communication devices to keep track of the activities of their field operators, which has been reported a huge source of distractions to the drivers on duty. The apparent roles played by the lack of institutional voids in the region contribute to the conception of the fourth phase of this research project.

The outcome of the multiple case study further shows that though most of the local logistics operators are resilient, there are still few who are relatively reluctant. This converges with significant differences in the moderating effects of the ICT experience and education of the owner-managers on the positive causal relationships between SB and PU; CR and IA, respectively. Through the findings of the study, it can be established that the seemingly reluctance of the local 3PL SMEs to adopt and update their skills may be influenced by the nature of contracts they have with their outsourcing logistics organisations, as the case of the food/beverage case firms, where business contracts are conducted mainly on temporary basis. Some others may be linked to resistance to technology innovation as in the case of firm 2, Apapa Port Complex. Before now, freight operations in Nigeria had mainly revolved around conveying agricultural products from the hinterland to the seaports, until the inception of the oil boom in the early 1970s when the trend reversed (Olanrewaju, 1987).

Currently, many freight activities involve the movement of finished and intermediate goods from the seaport and manufacturing companies to the hinterland (Alokan, 1988, Alokan, 1995, Powell and Sheffi, 1983) (Section 3.5, Chapter 3). As such, many of the local 3PL SMEs are usually involved into full haulage operations rather than basic and advanced logistics services (Evangelista, 2011) (see Section 3.4, Chapter 3), except those who are engaged with international organisations as local contractors, as in the case of the auto-parts/accessories case firms. Some others are engaged locally with the indigenous e-commerce outfits for local deliveries, as well as specialised outsourced logistics services from the health sector.

With the globalisation of SC processes and integration (Dayan and Ndubisi, In Press), it has become critical that the local 3PL SMEs should optimise their available resources to be able to cope with the continued digitalisation of the industry (Gunasekaran et al., 2017). Because of paperless logistics (Islam et al., 2013) and digitalisation of SCs (Shi et al., 2016) companies are now into pressure to upgrade their facilities to enable them fit to into global best practice. As such, this study envisages that only the informed local 3PLs can be able to make the necessary adjustments (Huanga et al., 2019, United Nations, 2015, Bellingkrodt and Wallenburg, 2015, Pedrosa et al., 2015, Cui et al., 2012, Flint et al., 2005). From the outcomes from the study, it

appears that the majority of the local 3PL SMEs are behind in tapping the modern technologies in the field. Hence, the need to develop sustainable strategies to improve ICT diffusion in the industry. This may involve total reorientation of the local logistics industry, starting from the institutional framework to educating the logistics operators and customers, with a view to improve the quality of logistics performance in the region (World Bank 2018, World Bank, 2013). Several of these issues are covered in the next Chapter of the thesis.

Further, the revelations made from this research investigation suggest that collaborative linkages across relevant stakeholder and development actors should be more about how to tackle the external factors. This has become more critical since the emergence of the global SC phenomenon that requires compatibility of transport and ICT resources infrastructure (Symesa and Phillipson, 2019, Yawar and Seuring, 2015, European Commission, 2011, Castka and Balzarova, 2008, Furgel and Lemke, 2006), well as globally/regional accepted relevant policies (Grimm et al., 2014). While on the hand, the internal factors need to be treated as secondary matters, amongst the local logistics operators and their logistics outsourcing contractors and organisations. Insights from this study support the conclusion from the technology acceptance model (TAM) (Venkatesh & Davis, 2000, Davis, 1993, Davis et al., 1989, Davis, 1989) that set of context-specific external factors predict the usefulness and ease of use of information systems, and, in turn, the behavioural intentions/actual adoption.

Within the context of ICT adoption at firm levels, Tornatzky and Fleischer (1990) argue that the combinations of technological (Kauffman & Walden, 2001) organisational (Chatterjee, Grewal, & Sambamurthy, 2002), and environmental factors (Kowath and Choon, 2001) are usually involved. Diffusion of innovation (DoI) theory (Rogers, 1995) also postulates that initial knowledge of existing innovation, persuasion, decision to adopt or not, implementations, and final confirmation (assimilation). The combinations of these factors are the within the need to integrate some of the ICT adoption/diffusion theories, models and frameworks to unpack specific issues that are peculiar to the local SMEs (Awa et al., 2015), as well as regional-specific issues study (Tob-Ogu et al., 2018). Finally, this study envisages that some of the salient issues raised in this study could be critical towards achieving sustainable logistics performance in Nigeria.

6.3.4 Conclusion of Chapter 6

This aspect of the research is used to offer industry insight concerning factors influencing efficient ICT diffusion in the Nigerian transport and logistics industry. Drawing evidence from the multiple case study, the study demonstrates that the explanations for the lack of ICT diffusion in the Nigerian transport and logistics industry lie not only the lack of infrastructure

and logistics competence (World Bank, 2018, 2013), but also on the characteristics of the specific industries in the region. The notion of the multiple comparisons used in this research is more searchingly on local logistics performance and the broader economic growth. The combination of the research results suggests that there are more challenging underlying issues than what is obtained superficially. These may have implications for establishing relevant specific regulations as done in the Nigerian port concession (Eniola et al., 2014). Hence, the need to consolidate research on the industry/firm-specific challenges, especially in this era of SC digitalisation (Bellingkrodt and Wallenburg, 2015, Pedrosa et al., 2015, Cui et al., 2012, Flint et al., 2005). Around the salient issues found in this research are the reasons why there are divergent characteristic of the local 3PL SMEs (Pokharel, 2005, Kilpala et al., 2005).

Although findings ways to address some of the locally-evolved external factors such as lack of transport and IT infrastructure represents a useful point of entry to address the research problems, this study argues that a step towards understanding industry-specific dynamic challenges would help find long-term solutions. Hence, the need to start directing focus on all components of the local logistics system to help address the ICT diffusion challenges, holistically. On this basis, scholars can better construct a useful argument to advance the applications of intelligent solutions in the developing logistics market, with its potential effects on improving global SC integrations/processes.

Chapter 7 – Phase 4 results and discussions (Institutional perspective)

Outline

This Chapter covers the results and discussions of phase 4 (final) phase of the study. The main objective relates to identifying existing policy initiatives in the industry and actions required to improve ICT diffusion in the Nigerian transport and logistics industry. Individually, the Chapter involves six Sections: overview (7.1), and the result Sections (7.2-7.5), and discussions and conclusions (7.6).

7.1 Introduction

The study envisages that ICT diffusion challenges in the Nigerian transport and logistics industry require policy intervention, with the collaborative efforts of the relevant stakeholders, which coincided with developing a three-staged ICT diffusion framework from the study (see Figure 7.1). The study adopts Nigerian IT policy as a point of entry for this phase to respond to the following research question:

- How do the local developmental schemes (policies) influence ICT diffusion amongst the local 3PL SMEs and the broader industry?

The primary qualitative studies (focus group discussion and in-depth and expert interviews) are conducted to address the following research questions:

- How do the local institutional forces shape ICT diffusion amongst the 3PL SMEs and the broader industry?
- Finally, what are the local stakeholders' perceptions of the ICT diffusion challenges amongst the local 3PL SMEs and their roles in mitigating them?

The bottom line of the research findings converged with the earlier phases of the study, concerning the negative consequences of institutional voids on the efficient ICT uptake in the Nigerian transport and logistics industry. Against this backdrop, an ICT diffusion framework is developed to guide mapping ICT diffusion challenges in the industry. It is important to state that the framework is not exhaustive but a good point of entry for the relevant stakeholders to consolidate. The combination of the issues presented above reflects the content of this Chapter, as guided by the associated research question below:

7.2 How do the local developmental schemes (policies) influence ICT diffusion amongst the local 3PL SMEs and the broader industry? (RQ VI)

The main objective of this part of the study is to underpin how local developmental schemes (policies) are influencing ICT diffusion amongst the local 3PL SMEs and the broader transport and logistics industry. The outcome of the document qualitative analysis (DQA) of the Nigerian ICT policy, designed to meet sectoral applications of ICT resources in the local economy (NITDA, 2001) is summarised in Table 7.1. As indicated, out of the identified sectoral needs (theme 1) and other needs (theme 2), transport and logistics issues are not recognised. According to the magnitude coding in Table 7.2, logistics and supply chains matters are raised four times (25%) as sub-sectoral needs under Arts/culture and Agriculture, respectively (see coding details in Appendix 7.3). The result indicates that local developmental schemes (policies) such as IT policy have demonstrated insignificant influence on the strategies to improve ICT diffusion in the Nigerian transport and logistics sector.

Table 7-1: Sectoral applications of Nigeria's national IT policy (Source, NITDA, 2001)

S/N	Policy goals (themes)	Policy statements
Sectoral needs (theme 1)		
i	Governance	To embrace transparent governance through appropriation of government wide information system (GWIS)
ii	Urban and rural development	To utilize IT tools for urban and rural development
iii	Trade and commerce	To establish an enabling environment for trade and commerce
iv	Arts, culture and tourism	To use IT to promote the image of Nigeria's arts, culture and tourisms
v	National and law enforcement	Protect and promote interests, assets, and safety of Nigerians at home and abroad
vi	Health care	To promote IT-based health systems to ensure quality of healthcare delivery
vii	Agriculture	To use IT tools to re-engineer agriculture to advance food sufficiency, security and employment
Other needs (theme 2)		
viii	Human resource development	To promote globally competitive IT manpower (human resource development).
ix	Government and private sector investment	Provide enabling environment for private sector investment
x	Infrastructure	To establish reliable information infrastructure that meets international standard
xi	Fiscal measures	To establish fiscal measures that stimulate investment and growth of IT sector
xii	Research and development	Promote IT sustainability, leapfrogging, and competitiveness through research and development
xiii	Legislation	Promote and protect right for information and use; privacy of users and upholding justice for all
xiv	Global consideration	Promote international collaboration in IT knowledge, investment and security
xv	IT popularization and awareness	Provide and enabling environment for cutting-edge information technology in the region
xvi	Policy implementation	Recognize IT as an agent for national development

Table 7-2: Qualitative data analysis of Nigeria's national IT policy (Source, NITDA, 2001)

Codes	Score (themes 1)	Score (theme 2)	Total (%)
IT education/training	7 (i-vii)	9 (viii-xvi)	16 (100)
Infrastructure	6 (i, ii, iii, iv, v, vi)	6 (ix, x, xi, xii, xv, xvi)	12 (75)
Private sector investment	2 (iii, vi)	5 (ix, xi, xiv, xv, xvi)	7 (44)
Data sharing and security	3 (i, v, vi)	3 (x, xii, xvi)	6 (38)
Employment	4 (ii, iii, v, vii)	2 (xiii, xi)	6 (38)
Awareness	3 (ii, iv, v)	2 (xv, xvi)	5 (31)
Competitiveness	1 (iii)	3 (ix, x, xii)	4 (25)
Collaborations	-	4 (viii, xi, xiii, xiv)	4 (25)
Logistics and supply chain	2 (iv, vii)	2 (viii, xiii)	4 (25)
Regulation	1 (iii)	3 (xi, xiii, xvi)	4 (25)
Funding		3 (viii, ix, xii)	3 (19)
Sustainability	2 (ii, vii)	1 (xii)	3 (19)
Advanced ICT application	1(iv)	1 (xvi)	2 (13)
Copyright protection	1 (v)	1 (xiii)	2 (13)
Efficiency	2 (ii, vi)	-	2 (13)
Leadership/professionalism		2 (x, xiv)	2 (13)
Total	36 (i-vii)	47 (viii-xvi)	83 (i-xvi)

* Numerals in brackets represent individual policy goal as displayed in Table 7.1

7.3 How do the local institutional forces shape ICT diffusion amongst the 3PL SMEs and the broader industry? (RQ VII)

Three broad themes emerged from the FGD data analyses with the associated subthemes and codes, as well as their magnitudes (see Table 7.3). The results indicate as follows: First, out of the 114 codes generated from the FGD data, institutional voids constitute (25%); structural (39%), and operational (36%) codes within the three broad themes. For the sub-themes, institutional voids comprise irregular intervention schemes/policies (41%) and political corruption (60%). The sub-themes are further sub-divided into four codes: low budget for innovation (11%) and fragmented approach (30%) for the irregular intervention/policies sub-theme. On the other hand, political corruption comprises misappropriation of public funds (26%) and nepotism (30%), (see Table 7.3). The structural problems comprise infrastructural deficits (86%) and poor bureaucratic process (14%) as subthemes. The corresponding individual codes involve unstable electricity supply (27%), dilapidated road network (23%), lack of data management system (20%), and lack of adequate telecommunication platforms (7, 15.40%) for

infrastructural deficits, while poor bureaucratic processes encompasses only disorganized sector (14%) as the lone code. The operation challenges as a theme involve reduced individual difference factors (74%), limited scope of business (12%), as well as lack of motivation (14%). The individual difference factors are further divided into low education status (18, 45.10%) and ICT experience (29%). The magnitude coding results correspond to 114 frequencies of 13 codes, 7 sub-themes, and three themes (see Table 7.3).

The results suggest that the FGD panellists deliberated more on the structural challenges and operational problems than on institutional voids. The outcome does not come as a surprise as both the structural and operational themes are the outcomes of the institutional voids, which inherently require more attention for critical accounting of the effects of the institutional-triggered challenges. Individual, political corruption (misappropriation of public funds and nepotism) represents the major issue treated within the institution void context, followed by irregular intervention/policy auctions (low budget for technology innovation and fragmented approach). The infrastructural deficits (unstable electricity, dilapidated road network, lack of data management system, and lack adequate telecommunication platforms) cover the portion of the structural challenges, followed by the poor bureaucratic process (disorganised sector). Last, the reduced individual characteristics factors (ICT experience and education of the local logistics operators) represent the main focus of the FGD panellists within the perspective of the operational problems, followed by the limited scope of business and lack of motivation.

Table 7-3: Thematic and magnitude coding results from the FGD data

Theme scores	Sub-theme scores	Code scores
Institutional void =29(25.40)	Irregular intervention schemes/policies = 12(40.70)	Low budget for innovations = 4(11.10)
		Fragmented approach = 8(29.60)
	Political corruption = 17(59.30)	Misappropriation of public fund = 7(25.90)
		Nepotism = 10(33.40)
Structural problems = 44(38.60)	Infrastructural deficits = 38(86.30)	
	Poor bureaucratic process = 6(13.70)	Unstable electricity supply = 12(27.30)
		Dilapidated road network = 10(23.20)
		Lack of adequate data management system = 9(20.40)
		Lack of adequate telecommunication platforms = 7(15.40)
Operational challenges = 41(36.00)	Reduced individual difference factors = 30(73.70)	Disorganized sector = 6(13.70)
		Low education status = 18(45.10)
	Limited scope of business 5(12.20)	Low of ICT experience = 12(28.60)
		Limited scope of business = 5(12.20)
Total = 3/144 (100)	Lack of motivation 6(14.10)	Lack of motivation = 6(14.10)
	7/114 (100)	13/114(100)

7.4 What are the local stakeholders' perceptions of the ICT diffusion challenges amongst the local 3PL SMEs and their roles in mitigating them? (RQ VIII)

Interviewees (Table 7.4) recalled the general lack of application of advanced ICT resources within the industry in the study site. However, most of them acknowledged that larger logistics organisations inherently benefit from the advanced ICT resources more than the smaller logistics operators based on their financial strengths and strategic position in the industry, in terms of regional and international collaborations. Likewise, the socio-economic status of the users was revealed as the major determinant of the demand for customised logistics services, as well as the geographical locations of services, resonating with Ezenwa (2014) who found that there are significant differences in demand for customised logistics services across various regions in Nigeria, based on differences in social-cultural orientations and social-economic status. Whilst the limited logistics performance in the region prevents a complete understanding of ICT facilitated logistics services/operations across the six-geopolitical regions of the country, it is clear from interviewees' responses that operational challenges are particularly problematic for small and medium sized companies.

The views of the interviewees concerning factors influencing ICT diffusion among the local logistics operators are demonstrated in Table 7.4, using summation signs (–/+) to denote negative and positive effects of the identified factors on the propensity of the local 3PL SMEs to acquire relevant ICT resources. All the expert interviewees agreed that the general lack of enforcement/regulation holds back ICT diffusion in the industry, classified as an institutional problem, including extortions by the local enforcement agencies, lack of definite purposes of the leadership of transport/logistics unions, irregular policies, and political instability. The respondents also stressed high cost of capital and infrastructural deficits categorised as structural problems, as well as the following operational drawbacks: high cost of vehicle maintenance associated with dilapidated road infrastructure, and lack of adequate manpower. Other identified operational drawbacks include limited ICT experience/education status of the owner-managers; lack supply chain collaborations, an unwillingness to pay more for customised services. There was also general agreement concerning how security challenges (terrorist acts and militancy) have disrupted logistics activities in some regions, while few respondents acknowledged geographical challenges (e.g., high temperatures) and cultural challenges (e.g., limited access to recipients during last-mile deliveries).

Table 7-4: Thematic and magnitude coding result for EI data

Code No	Key variables (codes)	Interviewees					Themes					
		I1	I2	I3	I4	I5	Institutional	Structural	Operational	Cultural	Geographical	Security
i	Lack of enforcement/regulation	-	-	-	-	-	5 (-)					
ii	High cost of vehicle maintenance	-	-	-	-	-			5 (-)			
iii	Lack of adequate manpower	-		-	-	-			4 (-)			
iv	High cost of capital	-	-	-	-	-		5 (-)				
v	Extortions by the local law enforcement agencies	-	-	-	-		4 (-)					
vi	Terrorism/militancy and highway armed - robberies	-	-	-	-	-						5 (-)
vii	Adaptation challenges of foreign manufactured vehicles	-				-					2(-)	
viii	Education status	+-		+-	+-	+-			4 (+/-)			

Table 7-4 Continued (2/2)

ix	ICT experience	+-	+-	+-	+-		4 (+/-)
X	Lack of definite purpose of the local transport/logistics associations	-	-	+	-	3(-), 1(+)	
xi	Lack of collaborations	-	-	-	-	-	5 (-)
xii	Infrastructure deficits	-	-	-	-	-	5 (-)
xiii	Irregular Policies	-	-	-	-	-	5 (-)
xiv	Unwillingness to pay higher for customized services				-		1 (-)
xv	Political instability	-	-	-	-	-	5 (-)
xvi	Limited access to recipient during home deliveries				-		1 (-)

*± responses scoring system

The respondents generally complained about their inability to modulate (influence) the rate of ICT diffusion in the industry and particularly among the local 3PL SMEs as the majority of them revealed that the locally-evolved issues are mainly linked to institutional failure. In his words, I1 specifically said: “Nigeria Port Authority (NPA) has no authority to enforce implementation of ICT tools among the local logistics operators around Nigeria’s seaports, but concentrates on the implementation of safety measure within the port premises and environ.” Continuing, I1 said, “based on my experience in this NPA, the local logistics operators lack requisite man-power in terms of mobile mechanic and drivers who can repair or handle basic electronic mechanisms in their vehicles or during discharge of logistics functions, and these issues can be linked to lack of basic infrastructure.” Again, I1 revealed thus “the majority of the fleet used by the local freight operators is ancient and cannot be suitable for modern freight activities.” Other interviewees highlighted other ICT diffusion drawbacks in the industry, for example, I2 said “we rarely hire the local logistics operators on a permanent basis and cannot extend our internal ICT resources to cover the short-term outsourced logistics services.”

The respondents confirmed that contracts are usually initiated through referrals with less official contractual agreements, and simple ICT tools are used (such as mobile phones) to keep track of consignments, which are frequently delayed due to dilapidated road networks, extortion by local law enforcement agencies, insecurity (highway armed robberies, terrorist acts and militancy). The respondent also noted that financial institutions in the study site charge up to 25% for capital. Also, I2 said: “perhaps the extortions of the local law enforcement agencies constitute low logistics performance in Nigeria as man-hours are usually due to unlawful delays on transit.” I5, I4 revealed that internet connections were usually disrupted in the regions affected by terrorist attacks/militancy. I3 supported that “the majority of the logistics operators purposely avoid hybrid vehicles due to temperature concerns.” As such, there were general concerns about the phasing out of the foreign-sponsored local assembling plants and lack of support for the indigenous automotive manufacturers that would have made fundamental provision for the high-temperature issues. I3 and I4 highlighted that owner-managers with sound education/ICT experience are more likely to improve their scope of businesses technologically. For the union leaders, I1 argued that majority of them are not innovative and inherently resisted previous attempts to innovate the system. On the other hand, the I3 revelation indicated that the union leaders are innovative and educated. The respondent blamed the government for failing to provide an enabling environment to sustain the industry. He lamented that the circumstances have led to a lack of foreign and local collaborators with the 3PL SMEs as the systems are not conducive to facilitate the business links, aligning with the comment from I2 that food manufacturing companies in the area (e.g., flour mills) typically hire 3PLs through

referrals. I3 disclosed that outsourcing firms are usually unwilling to pay more for ICT facilitated services.

Further, I4 linked the prevailing problems to lack of unity of purpose among the relevant stakeholders as well as the absence of long-term strategies/continuity of government developmental plans. Additionally, I5 raised issues concerning cultural challenges (Erumban and De Jong, 2006) and market structure (Caselli and Coleman, 2001) in the study site. For example, there are cases where the last mile operators are barred from accessing premises to deliver parcels to avoid contact with the residents, hampering provision of customised services relating to online orders. In sum, the results help to enrich the understanding of salient issues stalling ICT diffusion among 3PL SMEs in Nigeria, especially concerning the roles of stakeholders' reactions in modulating acceptability and rejection of relevant ICT tools. The findings reveal that despite signs of progress in addressing ICT adoption challenges among 3PL SMEs, the reactions of the relevant stakeholders/actors and their roles in modulating the acceptability/rejection of the ICT tools are not well integrated and hence fail to promote improvement in the collective welfare of local 3PL SMEs. Indeed, the chronical presentation in Table 7.4 indicates that present-day realities may have informed why the lack of ICT implementations persist among the 3PL SMEs. It is important to note that the majority of issues raised in this study culminated to the development of the three-staged ICT diffusion framework (Figure 7.1) as a long-term road map to improve logistics performance in Nigeria and similar environments.

7.5 Discussions and conclusion of Chapter 7

This section presents the discussions and conclusion for the last phase of the study, guided by the corresponding research questions as follows:

7.5. 1 the developed initiatives to address ICT diffusion concerns in Nigeria's transport and logistics sector

The outcome of the qualitative data analysis (QDA) of the Nigerian IT policy suggests that a limited attention has been given towards sectorial application the IT initiatives in the regional transport and logistics sector. Literature however indicates that the National IT policy lacks effective implementation across relevant sectors and is overdue for a review (Adedoyin et al., 2008). The revelation is not far from the physical assessment of public transport infrastructure in Nigeria during the researcher's field visit to Nigeria indicate that IT policy initiatives concerning infrastructural developments across sectors of the economy and on-the-ground conditions are far apart.

Literature argues that sectoral applications of national IT policy initiatives should cover the following sectoral applications in transport and logistics industry: (i) Provide adequate communication infrastructure for ease custom clearance processes through efficient application of advanced ICT tools. (ii) Improve transport/logistics public infrastructure to match international standards. (iii) Promote policies that advance efficient shipments, both locally and internationally. (iv) Harness local, state, national and global communication infrastructure in a way they can interact efficiently to enhance tracking and tracing of local and international logistic consignments, and (v) Enact necessary policies that may stimulate timeliness (Just in Time - JIT) logistics deliveries (Arvis et al., 2014, World Bank, 2013). In this study, it is argued that assessment of regional framework (Palsson and Kovacs, 2014, Tate, 2014, Dimaggio and Powell, 1983 Meyer and Rowan, 1977) can offer an important lens for assessing how local-evolved issues are influencing ICT diffusion in the Nigerian transport and logistics industry as demonstrated in the subsequent discussions.

7.5.2 The effects of institution in shaping ICT diffusion in Nigeria's transport and logistics industry

Nigeria's transport/logistics sector suffers from relatively poor infrastructure that fails to effectively spur ICT facilitated activities in the region, leading to a low level of regional logistics performance (World Bank, 2018, 2013). It is based on this understanding that this study was conceived to shed light on the underlying issues holding back the development of Nigeria's transport/logistics related infrastructure. The findings establish the causal links between institutional voids (irregular intervention/policies and political corruption) and the structural challenges (infrastructural deficits and weak bureaucratic processes). These combine to threaten the operations of the local 3PL SMEs in terms of reduced individual difference factors, limited scope business, and lack of motivation. Several structural challenges burden the local 3PL SMEs as a direct consequence of huge institutional voids in the region, including frequent vehicle breakdowns, associated with the dilapidated road infrastructure, inadequate data management systems, unreliable telecommunication services, and unstable electricity in the region.

Initiatives to improve ICT facilitated services amongst the local 3PL SMEs have often failed as the structural challenges remain persistent. Other locally-evolved challenges identified by the IEs include: (i) Institutional voids: Lack of enforcement/regulation, extortions by the local law enforcement agencies, lack of definite purpose of the local transport/logistics associations, irregular policies, and political instability. (ii) Structural challenges: High-cost of capital and infrastructural deficits. (iii) Operational challenges: High-cost of vehicle maintenance, lack of adequate manpower, lack of innovative skills of the owner-managers (ICT experience and education status), lack of

collaboration, and unwillingness to pay higher for customised services. (iv) Others include cultural challenges (limited access to recipients during last-mile deliveries), geographical challenges (adaptation challenges of foreign-purchased fleets), and security concerns (terrorism, militancy and highway armed robberies) (see Table 7.4).

These outcomes are consistent with the literature (Apulu, 2012, Tob-Ogu et al., 2018, Ezenwa et al., 2018, Mondragon et al., 2017). There is strong evidence from our study that when the local 3PL SMEs are overstretched with operational challenges, they lack motivation to acquire relevant ICT tools, a problem compounded by limited scopes of businesses and issues such as ICT experience and educational status (Hitt, 1999). The local 3PL SMEs have diverse socio-economic and geographical concerns stalling swift implementations of the relevant ICT tools to enhance their operations, including lack of willingness to pay higher for customised services, challenges of adaptations of the used foreign vehicles in the region, and cultural barriers. Based on the prevailing circumstances, local 3PL SMEs in the region are unable to secure sufficient ICT resources to bolster their operations/services.

Although our findings indicate that structural challenges create a range of operational drawbacks amongst the local 3PL SMEs, the fundamental locally-evolved problems stem from the institutional voids. Important in this respect are: (i) Lack of adequate funding for technology innovation. (ii) Inconsistency of the transport/logistics infrastructural development (iii) Lack of political will to improve logistics/transport and infrastructure in the region, and (iv) Lack of professionalism in the industry as key positions in the sector are often appointed by nepotism.

The combined effects of the institutional voids and the consequential structural problems on the operational characteristics of the local 3PL SMEs (low innovative skills, limited scope of business, and lack of motivation) offer explanatory power in understanding the influences of the institutional voids in region on ICT diffusion process in the transport/logistics industry. The evidence presented in this study demonstrates how lack of ICT innovation adoption among local 3PL SMEs (Gunasekaran and Ngai, 2003; Evangelista et al., 2013) is more likely in the presence of institutional voids (Tob-Ogu et al., 2018; Ezenwa et al., 2018). Scarce transport/logistics infrastructure and weak bureaucratic system (structural challenges) for example prevent the local 3PL SMEs in the region from maximising the perceived usefulness/ease of ICT resources, including other contextual issues presented by the expert interviewees. These align with the dampening effects of the lack of facilitating conditions and limited scope of business on the positive causal relationships between consumer readiness and perceived usefulness/ ease of ICT as found in the earlier stages of our research (Ezenwa et al., 2018).

Moreover, it reflects the case for the lack of significant mediation effects of the perceived usefulness/ease of use of ICT on the positive causal relationships between a set of exogenous variables (consumer readiness, the scope of business, and facilitating conditions) and the endogenous variables (ICT acquisition and decision quality) (Ezenwa et al., 2018). Although the local logistics operators did not show similar low vulnerability to ICT diffusion challenges due to their differences in scopes of business and innovative skills, in the continued absence of an adequate institutional framework that addresses the structural and operational challenges, the logistics and transport operators in Nigeria would face more operational burdens in future in adapting to the increasing global/domestic logistics and freight demands.

7.5.3 The stakeholders' perceptions of the ICT diffusion challenge in the sector and their roles in mitigating them

A range of expert interviewees' perceptions highlight the issues affecting ICT in Nigeria's transport and logistics/logistics industry has been identified. These expert interviews indicate how decisions on ICT adoption based on the facilitating conditions and predictive organisational factors are predicated on the institutional forces existing in the study site, for example, the dismantling of the electronic gadgets of imported fleets due to lack of matching intelligent road systems in the regions. Also, unsuitable temperatures for foreign manufactured vehicles can potentially stall the motivations of the local logistics operators to update their fleet and to acquire relevant ICT.

Because many facilitated logistics services/operations depend on related public infrastructure (World Bank, 2018, 2013), the poor public transport/logistics infrastructure in Nigeria tends to limit the local logistics operators to largely reactive responses. This constrains local logistics operators from achieving logistics performance, in terms of freight tracing/tracking, locally and internationally (World Bank, 2018, 2013). The lack of basic amenities can lead to a sense of deprivation/vulnerability among the local 3PL SMEs, as reflected in their crude adaptation of ICT resources to achieve specific organisational objectives (Tob-Ogu et al., 2018). With the added burden of the increasing over-head cost associated with high-cost of vehicle maintenance and private sourcing of power supply for example, opportunity to seek alternative sources mitigating the locally-evolved challenges are blocked/weakened, in terms of regional or international collaborations, as well as lack of resources to improve innovative skills.

How circumstances might change in future allowing improved logistics performance in the region, for instance through adoption of the paperless logistics operations/services found in other logistics sectors (Air Cargo World, 2017; IATA, 2017) is unclear, due to the persisting nature of the locally-evolved challenges.

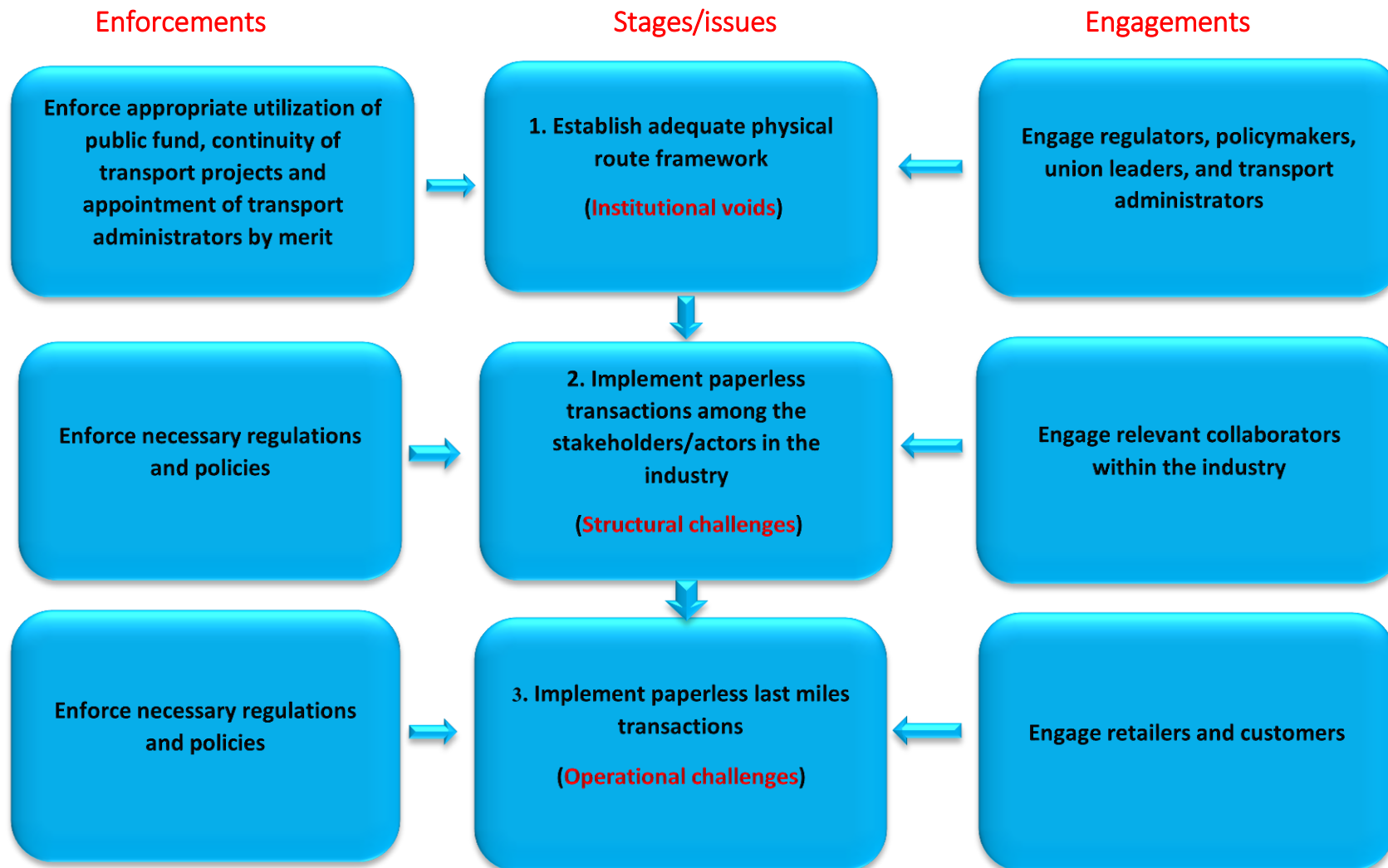


Figure 7-1: ICT diffusion strategies: 3 stage framework (Adapted: IATA, 2017)

Therefore, if local logistics operators and the relevant stakeholders lack the predictive power to map the future state of the industry, deciding on operational/strategic plans both in short and long-term may be challenging, and could further undermine the propensity of the relevant actors and entrepreneurs to invest in the sector.

Based on this understanding, the three-staged ICT diffusion framework (Figure 7.1) has been adapted as a potential guide to shaping the future of the Nigerian transport/logistics industry. The framework was conceived based on the three broad themes that constitute the conceptual framework: institutional voids, structural problems, and operational challenges (see Figure 4.13, Chapter 4). The development of this framework also recognises the engagement of the relevant stakeholders in deciding issues that pertain to transport/logistics projects in the region, as well as the need to integrate enforcement/regulations in the framework as a stimulating factor for improved ICT diffusion in the industry. Moreover, the framework recognises the need to address public corruption in the sector, in particular the judicious utilisation of public funds for infrastructural development and ensuring the right professionals are handling public and private transport administration and management. Additionally, the framework conceptualises the need for improved awareness of the importance of smart logistics services/operations (customised services), especially in the face of increased globalisation of supply chain management (Harris et al., 2015), and the growing focus on the developing logistics markets (Tob-Ogu et al., 2018).

Therefore, the three-stage ICT diffusion framework entails the following: First, establishment of adequate routes through the enforcement of efficiency and accountability in the use of public funds designated for transport/logistics infrastructural developments in the region, continuity of long-term transport/logistics projects beyond political regimes, and appointment of most qualified candidates for public and private transport and logistics administration/management. The first stage also involves engagement of relevant regulators, policymakers, logistics union leaders, researchers, and transport administrators for holistic understanding and planning of the project from the onset.

Second, implementation of paperless transactions among the intermediate stakeholder/actors and collaborators in the industry needs to be promoted. Finally, the implementation of paperless last-mile transactions through enforcement of the necessary regulations and policies is needed. In these stages, enforcement of necessary regulations and policies, as well as the engagements of the relevant stakeholders/actors will be required. It is important to note that the developed framework is not exhaustive but represents a point of entry towards mapping a future for the digitalisation of the transport/logistics industry for Nigeria's transport/logistics industry and similar environments. In doing this, the research design can move beyond merely understanding the stakeholders' perception

of ICT diffusion challenges in Nigeria's transport and logistics industry to the consideration of how the various issues identified in this study can be mitigated in a strategic manner.

7.5.4 Conclusion of Chapter 7

This research uses primary information accessed through primary qualitative studies (FGD and IEs) of the relevant stakeholders/actors and professionals in the industry to identify the mechanisms shaping how institutional voids in the study site influence the structural problem, and in turn, increase the operational challenges of the local 3PL SMEs. The baseline information realised from this study relates to understanding how institutional voids in the region are shaping the structural drawbacks in the sector, and as well, constrain the scope of business of the local 3PL SMEs. The study points to several locally-evolved issues requiring assistance to improve ICT diffusion among the local 3PL SMEs, as well as the broader industry. Of particular importance is the assistance that targets the improvement of transport/logistics-related infrastructure in the region, including the dilapidated road infrastructure, unstable electricity, lack of efficient data management, and affordable/reliable telecommunication services in the study site. Others include localisation of vehicle assembly and manufacturing plants in the study for the production of the locally friendly fleets, as well as improving the public and private management of the sector.

The study envisages that the structural and operational threats in the industry can be mitigated through addressing the institutional voids, for example, eradication of public corruption in the sector, as well as ensuring that the best professionals are engaged in the sector. The approach should also target ways to improve the innovative skills of the local logistics operators, as well as creating awareness of the importance of smart logistics operations/services, in terms of efficiency and clean environment. Besides sparking an academic interest, the research findings presented in this study have resonance for the logistics practitioners, development actors/entrepreneurs, and policymakers. For the logistics practitioners, the findings of the study and the conceptual model that has been developed from these may be useful in optimising operational strategies. Likewise, for the development actors, the finding of the study may allow identification of investment opportunities that will improve ICT diffusion.

Furthermore, policymakers may identify improved strategies-based around the developed three-staged ICT diffusion framework that will allow for more sustainable ICT diffusion planning in the sector. The study primarily calls for a reconsideration of the institutional voids characterising the region which are a cause for major concern for local logistics operators. The nation and its logistics sector need to bridge the gaps in digital innovation to enable local logistics operators to compete favourably in the global markets. The study has some limitations: (i) The study did not cover the

customers' view, for example the views of retailers and end-users, and (ii) the sample size of the participants is limited. Nevertheless, it is important to note that the FGD panellists and expert interviewees were purposefully selected for their expertise and experience from a larger sample (120) that participated in the earlier stages of our research program. Based on these limitations, extension of the work to investigate the customer perspective is recommended.

Chapter 8 - Synthesis of research findings and conclusion

Outline

This final chapter of the thesis is used to synthesise the key research findings (Section 8.1), scholarly contributions (Section 8.2), implications of the study (8.3), and recommendations/concluding remarks (Section 8.4).

8.1 Introduction

This research investigation aimed to explore the mechanisms influencing ICT diffusion in the Nigerian transport and logistics industry, using the local 3PL SMEs as a test-bed. The study comprises four phases:

- Desktop research and Scoping study;
- A questionnaire survey of the local 3PL SME and the associated structural equation modelling (SEM) quantitative analysis of the survey data;
- A multiple case study, and
- Concluding qualitative studies (focused group discussion and expert interviews)

The scoping study involved the initial engagement with the relevant stakeholders in the industry, which was used to explore varied ranges of locally-evolved issues affecting efficient ICT adoption amongst the local 3PL SMEs. This was built upon by the questionnaire survey of the local 3PL SMEs as a dynamic test-bed in the phase two study. The outcome of both studies converged, highlighting the dampening effects of the poor facilitating condition on the ICT uptake of the local logistics operators in the region (Chapter 5). Multiple case studies were conducted with this understanding to map how different 3PL SMEs categories across four selected industries in the region are responding to the locally-evolved challenges in the region. Key evidence indicates that there are industry-specific influences on the rates of ICT diffusion amongst the local 3PL SMEs. However, none of the firms attained high logistics performance based on the lack of business facilitating conditions region (Chapter 6).

Given the inherent influence of the regional institutional framework on the rest of the logistics system (Banomyong, 2017, Mondragon et al., 2017, Kayisire and Wei, 2016, Banomyong et al., 2008), the research further sought to pin down the policy initiatives required to improve ICT diffusion amongst the local 3PL SMEs and the broader industry. While several interventions and actions plan exist, concerning the sectoral applications of Nigerian IT policy, the transport and logistics sector appears hugely neglected in the policy initiatives. These led to conducting the last

qualitative studies (focus group discussion and in-depth expert interview) to underscore how institutional forces in the region are shaping ICT diffusion in Nigeria's transport and logistics industry. It also involves underpinning the stakeholders' perception of the research problems and their roles in modulating them. The results suggest that the substantial institutional voids in the region represent the bedrock of the lack of ICT diffusion in the sector, which the local stakeholders have limited influence to mitigate.

In light of these, this thesis provides a unique piece of empirically-rich research that suggests the need to address issues affecting ICT diffusion in the Nigerian transport and logistics industry in an integrated manner, using various perspectives of the study to shed light on the fundamental issues. Presenting the local 3PL SMEs as a dynamic test-bed of broad relevance in the context of ICT diffusion challenges in developing logistics markets such as Nigeria, the key contributions, implications, recommendation/concluding remarks for the study are covered in the subsequent sections.

8.2 Contribution to knowledge

Considerations of issues pertaining to ICT diffusion/adoption within the context of local 3PL SMEs and developing logistics markets lack in the mainstream literature (see Sections 3.4 and 3.5, Chapter 3), this study contributes to knowledge in theory building, research method (application of mixed-research methods in the form of triangulation), and nuanced empirical findings as discussed below.

8.2.1 Theoretical contributions

The study contributes theoretically by being the first to operationalise the integrated framework for the accurate prediction of ICT adoption amongst the 3PL SMEs (Awa et al., 2015). This sets the foundation for the development of the causal model to map the interrelationships of factors influencing ICT uptake amongst the local 3PL SMEs, which is lacking in the research field (Evangelista, 2011). This corresponds to extending the Technology Acceptance Model (TAM) (Davis et al., 1989), Technology-Organisation-Environment (T-O-E) framework (Tornatzky and Fleischer, 1990), Theory of Reasoned Behaviour (TRB) (Ajzen, 1991), and Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975) as an integrated model that can be replicated/adapted in the research field, particularly within the scope of the study. Similarly, the study contributes by extending the application institution theory (Bell, 1973, Meyer and Rowan, 1977) to underpin the Institutional perspective of the study. This aspect of the study has been considered critical, based on the inherent overriding influence of institutional framework over other logistics system (Banomyong, 2017, Mondragon et al., 2017, Kayisire and Wei, 2016, Banomyong et al., 2008).

8.2.2 Methodological contributions

Briefly, this study contributes methodologically through the application of advanced statistical techniques, particularly to underpin the mechanisms influencing ICT uptake, which is lacking in the field (Evangelista, 2011). Also, the adoption of the mixed-method approach, in the form of triangulation represents another useful methodological contribution of the research investigation (Jick, 1979). The triangulation technique adopted in this study is relevant in pinning down where key research findings support or conflict with each other, with the overall objective of improving the robustness of the research findings.

8.2.3 Empirical contributions

The empirical contributions relate to the new knowledge and insights gained from this study. Specifically, this study sheds light on the importance of developing a collaborative framework and enforcement strategies (KOMODA, 2009) to improve ICT diffusion in the developing logistics markets such as Nigeria. This follows the notion that other contextual barriers of ICT diffusion found in this study (e.g., technological, organisational, environmental, and user-related) (Cainelli et al., 2004) are somewhat related to the institutional voids in the study site. Also, the complex models adopted in this study help to shed light on the complexity of issues in the research domain. This applies explicitly to addressing the conflicting reports in the literature concerning the flexibility/innovativeness and reluctance of the local 3PL SMEs (Kilpala et al. 2005, Pokharel, 2005). The outcomes of the study broadly show that industry-specific and individual difference factors are critical in determining ICT adoptive capacity of the local 3PL SMEs, and perhaps the overriding distinguishing factors for the innovative and reluctance of the local 3PL SMEs. Moreover, the integrated model adopted in this study helps to map the intermediate characteristics of the local SMEs, which is lacking in the research domain (Awa et al., 2015).

8.3 Implications of the study

The section captures the research implications, divided into managerial, policy, and entrepreneurial impacts as highlighted below:

8.3.1 Managerial implications

The focus on the managerial implications of the study aligns with linking the research outcomes to improve the operational strategies of the local logistics operators, technologically. First, there is a need for the local logistics operators to concentrate more on improving their internal resources, mainly ICT experience and education status (business knowledge). This has become critical as the consumer readiness of the owner-managers was found the primary driver of ICT diffusion in the

Nigerian transport and logistics industry (Ezenwa et al., 2018). These represent critical factors in the modern job content of modern SC and logistics managers based on their links in enhancing information processing, communication, and decision-making (Dayan and Ndubisi, In press, Mintzberg, 1973).

Second, several revelations from the study are critical for strategic, tactical, and operational planning, which the owner-managers can exploit. Specifically, the outcome of the study proposes that the local 3PL SMEs action plans and strategies should reflect various industry-specific needs to ensure optimal applications of the relevant ICT tools. This aligns with the notion that the local 3PL SMEs by their characteristics are driven by market demand (Tidd, 2001), as observed from the multiple case study (Chapter 6). Moreover, the diagnostic insights gained from the multiple phases of the study formed the basis for the development of the ICT diffusion framework, with enforcement and collaboration implications for the local 3PL SMEs at the second and third phases of the framework (see Figure 7.1, Chapter 7).

8.3.2 Policy implications

The fourth phase of the study focuses on the institutional perspective of the study. Lack of adequate institutional framework in the local transport and logistics industry has featured prominently across the phases of the study. This appears to be the dominant source of the ICT diffusion barrier in the local transport and logistics industry. The desire to improve logistics performance in the region (World Bank 2018, 2013) gave rise to the development of the ICT diffusion framework (see Figure 7.1, Chapter 7). All of the three-phased processes of the framework are causally linked, with collaboration, and enforcement as overarching themes, which represents a point of entry for the local policymakers to address the problem.

8.3.3 Entrepreneurial implications

Beside sparking managerial and policy implications, the outcomes of the study have resonance for entrepreneurship in the form of technological development in the local transport and logistics industry. Precisely, through the study findings, entrepreneurs and development actors may tap into the digital gap in the sector as investment opportunities, particularly with the application of modern ICTs (e.g., Internet of things, Web and cloud technologies) which are less dependent on the traditional infrastructure (Harris et al., 2015, Perego et al., 2011a, ENABLE, 2010, Hewitt, 2008, Chavali, 2014).

More importantly, the outcome of the study has also drawn attention to developing specialised training centres for the local logistics operators, particularly for the application of the advanced

technology innovations in the field. To achieve this, the collaborative framework between the original equipment manufacturers/software developer, professional organisation (CILT and CloTA), government agencies (NITLDA) and the local logistics operators is vital here (see Section 7.5, Chapter 7). These align with the development of the recommendations raised upfront.

8.3.4 Implications for further studies

By specifying the context in which ICT diffusion can be improved in the context of developing logistics markets such as Nigeria, the study advances important ‘next steps’ that appear particularly promising in the research field as summarised below:

First, the results on the activities of the local 3PL SMEs in Nigeria are an important foundation for future studies within the context of developing logistics markets because they offer empirical case to expand theoretical and methodological contributions in the field. Specifically, the study advances the dynamic and complex nature of the locally-evolved issues influencing ICT diffusion within the scope investigated in this study. These combine to suggest that there is a need to sustain research towards unravelling the complex mechanisms influencing ICT uptake among the local 3PL SMEs to help stimulate ICT diffusion in the local transport and logistics industry. This has become critical as the supply chain and logistics activities continue to witness unprecedented technology transformation, which requires cooperative strategies between the technology suppliers, users and other stakeholders at various levels and regions.

Second, provision of scenarios for future technological development in the field, particularly as it may affect developing logistics markets. The concept aligns with the notion that if we understand what future technology development will look like, we can, to a certain degree, predict variation in future technology-related opportunities and challenges. The outcomes of the study call for the need to place industry and regional specific issues at the centre of efforts to understand, interpret and predict mechanisms influencing ICT diffusion in the field. This may involve improvements on the theoretical hypotheses on the predominant voices in the literature and policy circles on context-specific issues affecting local and global SC integration and management. This study lays the foundation in this direction by highlighting the importance of facilitating condition (FC) and enhanced scope of business (SB) in boosting the consumer readiness (CR), and in turn, perceived usefulness (PU) and perceived ease of use (PEOU) of ICT resources amongst the local 3PL SMEs. The present study also highlights digital divides within and across industries in the region, indicating that firm and industry backgrounds can reveal contextual differences in disaggregated analyses of factors influencing ICT uptake in the local transport and logistics industry. The bottom line is that these

contextual issues need further investigation to consolidate the study findings as the industry continues to evolve locally and internationally.

Third, the study recommends future studies to focus more on institutional issues to enhance the development of collaborative frameworks between government and relevant stakeholders within and across regions. These indicate the critical stance of various institutional frameworks in stimulating ICT diffusion in the local transport and logistics industry. This study envisages that institutionally-governed initiatives in this context have some way to go before a win-win integration approach can be realised as demonstrated by the study findings. These suggest that the template provided by the institutional processes can facilitate how the links between the locally cross-thematic issues can be understood, reconciled or negotiated, which advocates for vertical coordination approach. These coincide with the research findings of the present study and needs to build on.

Finally, the study recommends that while much attention has been paid to locally-evolved factors, future studies could also concentrate on comparing various contextual factors influencing ICT diffusion in the field across regions, encompassing various categories of economies. As revealed in this study, developing logistics market such as Nigeria has demonstrated resilience to achieve logistics performance amidst unfavourable FC and requires policy interventions to ameliorate some of the contextual factors identified in this study. To achieve this, we recommend that comparative case analyses should be conducted across regions, comprising distinct economies to support the deep-rooted revelations made in this study. It is against this background that the recommendations and concluding remarks are offered below.

8.4 Recommendations and concluding remarks

8.4.1 Recommendations

This thesis is the first Nigerian transport and logistics-focused study in the research domain. Following the outcome of the study, we recommend as follows:

First, there is a need to promote awareness of innovative technologies and skill and knowledge acquisition among the local logistics operators. In doing this, it departs from the mainstream information system adoption literature by using advanced statistical methods to demonstrate the relevance of advanced skill and business knowledge in moderating some of the identified locally-evolved deficiencies hampering efficient ICT uptake among the local 3PL SME.

Second, the study recommends the provision of frameworks that promote collaboration amongst the relevant stakeholders (e.g., consumers - local logistics operators, the original equipment

manufacturers (OEM), software developers/vendors, development actors, and policymakers). As demonstrated by the framework (Figure 7.1), the concept can offer locally-appropriate guidance for improving ICT diffusion in developing logistics markets such as Nigeria. Indeed, little work has been done to capture factors influencing ICT diffusion in the developing logistics markets' scale using an integrated approach, as demonstrated in this study. Hence the three-staged ICT diffusion framework represents the required point entry to fill this gap.

Third, subsidise the costs of ICT resources acquisition and training for the local logistics operators through the regional governments, the multinational logistics and SCs, and the development actors. The research phase four of this study set out to understand specific factors impeding ICT uptake among the local 3PL SMEs. The data captured instances of the high cost of capital, lack of requisite skill and an overall shortage of human resources in the local industry. The results point to a wider contextual issue affecting efficient ICT uptake among the local 3PL SMEs, which lack of human resources remained one of the top factors. In light of these, we further recommend the introduction of hands-on programmes in the local school curriculums (e.g., erp4school SAP sponsored programme) as an ideal step to mitigate the lack of trained human resources in the industry.

Fourth, enact requisite policies that could stimulate the application of paperless logistics transactions across various industries in the region. This aligns with the evidence from the multiple case studies which indicate digital gaps within and across distinct industries investigated in this study. Of course, this calls for the formulation of relevant policies and regulations to stimulate ICT diffusion in the broader local transport and logistics, which would, in turn, enhance logistics performance.

Last, ensure that intervention programmes are collaborative and enforced, as demonstrated in the three-faced ICT diffusion framework. This means that transport and logistics-related projects should be embedded in a continuous framework through consensual agreement amongst the key players in the local logistics industry. It is based on the notion that when integration is fully in place, it can serve as a means to an end, where the end is to improve ICT diffusion in the local transport and logistics industry through, e.g., provision of adequate routes, market structure and overall facilitating conditions that would combine to stimulate intelligent logistics uptake in the region. This approach orients towards the development of necessary political will for accelerated sustainable development of the local transport and logistics industry. The next section covers concluding remarks.

8.4.2 Concluding remarks

In conclusion, while the Nigerian transport and logistics industry has a long history of instability and lack of performance, the on-going globalisation of supply chain integration/processes represents an opportunity to catalyse lasting solutions to mitigate locally-evolved issues affecting transport and logistics performance in the region. Up till now, infrastructural development in Nigeria has been handled by the three main tiers of government (local, state, and federal governments) in the region. With the increasing lack of enabling environment across industries in the local economy, the study advises a change in the manner transport and logistics-related projects are handled in the region. Specifically, there is an urgent need to root out political corruption and irregular intervention approaches from development schemes in the region, to be replaced by a model of cooperation and enforcement as established in this study. With these, a sustainable business environment can be enthroned, which would, in turn, breed improved logistics performance in the region (World Bank 2018, 2013).

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Appendix 1 – Data collection documents

Appendix 1 comprises the University of Leeds Ethics approval and data collection documents as follows:

- Appendix 1a: The University of Leeds Ethics approval document
- Appendix 1b: Informed consent document
- Appendix 1c: Application letter seeking for inclusion of the scoping study as an agenda during the CILT's 2016 AGM in Abuja, Nigeria
- Appendix 1d: A sample of the informed invitation letter
- Appendix 1e: A sample of the information document

Appendix 1a: The University of Leeds Ethics approval document

Research and Innovation Service
Level 11, Worsley Building
University of Leeds
Leeds, LS2 9NL
Tel: 0113 343 4873
Email: ResearchEthics@leeds.ac.uk



UNIVERSITY OF LEEDS

Anthony Ekene Ezenwa
Institute of Transport Studies
University of Leeds
Leeds, LS2 9JT

ESSL, Environment and LUBS (AREA) Faculty Research Ethics Committee

University of Leeds

22 February 2017

Dear Anthony

Title of study: Smart Logistics Diffusion amongst Supply Chain Networks in Emerging Markets: A Case of Nigeria 3PL SME/Micro Operators

Ethics reference: AREA 16-056

I am pleased to inform you that the above research application has been reviewed by the ESSL, Environment and LUBS (AREA) Faculty Research Ethics Committee and following receipt of your response to the Committee's initial comments, I can confirm a favourable ethical opinion as of the date of this letter. The following documentation was considered:

Document	Version	Date
AREA 16-056 Ethical review form -Lagos Nigeria (2).doc	1	29/11/2016
AREA 16-056 ethical questionnaire.pdf	1	29/11/2016
AREA 16-056ethical focus-group template.docx	1	29/11/2016
AREA 16-056 ethical review INFORMATION SHEET1.docx	1	29/11/2016
AREA 16-056 ethical request letter cilt.docx	1	29/11/2016
AREA 16-056 ethical invitation letter.docx	1	29/11/2016
AREA 16-056 ethical consent form.docx	1	29/11/2016
AREA 16-056 Fieldwork Assessment Form - Lagos Nogeria.docx	1	29/11/2016

AREA 16-056 approval proof for risk assessment.docx	2	23/01/2017
AREA 16-056 flight ticket1.pdf	2	23/01/2017
AREA 16-056 new consent form.docx	2	23/01/2017
AREA 16-056 new Information Sheet.docx	2	23/01/2017
AREA 16-056 new Invitation Letter.docx	2	23/01/2017
AREA 16-056 updated focus-group discussion template.docx	2	23/01/2017
AREA 16-056 updated Ethical review form docx.docx	2	23/01/2017
AREA 16-056 updated pre-focus group questionnaire.pdf	2	23/01/2017
AREA 16-056 updated risk assement.docx	2	23/01/2017
AREA 16-056 Updated survey questionnaire.pdf	2	23/01/2017

Committee members made the following comments about your application:

- There is still a confusion between depersonalization and anonymization in this form (depersonalization is normally used in relation to 'big data' and large amount of records rather small numbers of focus groups or interviews).
- For clarity please change focus group consent form. At the moment, the form contradicts itself because it states that data can be made confidential and anonymous but also cannot.

Please notify the committee if you intend to make any amendments to the information in your ethics application as submitted at date of this approval as all changes must receive ethical approval prior to implementation. The amendment form is available at <http://ris.leeds.ac.uk/EthicsAmendment>.

Please note: You are expected to keep a record of all your approved documentation, as well as documents such as sample consent forms, and other documents relating to the study. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two-week notice period if your project is to be audited. There is a checklist listing examples of documents to be kept which is available at <http://ris.leeds.ac.uk/EthicsAudits>.

We welcome feedback on your experience of the ethical review process and suggestions for improvement. Please email any comments to ResearchEthics@leeds.ac.uk.

Yours sincerely

Victoria Butterworth

Research Ethics Administrator, Research & Innovation Service

On behalf of Dr Kahryn Hughes, Chair, [AREA Faculty Research Ethics Committee](#)

CC: Student's supervisor

Appendix 1b: Informed consent document

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I hereby grant permission to use the information I provide as data in the PhD research study on Smart Logistics Diffusion Strategies amongst Supply Chain Networks in Emerging Markets: A Case of Nigeria SME/Micro 3PL. I allow publishing or presenting of the information provided in any public form. I understand that I have the right to refuse to answer any question or stop participating at any time without any reason. I am aware that the information provided will be kept confidential, and no one else except the researcher will have access to the information documented after the focus group discussion. I have been informed that focus group data is never fully anonymous because the people involved in the group discussion are potentially aware of who gave what response. I am also aware that once people participate in a focus group it is not possible to delete the data they have provided or withdraw it because it is shared with a group. Finally, I understand that since focus group are be undertaken, information provided could be anonymised but potentially identifiable.

Name of the participants (please print)

Signature.....

Date (dd / mm / yy)

Appendix I c: Application letter seeking for inclusion of the scoping study as an agenda during the CILT's 2016 AGM in Abuja, Nigeria

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Maj Gen UT Usman (rtd), FCILT

The National President (NP)

CILT, Nigeria

Dear Sir,

RE: APPLICATION FOR INCLUSION OF A 'FOCUS GROUP DISCUSSION' OF A PhD RESEARCH AS AN AGENDA IN THE 2016 CILT AGM.

I write to seek your executive approval of inclusion a *focus group discussion* of my PhD research as an agenda in the forthcoming 2016 CILT AGM.

I am member of the Institute (Reg. NO: 203600) and a PhD research student at the University of Leeds (Institute for Transport Studies), United Kingdom under the supervision of Dr Anthony Whiteing and Daniel Johnson. I am currently undertaking a research that considers the "diffusion of smart logistics amongst supply chains in emerging economies; a case of Nigeria third-party logistics (SMEs) firms".

As a major stakeholder in the industry in Nigeria and Africa as a whole, it is important to know your view regarding issues surrounding diffusion of intelligent logistics amongst supply chains in Nigeria and the African continent. Result from the discussion would be very helpful to validate the proposed survey that shall be subsequently conducted on the subject.

The general objective of the research is to improve our understanding of intelligent logistics processes through definitions of boundaries of the dimensions of the conceptual framework. And to provide theoretical model that would enable intelligent policy makers, stakeholders, software developers, and logistics service providers maximize their insight on any proposed new smart logistics for proper evaluation prior to their final adoption.

The attached is my supervisor's recommendation letter and curriculum vitae.

Yours Faithfully



Anthony Ezenwa (Reg. NO: 203600)



Appendix Id: A sample of the informed invitation letter

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UNIVERSITY OF LEEDS

Chattered Institute of Logistics and Transport

Nigeria

15b Awolowo Road,

South-west, Ikoyi Lagos

Date.....

Dear.....

With reference to the application dated..... to the Institute, I would like to invite you to participate in the *focus-group discussion*-based research study. A brief description of the intent of the research and an outline of the study is provided below.

Research Study Introduction

I am conducting research on *Smart Logistics Diffusion Strategies amongst Supply Chain Networks in Emerging Markets: A Case of Nigeria SME/Micro 3PL*. My work is based on a problem-oriented approach with the intent to recommend research-based solution to the challenges of adopting intelligent devices amongst SME/Micro third-party logistics operators in the emerging markets, particularly Nigeria. This research intends to take into account relationship among set of independent variables- Consumer (SME/Micro 3PL) readiness, Scope of business (activities), Facilitating conditions (Environment); Mediation variables- Perceived usefulness of ICT, Perceived ease of use of ICT; and set of dependent variables- ICT acquisition and Decision quality. To achieve the specified objectives, the research methodology has been devised and both quantitative (questionnaire survey) and qualitative (focus-group discussion and case study survey) will be adopted for data acquisition. At exploratory stage of the research, I am conducting focus-group discussion with the stake-holders in the industry to map out the potential strategies to improve logistics/services in the emerging markets.

Selection of Participants

You have been selected to participate in the focus-group discussion study as a member of Chattered Institute of Logistics and Transport that is responsible for transport and logistics planning, training of professionals and formulation of transport and logistics related policies. Your experience as a logistics and transport specialist can offer insight to the logistics and freight problems we intend to resolve via this research.

Involvement in the Research

Taking part in the research is entirely voluntary and you may choose to discontinue or withdraw from the research at any time without providing a reason. The research will involve discussions to understand how you feel or think about the subject. Sets of formalised specific questions will be addressed while the discussion lasts.

The information you may provide during the proposed discussion will be kept confidential, and no one else except the researcher will have access to the information that will be documented during the focus-group discussion. However, it is important to inform you that focus-group data is never fully anonymous because the people that will be involved in the discussion will potentially be aware of who gave what response. It is also worthy to note that once people participate in a focus group discussion it is not possible to delete the data that have been provided because it might have been shared with other group members. Above all, since focus-group discussion is to be undertaken, information provided could be anonymised but might be potentially identifiable.

Procedure

At the beginning of the discussion, you will be asked to sign the consent form to indicate that you give me your consent to participate in the study and allow me to record and transcribe your input in the discussion to assist in developing my understanding of logistics problems in Nigeria. The discussion will take about 50 to 70 minutes. The discussion will be preceded by completing pre-focus questionnaire. The focus-group discussion template is prepared within the framework of perceived logistics challenges in Nigeria; the potential solutions; ICT adoption related issues. During the interview, I will take some notes of the things that you say and will also record it in the audiotape for transcription and coding at a later date. The outcome of the study will form a part of my PhD thesis and will be published in academic journals. Your participation is completely voluntary, but should you feel concerned you have the right to stop participating at any time. Any part of the interview that you want removed will be deleted.

It is hoped that you will enjoy taking part in the study. The tentative date for the discussion is.....; during the..... Annual General Meeting of the Institute. Should you have any question or concerns about the study or procedure, please feel free to contact me. I can be reached on +447708852676 or via email at tsaee@leeds.ac.uk . My field supervisor can also be reached in Nigeria on +2347031033257

Thank you for your assistance and look forward to meeting you

Yours sincerely

Anthony Ezenwa

Appendix 1e: A sample of the information document

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UNIVERSITY OF LEEDS

SMART LOGISTICS DIFFUSION STRATEGIES AMONGST SUPPLY CHAIN NETWORKS IN EMERGING MARKETS: A CASE OF NIGERIA SME/MICRO 3PL

You are kindly invited to take part in a *focus group discussion* of the named research project. Please take some time to read through the following information carefully, before deciding to take part. It is important for you to understand the purpose of the research and what it will involve. If you require any further information, please do not hesitate to contact me.

Research Study Introduction

I am conducting research on *Smart Logistics Diffusion Strategies amongst Supply Chain Networks in Emerging Markets: A Case of Nigeria SME/Micro 3PL*. My work is based on a problem-oriented approach with the intent to recommend research-based solution to the challenges of adopting intelligent devices amongst SME/Micro third-party logistics operators in the emerging markets, particularly Nigeria. This research intends to take into account relationship among set of independent variables- Consumer (SME/Micro 3PL) readiness, Scope of business (activities), Facilitating conditions (Environment); Mediation variables- Perceived usefulness of ICT, Perceived ease of use of ICT; and set of dependent variables- ICT acquisition and Decision quality. To achieve the specified objectives, the research methodology has been devised and both quantitative (questionnaire survey) and qualitative (focus-group discussion and case study survey) will be adopted for data acquisition. At exploratory stage of the research, I am conducting focus-group discussion with the stake-holders in the industry to map out the potential strategies to improve logistics/services in the emerging markets.

Selection of Participants:

The participants are to be recruited from the representatives of the logistics practitioners; the researchers/academia and the policy makers. Their views and contributions at this stage of the research will be inestimably valued.

Involvement in the Research:

Taking part in the research is entirely voluntary and you may choose to discontinue or withdraw from the research at any time without providing a reason. The research will involve discussions to understand how you feel or think about the subject. Sets of formalised specific questions will be addressed while the discussion lasts.

The information you may provide during the proposed discussion will be kept confidential, and no one else except the researcher will have access to the information that will be documented during

the focus-group discussion. However, it is important to inform you that focus-group data is never fully anonymous because the people that will be involved in the discussion will potentially be aware of who gave what response. It is also worthy to note that once people participate in a focus group discussion it is not possible to delete the data that have been provided because it might have been shared with other group members. Above all, since focus-group discussion is to be undertaken, information provided could be anonymised but might be potentially identifiable.

Data Protection and Confidentiality:

All personal information gathered during the course of the research project will be kept strictly confidential, and you will not be identified personally in any report or publications that result from this work.

The audio recording made during the interview will be used for analysis and transcription purposes only, no other use will be made without permission and no one outside the project will have access to the original recordings. All the information provided by the respondents/participants will be kept safe by the researcher. It would be locked in a safe locker or cabinet and only the researcher will have access to it. Example of materials that be stored in the safe cabinet/locker include the consent forms, information sheet, and the invitation sheets. Alternatively, electronic data will be encrypted and locked with strong password that would only be known by the researcher.

Dissemination of Results:

The results of this research will be written up in my doctoral thesis, and hopefully published in academic journal articles.

Further Information:

If you have any further information, please contact either my supervisors or myself.

- Dr Anthony Whiteing (Supervisor)
Director of Student Education, ITS University of Leeds
A.E.Whiteing@its.leeds.ac.uk +44 (0)113 34 35359
- Daniel Johnson (Supervisor)
Senior Research Fellow, ITS University of Leeds
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- Ezenwa, Anthony Ekene
TETFund PhD Scholar,
Institute for Transport Studies, University of Leeds
tsaee@leeds.ac.uk +44(0)7708852676

You will be provided a copy of this information sheet and a signed consent form to keep.

Thank you for taking the time to participate in this research project.

Appendix 2 -Scoping study

Appendix 2 covers the guiding questions for the scoping (phase 1) study

2.1 Introduction and informed consent information

You are welcome and thank you for volunteering to participate in this focus group discussion, which is undertaken as part of the PhD research at the Institute of Transport Studies, University of Leeds, United Kingdom.

My name is Ezenwa Anthony Ekene, PhD research student of the University and also a member of CILT, Nigeria. Here with me are;and, they will assist me in conducting this meeting.

Please, I would like you to introduce yourselves.

It is important to let you know that your invitation is based on your experience and expertise as transport and logistics planners, trainers, practitioners and policy formulators in the field. Your participation is voluntary and you are free to withdraw at any time without giving reason and without any negative consequences. As courtesy demands, you are expected to put your mobile phones in silent mode.

The subject of discussion is **“Information and Communication Technology (ICT) dissemination in road freight and logistics in Nigeria”**.

This research project is for academic purpose only. There is no wrong or right answer to questions. Feel free to express yourselves even when your opinion may be different from what others have to say. The essence of the discussion is to explore the immediate feeling of professionals like you about the research topic and how it may affect the immediate research environment. Your participation in this focus group discussion will enable us capture the problem(s) associated in the research area.

2.2 Opening Question

2.2.1 Do you think that there are challenges in the effective and efficient distribution/delivery of goods and service in Nigeria?

2.3 Transition Questions

2.3.1 Do you consider the usage of ICT to be useful in improving the logistics/freight process in Nigeria or otherwise?

2.3.2 What is your opinion concerning direct order placement by individuals from manufacturer's warehouses, resulting to small order placement and demand for Just-in-Time (JIT) delivery?

2.3.3 What is your view about effective involvement of 3PL Micro/SME operators in the logistics service industry in Nigeria and do you think they are constrained in any way?

2.4 Main Questions

2.4.1 What is your view about the usefulness and ease of use of commonly used ICTs in the logistics sector in Nigeria?

2.4.2 Do you think that present freight and logistics situation in Nigeria can be improved via adoption of advanced ICTs even among the small-scale operators?

2.4.3 Do you think that most 3PL SME companies in Nigeria are ready to adopt advanced ICTs in their operations?

2.4.4 Do you think that the scope of business of 3PL SME operators is related to the extent they adopt ICTs in their operations?

2.4.5 What extent do you think that the conditions of transport and logistics public infrastructures facilitate the adoption of ICT, especially among 3PL SME operators in Nigeria?

2.4.6 Do you think that **experience and frequency** of use of smart logistics devices by the logistics operators will affect the effect of (i) scope of business of the operators; (ii) their readiness to adopt advanced smart solutions and (iii) to cope with the present transport and logistics public infrastructures.

2.4.7 What is your opinion concerning the extent USEFULNESS AND EASE USE of smart logistics solutions determine ICT acquisition and its impact in the decision quality, especially among 3PL SME operators in Nigeria?

2.5 Ending Questions

2.5.1 In the light of your knowledge and experience, what improvement measure do you think are the most appropriate to raise the level of participation of 3PL SME operators in Nigeria?

2.5.2 Which steps do you think should be taken to improve the extent of diffusion/dissemination of smart solution among 3PL SME operators in Nigeria? Since it seems they would be thrown out of business in the nearest future in they fail to align to the wave of automation of businesses, especially in logistics industry.

2.5.3 Finally, are there other points, recommendations or opinions you would want to share?

Appendix 3 -Questionnaire survey

This section covers the draft of the questionnaire survey

3.1: Introduction

Dear Respondent,

I write to invite you participate in this survey, which is being undertaken as part of the PhD research at the Institute for Transport Studies, University of Leeds, United Kingdom. The purpose of the survey is to investigate mechanisms influencing ICT diffusion in the Nigeria's transport/logistics industry using evidence of the small and medium third-party logistics operators (3PL SMEs) in the region. Your responses will be treated in strictest confidentiality and will be used for academic purposes only. Your participation is completely voluntary, but should feel concerned, you have the right to stop participation at any time.

The questionnaire will take you between 17 – 23 minutes to complete.

Many thanks for your anticipated considerations

Yours Sincerely

Anthony E Ezenwa

PhD Research Student, Institute for Transport Studies, University of Leeds, United Kingdom

tsaee@leeds.ac.uk +44(0)7708852676

3.2: Demographic information of respondents

3.2.1 Company name (optional)						
3.2.2 Contacts (optional)	1.Address: 2. Emails: 3. Telephone (mobile) number:					
3.2.3 Position/role of the respondent	1.General Manger/Managing Director/CEO () 2. Assistant General Manager () 3. Operations Manager () 4. Other management staff () 5. Prefer not to say () 6. Others:					
3.2.4 Age						
3.2.5 Gender	1. Male () 2. Female () 3. Prefer not to say () 4. Others					
3.2.6 Years of ICT experience						
3.2.7 Education status	1. None () 2. Primary () 3. Secondary () 4. Higher education () 5. Postgraduate () 6. Others:					
3.2.8 Frequency of use of ICT	1. Often () 2. Daily () 3. Weekly () 4. Rarely () 5. Nil ()					
3.2.9 Areas of application of ICT tools	1. Office documentation () 2. Communication 3. Transaction 4. Tracking/tracing of transport operations 4. Inventory & warehouse management					
3.2.10 Average size of employees						
3.2.11 Minimum education qualification drivers	1. None () 2. First School Leaving Certificate () 3. High School 4. First degree & above ()					
3.2.12 Minimum ICT experience of drivers	1. None () 2. Low () 3. Moderate () 4. Advanced ()					
3.2.13 Sources of financial supports	1. Commercial bank () 2. Government interventions () 3. Personal savings () 4. Shareholders ()					
3.2.14 Average fleet size						
3.2.15 Affiliated supply chain						
3.2.16 Years of existence of firm						
3.2.17 ICT profile	ICT tools	Use	Plan to use	No plans	Undecide	Others
	Telephone					
	Company website					
	Vehicle positioning system (GPS)					

	Automatic picking system (APS)					
	Frequency identification system (RFID)					
	Land area network (LAN)					
	Enterprise resource planning (ERP)					
	Customer relationship management (CRM)					
	Barcode scanning for product tracking					
	Electronic invoice					
	Electronic route planning					
	Automatic equipment identification (AEI)					
	Warehouse management system (WMS)					
	Onboard data recorder					
	Freight and fleet manager					

3.3: Issues regarding usefulness of ICT in your firm

Items	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
3. 3.1 Adoption of ICT in your operations increases your capacity					
3.3.2 Adoption of ICT in your operations increases your productivity					
3.3.3 ICT adoption enhances the satisfaction of your customers					
3.3.4 ICT adoption makes it easier to accomplish tasks in your firm					
3.3.5 Applying ICT in your operations saves time					
3.3.6 ICT adoption is generally useful in your firm					

3.4: Issues regarding ease of use of ICT in your firm

Items	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
3.4.1 Learning to apply ICT in your firm is always easy					
3.4.2 Procuring new ICT tools to					

enhance your operations is always easy					
3.4.3 ICT tools are easy to use in your firm					
3.4.4 Your employees find it easy to use ICT					
3.4.5 Your employees feel engaged when using ICT tools					

3.5: Issues regarding scope of business in your firm

Items	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
3.5.1 There is existing business continuity plan in your firm					
3.5.2 There is department or someone in your organisation that is responsible for your business continuity plan					
3.5.3 Your firm encourages other partners to have business continuity plan					
5.4 There are several methods of communication whenever there are service disruptions					

3.6: Issues regarding facilitating condition in your firm

Items	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
3.6.1 The use of ICT is encouraged in your supply chain by the government					
3.6.2 There are measures in your supply chain that control entry and exit of 3PLs					
3.6.3 The condition of the road infrastructure in Nigeria facilitates your usage of ICT					
3.6.4 Limitations of usage of ICT in your firm affects your operations					
3.6.5 Your firm has the requisite fund to acquire appropriate ICT tools for your operations					

3.7: Issues regarding readiness to adopt ICT in your firm

Items	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
3.7.1 Your employees see new ICT tools to be mentally stimulating					
3.7.2 There are ICT software that					

allow you tailor your operations to fit your specific needs					
3.7.3 Your management considers it safe to conduct business online transactions					
3.7.4 Your employees are not embraced when struggling to cope with using newly introduced ICT resources in your firm					
3.7.5 Your firm is usually among the first group in your supply chain that adopts intelligent solutions					

3.8: Issues concerning ICT acquisition in your firm

Items	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
3.8.1 There are ICT tools owned by your firm that are not regularly in use in your operations					
3.8.2 There are ICT personnel in your firm that are engaged on third-party basis					
3.8.3 The planning process for ICT acquisition in your firm includes supports for the device maintenance throughout its entire life cycle					
3.8.4 Your firm has trained ICT and software management personnel					
3.8.5 The software-related contractual requirements meet the expectations of your firm					

3.9: Issues regarding decision quality in your firm

Items	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
3.9.1 ICT applications improve your management decision quality					
3.9.2 ICT applications guide your management in taking right operational decisions (e.g., the extent of cooperation with other partners)					
3.9.3 ICT applications enable your management to take right customer-related decisions (e.g., change in demand/taste)					
3.9.4 ICT reduces the extent of time taken in deliberations in your firm					
3.9.5 ICT applications help your firm to make wide consultations before					

making decisions					
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Appendix 4 -quantitative analyses outputs

This section covers some quantitative analyses outputs:

- Appendix 4a: Exploratory factor analysis (EFA) outputs
- Appendix 4b: Confirmatory factor analysis (CFA) outputs
- Appendix 4c: Structural model outputs
- Appendix 4d: Bootstrapping (indirect effects) test outputs

Appendix 4a: Exploratory factor analysis (EFA) outputs

Table 4a (i): KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.914
Bartlett's Test of Sphericity	Approx. Chi-Square	7092.450
	df	561
	Sig.	< 0.001

Table 4a (ii): Goodness-of-fit Test

Chi-Square	df	Sig.
555.797	344	< 0.001

Table 4a (iii): Multicollinearity tests

Independent variable	Dependent variable	VIF value
Scope of business	Facilitating condition	1.196
	Consumer readiness	1.196
Consumer readiness	Facilitating condition	1.292
	Scope of business	1.292
Facilitating condition	Scope of business	1.340
	Consumer readiness	1.340

Table 4a (iv): curve estimation tests

Dependent variable	Independent variable	F-value
ICT adoption	Perceived usefulness	218.728
ICT adoption	Perceived ease of use	184.746
Decision quality	Perceived usefulness	184.084
Decision quality	Perceived ease of use	103.050
Perceived usefulness	Consumer readiness	54.311
Perceived ease of use	Consumer readiness	133.190
Perceived usefulness	Scope of business	47.982
Perceived ease of use	Scope of business	61.461
Perceived usefulness	Facilitating condition	28.439
Perceived ease of use	Facilitating condition	29.021

p. value < 0.001

Table 4a (v): Communalities

Items	Initial	Extraction
readi_1	.511	.505
readi_2	.690	.790
readi_3	.575	.583

readi_4	.612	.612
readi_5	.573	.557
scope_1	.450	.509
scope_2	.507	.602
scope_3	.444	.493
scope_4	.463	.491
faci_1	.633	.635
faci_2	.726	.747
faci_3	.776	.825
faci_4	.739	.752
faci_5	.726	.742
useful_1	.700	.645
useful_2	.790	.778
useful_3	.826	.845
useful_4	.859	.889
useful_5	.730	.686
useful_6	.630	.560
ease_1	.584	.573
ease_2	.742	.780
ease_3	.684	.704
ease_4	.740	.778
ease_5	.627	.629
ict_aqu1	.572	.559
ict_aqu2	.561	.600
ict_aqu3	.519	.558
ict_acq4	.559	.587
ict_aqu5	.408	.355
dec_2	.701	.708
dec_3	.751	.837
dec_4	.627	.594
dec_5	.658	.642

*Extraction Method: Maximum Likelihood

Table 4a (vi): Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	11.301	33.238	33.238	10.777	31.696	31.696	7.887
2	3.796	11.164	44.402	3.418	10.052	41.748	5.498
3	2.816	8.284	52.686	2.555	7.514	49.261	6.918
4	2.117	6.227	58.913	1.817	5.344	54.605	6.076
5	1.770	5.205	64.118	1.438	4.229	58.834	6.198
6	1.642	4.829	68.947	1.327	3.901	62.735	7.258
7	1.153	3.391	72.338	.821	2.413	65.148	4.494
8	.707	2.079	74.418				
9	.644	1.895	76.313				
10	.640	1.883	78.196				
11	.555	1.631	79.827				
12	.509	1.498	81.325				
13	.495	1.457	82.782				
14	.472	1.388	84.171				
15	.449	1.322	85.492				
16	.435	1.279	86.771				
17	.402	1.182	87.953				
18	.392	1.154	89.107				
19	.372	1.095	90.202				
20	.337	.991	91.193				
21	.315	.927	92.119				
22	.309	.908	93.027				
23	.298	.877	93.904				
24	.263	.773	94.677				
25	.260	.766	95.442				
26	.232	.681	96.123				

27	.227	.668	96.791				
28	.205	.603	97.394				
29	.201	.591	97.985				
30	.168	.495	98.479				
31	.153	.450	98.930				
32	.144	.423	99.352				
33	.132	.390	99.742				
34	.088	.258	100.000				

Table 4a (vii): Factor loading and Cronbach's Alpha scores

Items	Factor loadings						
	1	2	3	4	5	6	7
Cronbach's Alpha	0.940	0.930	0.911	0.880	0.896	0.836	0.804
useful_4	.975						
useful_3	.950						
useful_5	.824						
useful_2	.790						
useful_1	.761						
useful_6	.720						
faci_3		.925					
faci_5		.880					
faci_4		.865					
faci_2		.854					
faci_1		.738					
ease_2			.912				
ease_4			.884				
ease_3			.804				
ease_5			.777				
ease_1			.649				
readi_2				.972			
readi_3				.748			
reeadi_5				.740			
readi_4				.710			
readi_1				.699			
dec_3					.930		
dec_2					.815		
dec_4					.737		
dec_5					.710		
ict_acq2						.785	
ict_acq3						.713	
ict_acq1						.706	
ict_acq4						.658	
ict_acq5						.496	
scope_2							.775
scope_3							.710
scope_1							.697
scope_4							.641

*Extraction method: Maximum likelihood; Rotation method: ProMax with Kaiser Normalization; Rotation converged in 7 iterations

Appendix 4b: Confirmatory factor analysis (CFA) outputs

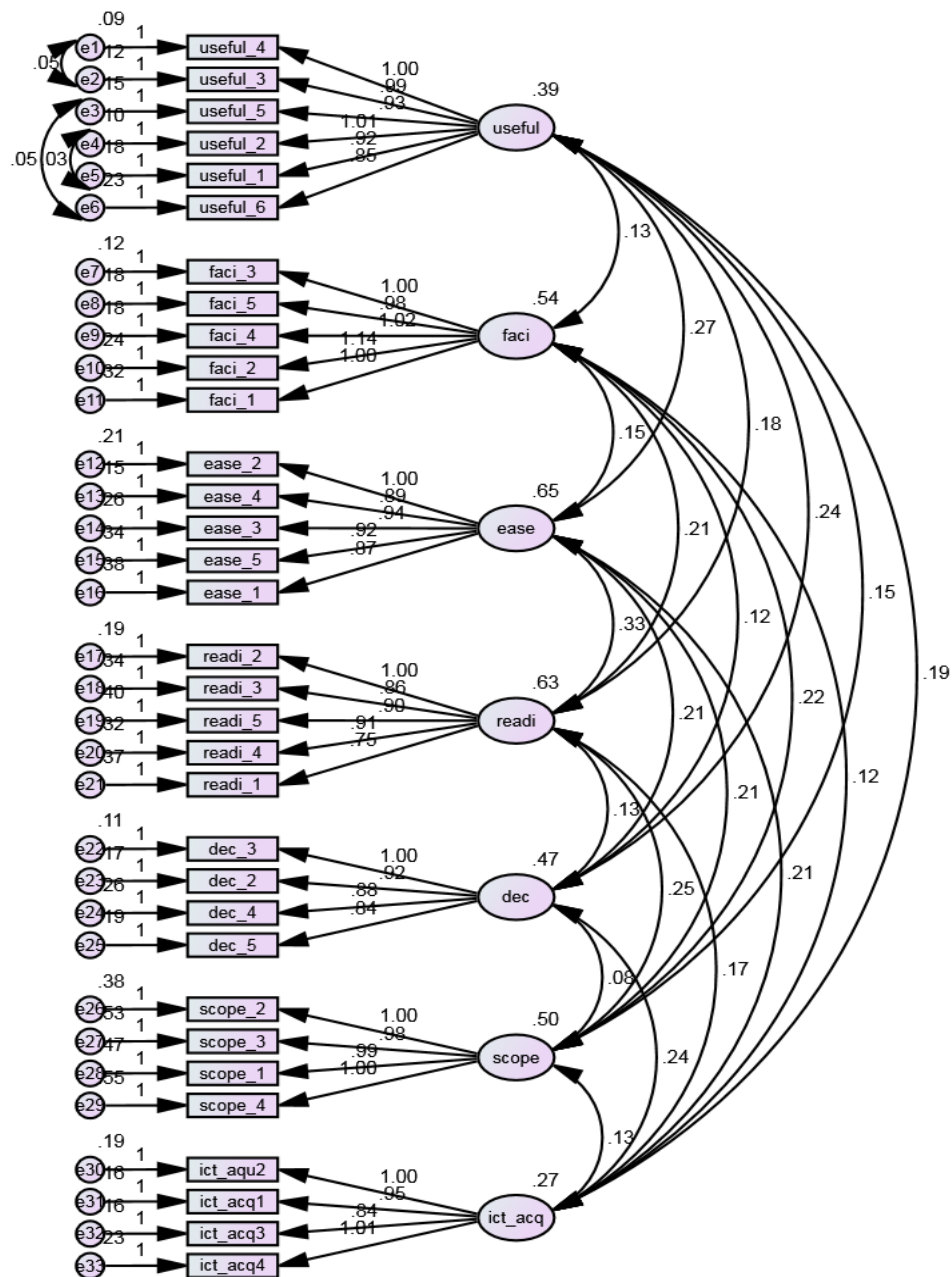


Figure 4b (i): CFA initial model

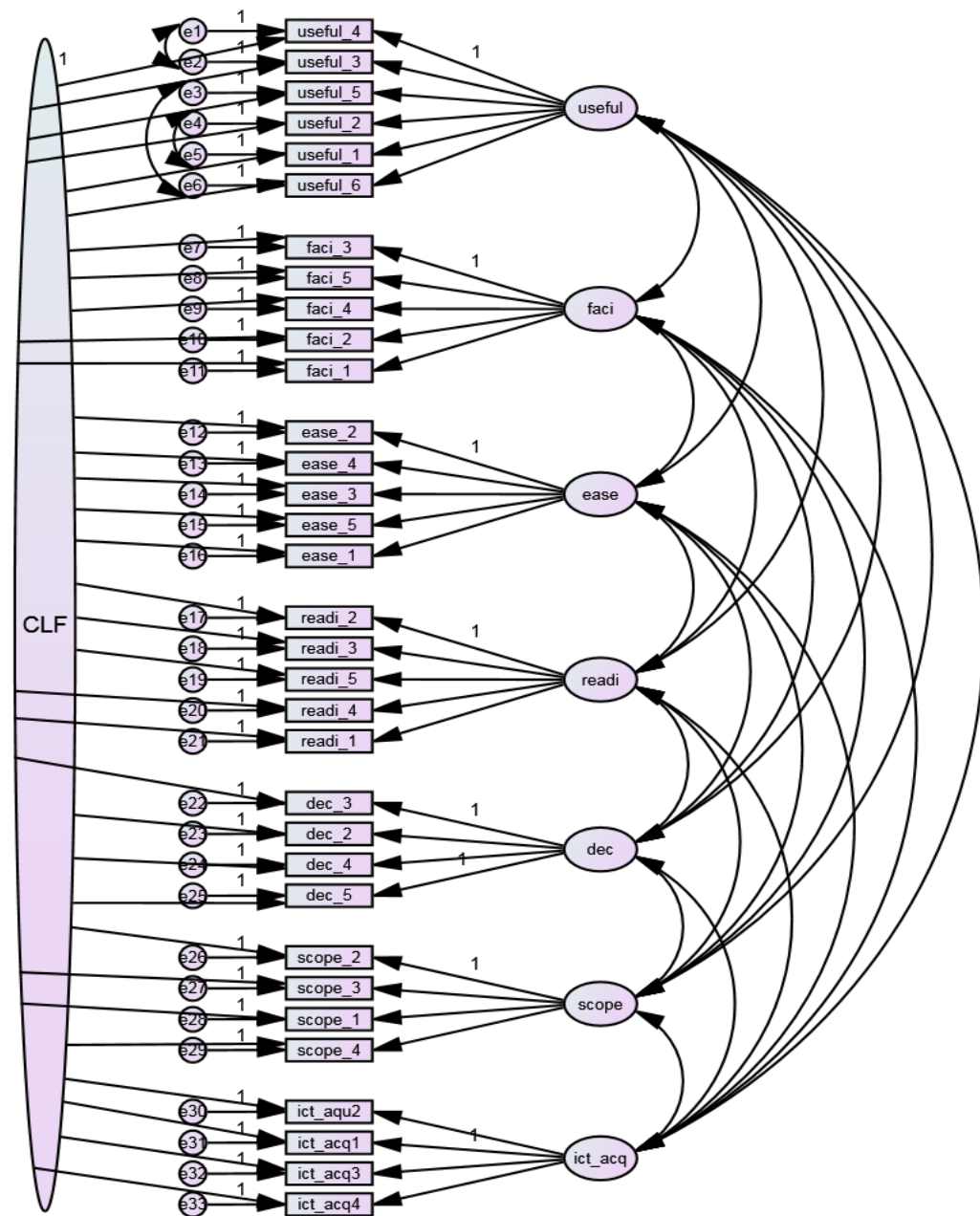


Figure 4b (ii): CLF model for common bias analysis

Appendix 4c: Structural model outputs

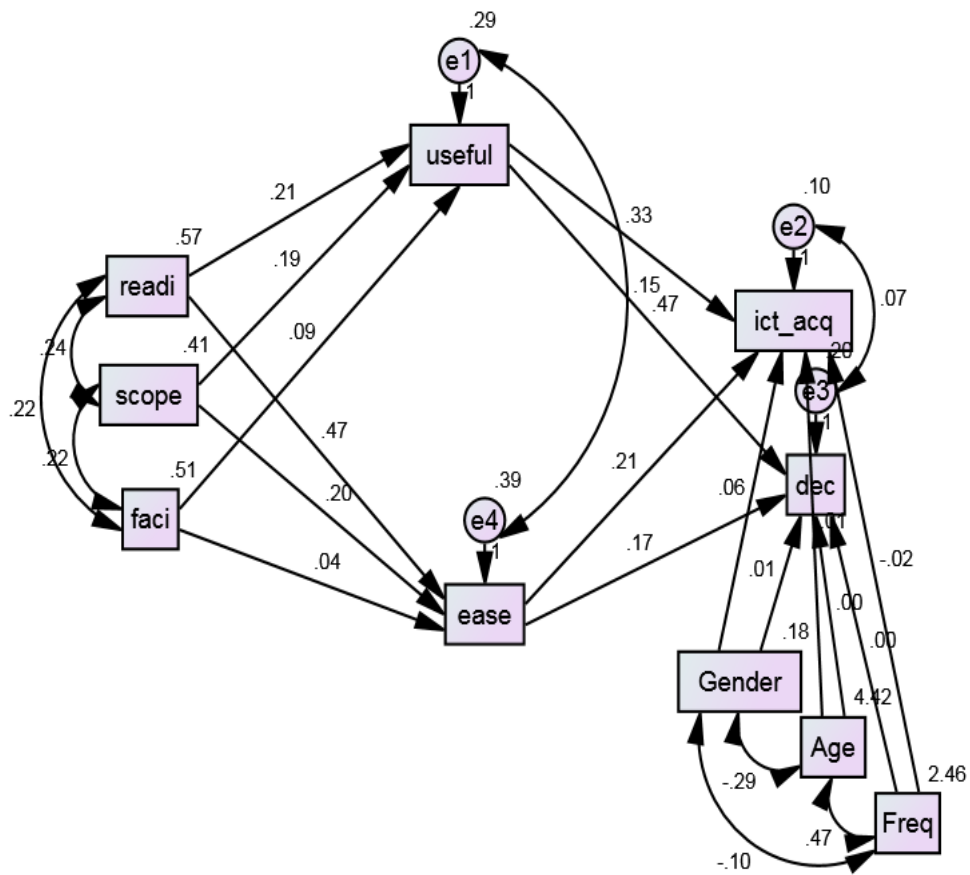


Figure 4c (i): Initial causal model

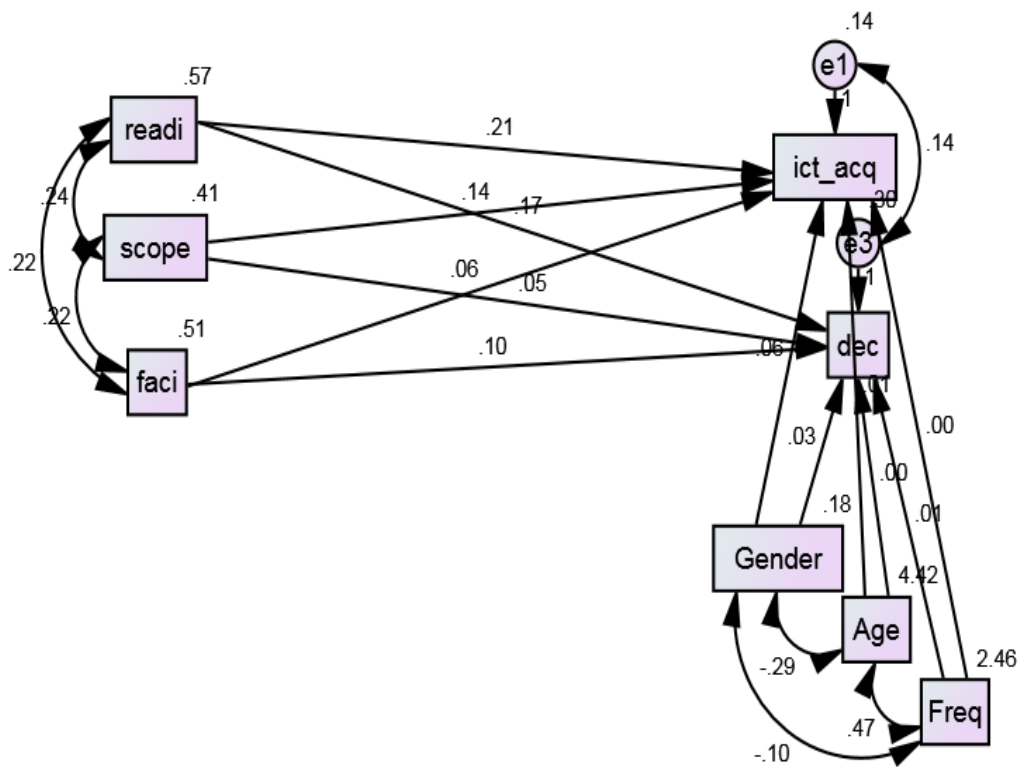


Figure 4c (ii): Direct without mediation tests

Table 4c (i): Direct without mediation non-standardised regression weight outputs

Items			Estimate	S.E.	C.R.	P
ict_acq	<---	Gender	.061	.055	1.103	.270
dec	<---	Gender	.025	.080	.317	.751
ict_acq	<---	Age	.006	.011	.525	.600
dec	<---	Age	.005	.016	.305	.760
dec	<---	Freq	.015	.021	.720	.472
ict_acq	<---	Freq	.001	.014	.076	.939
ict_acq	<---	readi	.212	.035	6.123	***
dec	<---	readi	.173	.050	3.436	***
ict_acq	<---	scope	.136	.042	3.210	.001
dec	<---	scope	.048	.061	.775	.439
ict_acq	<---	faci	.059	.036	1.646	.100
dec	<---	faci	.097	.052	1.856	.063

Table 4c (ii): Direct without mediation standardised regression weight outputs

Items			Estimate
ict_acq	<---	Gender	.058
dec	<---	Gender	.019
ict_acq	<---	Age	.027
dec	<---	Age	.018
dec	<---	Freq	.040
ict_acq	<---	Freq	.004
ict_acq	<---	readi	.357
dec	<---	readi	.224
ict_acq	<---	scope	.194
dec	<---	scope	.053
ict_acq	<---	faci	.094
dec	<---	faci	.119

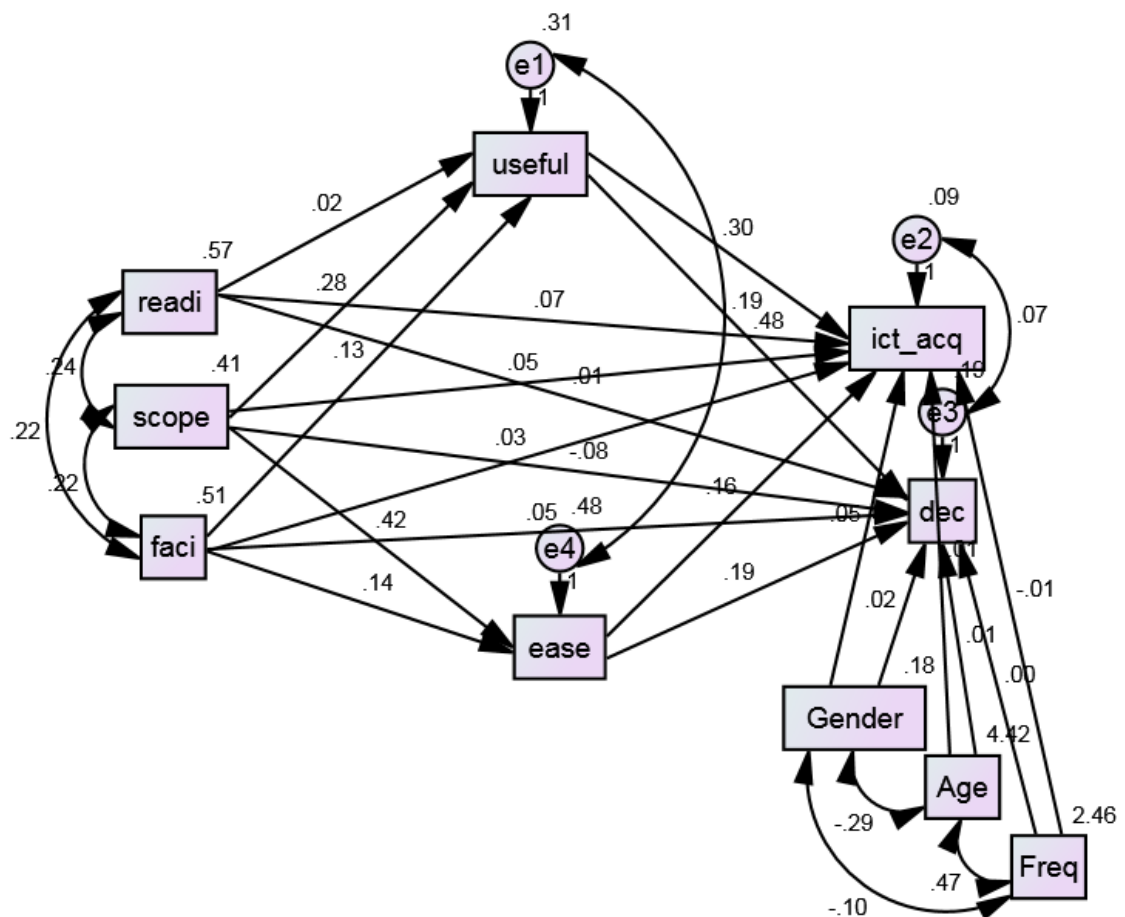


Figure 4c (iii) A sample of direct with mediation tests (CR/PU/IA)

Table 4c (iii): Direct with mediation non-standardised regression weight outputs

Items			Estimate	S.E.	C.R.	P
useful	<---	readi	.020	.044	.446	.656
ease	<---	scope	.422	.071	5.915	***
useful	<---	faci	.127	.053	2.413	.016
useful	<---	scope	.276	.061	4.536	***
ease	<---	faci	.142	.064	2.209	.027
ict_acq	<---	useful	.301	.037	8.196	***
dec	<---	useful	.478	.053	8.949	***
ict_acq	<---	ease	.159	.029	5.421	***
dec	<---	ease	.185	.043	4.328	***
ict_acq	<---	Gender	.054	.044	1.237	.216
dec	<---	Gender	.017	.064	.266	.790
ict_acq	<---	Age	.006	.009	.626	.532
dec	<---	Age	.005	.013	.395	.693
dec	<---	Freq	-.003	.017	-.191	.849
ict_acq	<---	Freq	-.012	.011	-1.046	.296
ict_acq	<---	readi	.075	.028	2.685	.007
dec	<---	readi	-.013	.041	-.325	.745
ict_acq	<---	scope	.048	.036	1.348	.178
dec	<---	scope	-.078	.052	-1.499	.134
ict_acq	<---	faci	.027	.029	.912	.362
dec	<---	faci	.048	.043	1.129	.259

Table 4c (iv): Direct with mediation standardised regression weight outputs

Items			Estimate
useful	<---	readi	.025
ease	<---	scope	.354
useful	<---	faci	.149
useful	<---	scope	.293
ease	<---	faci	.132
ict_acq	<---	useful	.414
dec	<---	useful	.497
ict_acq	<---	ease	.278
dec	<---	ease	.244
ict_acq	<---	Gender	.053
dec	<---	Gender	.013
ict_acq	<---	Age	.027
dec	<---	Age	.019
dec	<---	Freq	-.009
ict_acq	<---	Freq	-.043
ict_acq	<---	readi	.128
dec	<---	readi	-.017
ict_acq	<---	scope	.071
dec	<---	scope	-.086
ict_acq	<---	faci	.043

dec	<---	faci	.059
-----	------	------	------

Table 4C (v): Bootstrapping outputs (CR -U- IA/DQ)

	Freq	Age	Gender	faci	scope	readi	ease	useful
ease
useful
dec020	.008	.767	...	...
ict_acq018	.006	.825	...	...

Table 4c (vi): Bootstrapping outputs (SB -PEOU- IA/DQ)

	Freq	Age	Gender	faci	scope	readi	ease	useful
ease
useful
dec015	.112	.011	...	...
ict_acq041	.112	.009	...	...

Table 4c (vii): Bootstrapping outputs (FC – PU- IA/DQ)

	Freq	Age	Gender	faci	scope	readi	ease	useful
ease
useful
dec103	.009	.016	...	...
ict_acq108	.011	.013	...	...

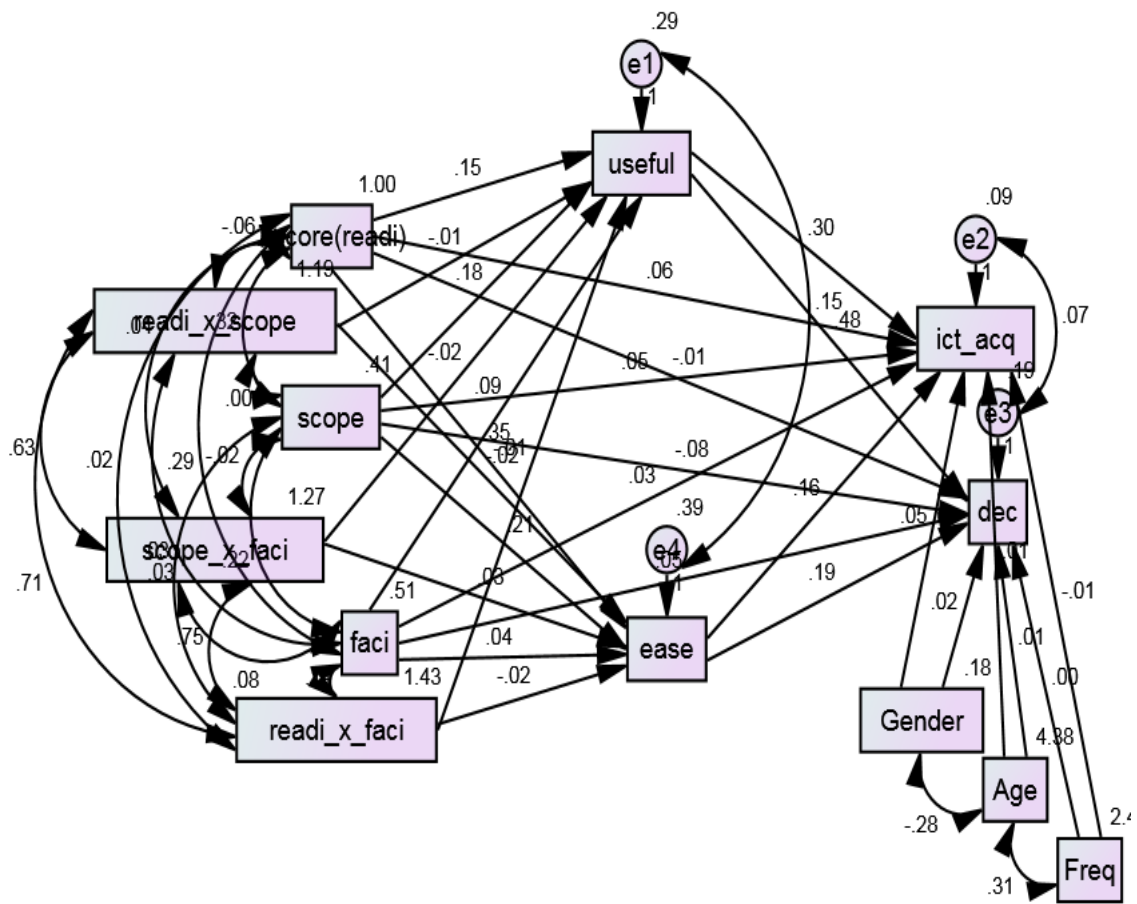


Figure 4c (iv): Two-way interaction effects analyses outputs

Table 4c (viii): The non-standardised regression weight of interaction analysis

			Estimate	S.E.	C.R.	P
useful	<---	Zreadi	.155	.038	4.108	***
ease	<---	scope	.205	.070	2.925	.003
useful	<---	faci	.093	.052	1.775	.076
ease	<---	Zreadi	.349	.043	8.050	***
useful	<---	scope	.184	.061	3.027	.002
ease	<---	faci	.040	.060	.661	.508
useful	<---	readi_x_scope	-.005	.036	-.139	.890
ease	<---	readi_x_scope	-.015	.042	-.364	.716
useful	<---	scope_x_faci	-.020	.035	-.565	.572
ease	<---	scope_x_faci	.030	.041	.736	.462
useful	<---	readi_x_faci	-.010	.034	-.294	.769
ease	<---	readi_x_faci	-.025	.040	-.626	.531
ict_acq	<---	useful	.301	.037	8.196	***
dec	<---	useful	.478	.053	8.949	***
ict_acq	<---	ease	.159	.032	5.007	***
dec	<---	ease	.185	.046	3.997	***
ict_acq	<---	Gender	.054	.044	1.251	.211
dec	<---	Gender	.017	.063	.269	.788
ict_acq	<---	Age	.006	.009	.626	.532
dec	<---	Age	.005	.013	.395	.693
dec	<---	Freq	-.003	.016	-.193	.847
ict_acq	<---	Freq	-.012	.011	-1.059	.290
ict_acq	<---	Zreadi	.056	.023	2.424	.015
dec	<---	Zreadi	-.010	.034	-.294	.769
ict_acq	<---	scope	.048	.035	1.394	.163
dec	<---	scope	-.078	.050	-1.550	.121
ict_acq	<---	faci	.027	.029	.918	.358
dec	<---	faci	.048	.042	1.137	.256

Table 4c (ix): The standardised regression weight of interaction analyses outputs

			Estimate
useful	<---	Zreadi	.254
ease	<---	scope	.172
useful	<---	faci	.109
ease	<---	Zreadi	.455
useful	<---	scope	.195
ease	<---	faci	.037
useful	<---	readi_x_scope	-.009
ease	<---	readi_x_scope	-.022
useful	<---	scope_x_faci	-.037
ease	<---	scope_x_faci	.044
useful	<---	readi_x_faci	-.020
ease	<---	readi_x_faci	-.039
ict_acq	<---	useful	.407
dec	<---	useful	.499
ict_acq	<---	ease	.272
dec	<---	ease	.244
ict_acq	<---	Gender	.052
dec	<---	Gender	.013
ict_acq	<---	Age	.026
dec	<---	Age	.019
dec	<---	Freq	-.009
ict_acq	<---	Freq	-.042
ict_acq	<---	Zreadi	.125
dec	<---	Zreadi	-.017
ict_acq	<---	scope	.069
dec	<---	scope	-.086
ict_acq	<---	faci	.042
dec	<---	faci	.059

Table 4c (x): Critical ration estimation of differences of ICT experience of the owner-managers (Multiple moderation effect analyses outputs)

			ExpLow		ExpHigh		z-score
			Estimate	P	Estimate	P	
useful	<---	readi	0.061	0.303	-0.007	0.913	-0.779
ease	<---	scope	0.429	0.000	0.403	0.000	-0.184
useful	<---	faci	0.141	0.035	0.093	0.255	-0.453
ease	<---	faci	0.072	0.408	0.230	0.016	1.225
useful	<---	scope	0.178	0.022	0.387	0.000	1.706*
ict_acq	<---	useful	0.338	0.000	0.258	0.000	-1.083
dec	<---	useful	0.480	0.000	0.511	0.000	0.295
ict_acq	<---	ease	0.166	0.000	0.152	0.001	-0.232
dec	<---	ease	0.211	0.000	0.146	0.028	-0.764
ict_acq	<---	Gender	0.045	0.439	0.087	0.174	0.482
dec	<---	Gender	0.104	0.230	-0.056	0.543	-1.267
ict_acq	<---	Age	-0.012	0.329	0.027	0.030	2.232**
dec	<---	Age	-0.004	0.810	0.016	0.386	0.778
dec	<---	Freq	0.030	0.201	-0.030	0.210	-1.791*
ict_acq	<---	Freq	-0.003	0.874	-0.022	0.191	-0.838
ict_acq	<---	readi	0.078	0.029	0.061	0.150	-0.306
dec	<---	readi	-0.029	0.588	0.004	0.952	0.402
ict_acq	<---	scope	0.078	0.085	0.024	0.659	-0.753
dec	<---	scope	0.015	0.827	-0.183	0.021	1.899*
ict_acq	<---	faci	0.015	0.686	0.038	0.407	0.386
dec	<---	faci	0.027	0.627	0.073	0.259	0.548
Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10							

Table 4c (xi): Critical ration estimation of differences of education status of the owner-managers (Multiple moderation effect analyses outputs)

			EduLow		EduHigh		z-score
			Estimate	P	Estimate	P	
useful	<---	readi	0.009	0.878	0.030	0.634	0.235
ease	<---	scope	0.430	0.000	0.409	0.000	-0.150
useful	<---	faci	0.161	0.027	0.094	0.222	-0.628
ease	<---	faci	0.134	0.148	0.162	0.070	0.215
useful	<---	scope	0.247	0.006	0.299	0.000	0.431
ict_acq	<---	useful	0.249	0.000	0.349	0.000	1.376
dec	<---	useful	0.463	0.000	0.514	0.000	0.479
ict_acq	<---	ease	0.170	0.000	0.182	0.000	0.202
dec	<---	ease	0.154	0.005	0.210	0.002	0.650
ict_acq	<---	Gender	0.013	0.804	0.101	0.152	0.989
dec	<---	Gender	-0.071	0.379	0.161	0.111	1.794*

ict_acq	<---	Age	-0.004	0.749	0.011	0.440	0.798
dec	<---	Age	0.011	0.529	0.003	0.885	-0.306
dec	<---	Freq	0.058	0.083	-0.074	0.162	- 2.111**
ict_acq	<---	Freq	-0.009	0.698	-0.023	0.531	-0.333
ict_acq	<---	readi	0.012	0.743	0.143	0.000	2.383**
dec	<---	readi	0.006	0.912	0.006	0.918	0.001
ict_acq	<---	scope	0.059	0.219	0.026	0.617	-0.465
dec	<---	scope	-0.056	0.434	-0.107	0.146	-0.504
ict_acq	<---	faci	0.062	0.093	-0.012	0.797	-1.256
dec	<---	faci	0.001	0.980	0.080	0.217	0.926
Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10							

Appendix 5 – multiple case studies

This section covers the guiding questions for the multiple case studies

5.1 Introduction and informed consent

Thank you for granting us this interview; it is undertaken as part of a PhD research programme at the Institute for Transport Studies, University of Leeds, United Kingdom.

My name is Ezenwa, Anthony Ekene, PhD research student of the above University. Here with me are; they will assist me in conducting the interview.

It is important to let you know that the selection of your firm as a case firm for the study is based on your reputation and experience in the sector. Your participation is voluntary and you are free to withdraw at any time without giving reasons and without any negative consequences. As courtesy demands, you are expected to put your mobile phone on silent mode.

The subject of the discussion is about **“Information and Communication Technology (ICT) usage in road freight and logistics in Nigeria”**.

The research project is for academic purpose only. There is no wrong or right answer to questions; feel free to express yourself to the best of your knowledge. The essence of the discussion is to explore your practical experience concerning the stated subject.

5.2 The guiding questions according the research themes

Themes	Guiding questions
Firm and industry backgrounds	i) What are the circumstances that led to the establishment of your organisation, including the initial staff strengths, scope of business, fleet size and ICT profile? ii) What is your current status, in relation to the above attributes, including your ICT experience and educational levels? iii) What are your major current operational challenges that portends SC risks?
ICT adoption processes	iv) What are your ICT-facilitated activities? v) What are the type of information shared or stored with the application of ICT resources vi) How do you acquire ICT resources and management
Pre-determined logistics performance	vii) What are your anticipated logistics performance? ix) How much have they been achieved? x) What are your major drawbacks?
Potential strategies to improve ICT uptake	xi) What are the possible strategies that can be adopted to improve ICT uptake in your organisation? Xii) What possible strategies can your organisation adopt to improve ICT uptake?

5.3 ICT profile

Items	Use	Plan to use	No plans	Undecided
Telephone				
Company website				
Online booking				

Vehicle positioning system (GPS)				
Automatic picking system (APS)				
Frequency identification system				
Land area network (LAN)				
Enterprise resource planning (ERP)				
Customer relationship management (CRM)				
Barcode scanning for product tracking				
Electronic invoice				
Electronic route scheduling				
Automatic equipment identification				
Warehouse management system				

Appendix 6 -FGD and IEI

This section encompasses the guiding questions for the qualitative studies (focus group discussion and in-depth expert interviews)

6.1 Demographic characteristics of the participants

Items	Reponses
6.1.1 Name (optional)	
6.1.2 Age(optional)	
6.1.3 Highest level of education	1. None () 2. Primary () 3. Secondary () 4. Higher education () 5. Post graduate education () 6. Others (specify)
6.1.4 Name of organization	
6.1.5 Designation	
6.1.6 Years of experience	

6.2 Introductory questions

6.2. 1 What is your view about the current transport, logistics, and supply chain operations in Nigeria?

6.2.2 What is your assessment of the commitment of the Nigerian government towards enhancing logistics and supply chain operations/performance in the region (e.g., through policy formulations, infrastructural development, and support for 3PL SMEs)?

Phenomena you think has been explored or need to be explored	Responses
Through policy formulation/interventions	
Infrastructural development	
Funding of technology innovation	
Support/encouragement for local logistics operators	
Others (specify)	

6.2.3 What is your view about the impact of the advancements of ICT resources on the logistics and supply chain management (comparing developed and developing nations)?

Phenomena you think have been mostly affected	Responses
E-commerce	
Out sourcing of logistics functions	
Supply chain integration	
Activities of the local logistics operators	
Others (specify)	

6.3 Main questions

6. 3.1 Do you think the rate of ICT diffusion in the Nigeria's transport and logistics industry could reasonably meet the modern logistics and supply chain needs?

Possible scenarios	Responses
International shipments/custom clearance procedures	
Last mile deliveries	
Collaborations among supply chain partners	
Financial transactions	
Provision of customised services	
City logistics	
Globalisation of supply chain processes and integrations	
Others (specify)	

6. 3.2 What have been the major effects of these of the above identified phenomena and possible scenario on the activities of the local logistics operators?

Possible impacts	Response
Scopes of businesses	
Motivation	
ICT experience/training	
Education status/training	
ICT acquisition/decision quality	
Others (specify)	

6. 3.3 How do you think that the relevant stakeholders have intervened (modulated) ICT diffusion challenges in the Nigeria's transport and logistics sector, particularly regarding the local logistics operators?

Possible phenomena	Responses
Regulations/policy actions	
Enforcements	
ICT Training programme	
Moral support or welfare package	
Subsidy/special intervention	
Others (specify)	

6. 4 Concluding questions

6.4.1 Based on your knowledge and professional experience, what improvement measures by the government and the relevant stakeholders to raise the level of ICT diffusion in the Nigeria's transport and logistics sector?

6.4.2 What are the expectations of the local logistics operators in the present circumstances of the transport and logistics sector and the overall local economy?

6.4.3 What do think the future of the Nigerian transport/logistics sector would be like if nothing is done regarding the present circumstance?

6.4.4 Are there other points, revelations, or recommendations you want to share?

Appendix 7 – Transcript, qual outputs, and coding guide

This section covers the sample of the qualitative transcripts, outputs and coding guides

7.1 FGD transcript

q.1. locally evolved conditions

Q.1. Are there locally evolved conditions that enhance or dampen ICT adoption?

R3: No doubt, technology is the driving force, that's driving the economy of any nation. With the over blowing population, we have in this country, limited transportation infrastructure, it is a huge task in terms of organizing the traffic management in the presence of the dilapidated in infrastructure, there is no doubt that information and communication technology will play a crucial role in trying to ease the situation.

R3, r4: No doubt we have infrastructure challenges in Nigeria be it whatever; road, electricity, etc. The one key issue is always about power and which seems to be very big challenge which up till today there has not been resolution on it. Power could destabilize the operations of these ICT facilities, when they are not adequate. Due to the prevailing situation, most of the 3PL SMEs are avoiding ICT systems because of the huge financial implications resulting from lack of facilitating conditions, especially power. You know it is very costly (added extra budget to them) to maintain private power supply, as it increases operating costs. However, because of the importance of the ICTs in the modern businesses, I suggest that the 3PL SMEs should opt for cheaper alternative power supply such as inverter (solar energy supply) to enable them serve their clients efficiently. I don't want to over flog this issue; we all know that lack of enabling environment is a long age issue in this country.

R1: I will speak from the perspective of a lay man on the street. Right, now we all know that transport system is majorly run by touts such as the National Union of the Road Transport Workers (NURTW), RTM, etc. From my experience in maritime business, there are a lot of touts also in the maritime activities (especially clearing agents) in Nigeria. It depicts that corruption is another big factor that hinders ICT adoption in organizations, as the traditional system encourages non accountability/non transparency. We witness the same corrupt practices when managers opt for traditional inventory system than adoption of inventory allocations software in warehouses. As the latter will reduce fraudulent practices at minimal level. Another serious challenge is lack of steady electricity, which some of the software requires to function efficiently. Some organizations shy away from technology innovation because of cost maintenance especially as related to cost of generating private power supply.

R1, r6: Let me give you an example of what I wanted to talk as a case study - our communication system is very expensive; the data in this country is very expensive; alright; data would make you communicate is expensive; communication is expensive to compare to what is obtainable in advanced nations like UK. Apart from that, it is not also reliable as the vendors in this study fail to upgrade the services here. For example, in London, 4G network has been in existence for over 100 years but we are just witnessing it in this clime of the world.

R2: I want to go straight to some basic things that really bedevil the Nigerian technology and transport industry. One of them is budgeting in technology and ICT. You will find out properly, that our government has never harnessed the sector. Any time we have a budget for the year, the above stated issues are not put into considerations. This situation has continually watered the down the

professionalism in the industry. You can draw comparison with the budget in technology and innovation in other advanced nations like UK and the way it is organized. Here in Nigeria do not support even NGO Like the one we established in PH; the safety ambassadors - Now, what does this organization do? Or try to achieve? We capture transport or traffic incident and report at appropriate agencies as there is no common operational CCTV in public places as commonly observed in the developed countries. This kind of infant innovation can be encouraged where government is responsive to innovation. The idea also would enhance collaboration with relevant agencies such as FRSC. Another issue in Nigeria is the problem of sufficient and accurate data base. In developed nations like UK, they have what they call counting; it covers the residents and their residential addresses; their occupations; their mode of transportation. All this information will help in appropriate planning. But it sorely lacking in Nigeria, from National to state, and ward levels. Without these databases, we will not informed planning that yields the desired result.

R5: You know what happened in em (2), not just in Nigeria, what is happening in the developing country is because of the fact that the impact of their business has not been felt because of the ICTs hindrances.

R5, r7: I mean there is that coherence in the shipping document from the shipper to the importer, within a twinkle of an; these are what 3PL providers should, like the indigenous ones have not been to actualize...., you cannot just be able to become a 3PL provider and you don't have linkage overseas (R – or online presence); lack of online presence, lack of partners in foreign countries are what are affecting them.

q.2. manifestation of the ICT diffusion

Q.1. How do ICT diffusion manifest among the 3PL SMEs in the study site?

R3. For example, IT (information technology) helps to locate parking spaces easily. There are a lot of intelligent support, in terms of distribution; you can have supply chain reference model that monitors different forms of supply chains, from production/manufacturing to distribution and making sure that the product gets to the actual consumer on time to improve the service level. You know, lead time count because that is another aspect that most organization look out for, they check the efficiency of the distribution turnaround and inventory turnaround management, so that you will be able to see what time does it take to use/sell a particular product or get it replaced within a particular time. It is also important in the geographical distribution aspect. I think ICT has a lot enormous opportunities in the logistics sector.

R3, r8 ; another thing I want to add is (1) flexibility em (2x) ease of user interface should be taken note of that we simply em (2x) some of the inputs such as when you log on to the internet, log in is even a problem to people, even creating an email or something.

R3, r7 ; I have a friend who have em (4x) tourism package, travel and tour, he procured arrangement for leisure trips, vacations and things like that; all these are done at zero based; he started with zero and today he has a million turn over and I can tell you this is the future, we have self-driven cars today, self-driven bicycles and cycles. Information technology is the key, it is all about how we harness it; that's the point; how do we harness it efficiently and effectively. That's my point. Thank you very much.

R1: When you bring ICT into any process, any system, it tends to regularize the system, put it in a system procedure for instance: when I was working in the port, there is an ICT system, they called ASKUDA ++. The system allows you to improve operations. When you have people, who are not

learned into the system and they are not ICT skilled, they would find a way to scuttle it. Now there an agent in the port who spoilt the app we use and he does not care the efficiency of those such apps because of ignorance. The same applies in the BRT transport system in Lagos under the management of LAMATA. A proposal has been sent that you can use ICT system to buy your ticket online (on the go) London Transport for London. But the project failed due lack of ICT experience by the managers of the operating agency (LAMATA) and also to cover their corrupt practices. Although, education has a lot to play to harness both ICT experience and job integrity.

R4: ICT has played a very huge role here in Nigeria and it is helping business to thrive. It is linking supplier with retailer and then distributors and making ease of use movement here in Nigeria. But for the users, the interface has really been a problem. The difficulties of usage of the appliance. I think we need more education. I think we need more user-friendly ICT system that would transmit in our local language and then in a way or manner that our people will appreciate it in doing business and transporting their goods. I think ICT has played a very important role here in Nigeria in transport. It has really driven the industry. Thank you

R5, r8: But now that the awareness is coming up; the 3PL services providers in the logistics industry has come to realize the impact of ICT, with ICT, for example, the transportation of the shipping document from the shipper to the importer, it can be done within 5 minutes, and if you like at what Panalpina has laid down in Nigeria, though in most areas they are not here, but Borere West African logistics is taking their place.

R5, r9: When we talk about ICT maintenance, it is expensive here in Nigeria. We are just trying to queue into it. But I think that, as time goes on progressively, we would be there, it is just a matter of time but am affirming to you that without ICT compliant, you will be highly limited in your business and people will not know about you.

R1: Let me give some light, thank God for the ASUKUDA ++, again there is this global scan (single boost declaration) that have been adopted in the port operations, including the 'forex de pa'. Now the government have this policy in place and have implemented them reasonably to the extent that agents can stay at the comfort of their homes to do their business. Now, the question is why the governments can't extend similar policies to other modes of transport. The situation suggest that government is not holistic (piece meal) in their reform approach as they should have included other modes of transport in the reformation programme ongoing in the Nigeria ports, thereby forcing the 3PL SMEs to adopt relevant ICT and in turn raising the scope of the 3PL SMEs. In conclusion, the govt. is responding recently with these examples but we are calling for more as professionals.

q.3. operational challenges

Question 3: What operational challenges do 3PL SMEs face to adopt relevant ICT in the study site?

R1: actually, there is what we call 'non vessel common carriers' (NVCC) (3PL arrangement). If we look at every 3PL, most of them in Nigeria have a special case (indicates various forms of 3PL services and operations) and we need technology to address these issues. We need the website for contacts and for visibility and also need your phone which is a very important ICT tool. Every third-party logistics owner in Nigeria needs ICT, even some old logistic and freight owners in the country are realising the importance of ICT. Currently, 3PL can manage not having an office but they cannot survive without web presence. There are what we call common carriers, they adopt 'goods groupage to consolidate goods and freight forward, without necessarily using a container. This method also entails that the 3PL may not also necessarily have all the necessary shipping documents (read up goods groupage) To achieve this this level of business (tracking the movement of the goods across

various modes of transport, which are owned by different individuals), a 3PL must have some level of ICT experience and adoption. The truth remains, in order to keep track of everything in this business, the operator cannot escape adequate knowledge of ICT and the business. Specifically, ICT adoption in the 3PL business ensures ease of work, accuracy and precision. It is very important that every third-party logistics person must make use of ICT to remain relevant in the field.

R3: like my colleagues mentioned about the issue of data base and budget. I think it is a special one because we are looking at volume, we are looking at networking, and we are looking at clients based. Actually, in Nigeria I used to wonder because the coordination of things in this country is not right. Actually, the coordination of things/activities is a key in logistics operations. Based on the situation of things in Nigeria data base system I wonder how logistics operator survive here. I travelled one time to Kanza city and used a shuttle bus and I have some luggage because I bought some things online, I just stayed in my hotel and make some purchase, I sent through "more for Africa". You could see the concept they are trying to use to reduce the budget because of low turnaround nature and they are able to attract volume of things they can do. It is something you can say the owner/managers themselves; the orientation. I may say that some of them have a phobia for technology. In fact, they are not seeing it as a solution based, but as a burden. If there is any special constraints, it should be in the area of perception. Especially among the old and core traditional firms among them that refuse to accept that the business concept has changed due to globalization.

R1, r7: I think when we talk about ICT infrastructure, one basic thing I would say is power. Power comes first. I think when I stated some of the first example, when I was citing how we tried to introduce ICT in an inventory management of some organizations, and they refused; basically because of power. As mentioned earlier, the cost of running private electric supply is very expensive and discourage the 3PL SMEs from adopting. (Can we rank the infrastructure as they affect ICT adoption?)

q. 4. SoB vs IA variability

Q.1. what underlying factors shape scope of business and exposure to ICT adoption variability and challenges among the 3PL SMEs?

R4: I think that the 3PL SMEs are willing to accept it, just that they need more training to be able to handle it. There are technologies but the people need to understand how it works; how to appropriate it; how to apply it; how to take advantage of it. I think there is still a gap between accepting the relevant technologies and understanding how it would improve their businesses. It is apparent that if they bridge this gap, they would appreciate the effect of intelligent solutions in their business activities.

R5: I think a way forward, I am just suggesting that the 3PL should have synergy with foreign partners, they can be an agent, they can be logistics brokers, just like what we have in the insurance broker, we have em (2x) estate brokers, we should have that, that should actually be useful to adopting ICT in logistics to promote supply chain services em (2x). I think that would go a long way

R5, r8: To support his point, I think in an international trade in Nigeria, the central bank has made it such that if you are not ICT compliant, you can't even think of – you know put import application, you don't even apply for your pass; you don't even get your duty assessment when you are involved in a 3PL business; am talking about the freight forwarder now. So, you must be in total conformity with the new dynamic system in the industry. If you look at the global world like Germany, they have freight, em (2x) commerce. The freight commerce is doing a lot, shipping things across the region (Europe), they partner with transport ambassadors, all they need is to source for registered freight

forwarders that are accredited, they put their prices online, they submit the service they do online and then, they are there to man the web; wherever cargo is coming from, because their high of technology in ICT has given them these added advantage.

R1, r2: please let me quickly put something sir; Now, the thing is that every 3pl operators know that if you don't appreciate technology, you would be phased out. Now, we have jumia and we have konga; we have people who does ordering online. The same applies to 3PL SMEs and other businesses as most business is moving towards e-commerce and e-businesses. It is apparent currently that no organization can survive without technology innovation, mainly ICT, and 3PL SMEs should not be an exception.

R1, r6: In the transport and logistics operations, ICT adoption does not necessarily mean mobile phones and internet services but sophisticated communication systems such as EDI and GDI systems, etc. This advanced tool is very necessary in the proper coordination of logistics and supply chain management to meet the demand of the customers.

R1: Cuts in, the fact still remain that we have core traditionalists in the sector who may find it difficult to blend to the industry (thanks God that we still have some boys who are willing to join 3PL services in Nigeria), given to the fact that what we call mellenial children (R –ICT compliant children) are not into 3PL and would be difficult to adopt to adopt. Now! Because somebody will ask you ask you how did you do this, I copied this from this side, my brother, I don't understand, my friend, I don't understand, give me file. Now because why, he is finding it difficult to use. If you take this approach, if they learn the ICTs and use it very well, the problem is that they don't not learn. Now, if you talk about ICT and you are 3PL and you don't have, you don't have ICTs (online presence); you are not ready to work. Now, I will tell you two things; I will tell you a secret and what I do in my part time; I procure things abroad (R-e-procurement), yea, e-procurement, thank you, now, I got eBay, I got amazon, I go to Alibaba, I go to express, sourcing for products at a very cheaper rate (price), bringing to Nigeria here at affordable price. Now! I am good at ICT, I have ICT, I have my online presence, I do it. Now, it is because I want to catch clients, I got clients site, I say look, if you want to buy this abroad, come to my site, I can cargo it from Dubai, China and bring it for you here in Nigeria. I relate to somebody in LinkedIn and I say Oh, you are a freight forwarder here and I say I am a freight forwarder also. That is good, I have a cargo, pick it up at so so industries; bring it to Nigeria, I will receive it in Nigeria. I am not in Lagos but present in Abuja, I called a friend who is an agent and I say please, this is this, I want in Abuja but my online presence tells you I collect cargo world-wide. Now, the ease of use has allowed me to outsource and to partner and for those who are not ready to learn who sees it as headache, it would be very difficult to become an agent.

R1, 3: Let me give some light, thank God for the ASUKUDA ++, again there is this global scan (single boost declaration) that have been adopted in the port operations, including the 'forex de pa'. Now the government have this policy in place and have implemented them reasonably to the extent that agents can stay at the comfort of their homes to do their business. Now, the question is why the governments can't extend similar policies to other modes of transport. The situation suggest that government is not holistic (piece meal) in their reform approach as they should have included other modes of transport in the reformation programme ongoing in the Nigeria ports, thereby forcing the 3PL SMEs to adopt relevant ICT and in turn raising the scope of the 3PL SMEs. In conclusion, the govt. is responding recently with these examples but we are calling for more as professionals.

q.5. SoB vs understanding IA/DQ challenges interactions

Q.2. How relevant is scope of business in understanding ICT adoption challenges in LSN?

R2: when you talk about scope, there are vast areas. I think most of them are doing well by putting their best. Some of them has even gone to the level of outsourcing when they cannot stand the financial obligations involved in ICT; I suggest that others should be innovative to take actions or seek alternatives that best suits their particular circumstances. The truth remains that scope of business is vast in this type of business. A very good example is the scope of business of Coca-Cola; their chains don't go broken that they have adopted some several systems. A situation whereby production can never end in a particular plant. This is an example of scope they have adopted to enable them remain competitive.

q.6. effects of the MV on the r/s btw DVs and IVs

Q1. How do the PU and PEOU of ICT mediate the relationship between IVs (consumer readiness -CR, the scope of business -SoB, and facilitating conditions-FC) and DVs (IA and DQ) respectively?

R 3, Alright, thank you very much, I happen to be last person contribute and the first person to speak actually. Em, my contribution is ICT is the key and is the future, we have to embrace the trend, and we have to be ready for the change.

R1: The thing is that in 3PL, that I have known sir, I will not say how far but how well have we influenced those people. Now, assuming you say (i1 cuts in, can we see the face of Usman) how well, if you talk about pharmaceutical goods, there is a friend who come and say look, Ade I am looking for job, I need this (4x). I say look, you did what? You are a pharmacist, yes, he said I am a pharmacist. Then I said no need, create a website, every pharmaceutical shop in your neighbourhood, get them on that website, get their drugs on that website, drive traffic to that site, see what will happen. The guy did it, lo and behold the site is selling, and sometimes it turns out that somebody is looking for a drug and need to tour the whole of Abuja to get one particular drug but with this idea, no. You just need to search which store is having this particular drug and you place your order. So right now, it is like we are bending the people, the industry to what? To accept ICT. That will drag us back to what I say earlier on about education (General laughter from the background).

q.7. effect of ICT EXP/EDU on r/s btw scope/PU; and CR/IA

Q.2. Are there significant differences in ICT experience and educational status of the owner/managers and how do that moderate the relationship between the SoB and PU of ICT, and the relationship between CR and IA respectively?

R2: OK, I hope you are talking about how experience of most logistics of operators do affect their readiness to adopt, and their scope of business. Let me use this case to buttress a point; someone who is into public transport system. Without adequate applications of ICT you will be faced with human factor (error and corruption) and the associated cost implications. It also affects efficiency of management of various forms of employees associated with transportation and drivers. To avoid these issues, intelligent transportation system is inevitable. Nevertheless, without adequate ICT experience of the owner/managers the benefits of the ICTs in their operations may not be properly harnessed. On the other hand, it would affect their scope of business; because the more you get more ICT experience, the more you use it to expand your scope of business.

R1: sorry, I want to buttress a point. For example, I would want just use two case studies; one is called Konga and the other Jumia, Ok? They both came up almost the same time but because Jumia actually got upper hand in terms of better services, that is why they spread from Lagos to other branches across Nigeria. With the experienced managers, they can handle their clients effectively

especially with their return policy and quality products. Whereas the Konga management have weak management acumen and they are losing markets to their competitors. Right now, they are losing customers because of sale of substandard products. A good manager who has experience would always capitalise on the weakness of their competitors to enhance their market strategies or quality as buttress with the case study between Jumia and Konga. Ordinarily, they were disadvantaged when they both started. I think, experience really count because what everyone is looking for in ICT is confidence; do I trust the system? Do I trust the people that run the system? How efficient they because turnaround time is very critical in supply chain management. On a lighter note, experience really count in everything in life.

R5: I have worked in several logistics companies and in various departments. I think experience count in the sense that experience bring about sustainability of legacy in the industry. To ensure sustainability in the industry, I recommend adequate mentoring system for the upcoming ones to sustain what already have been established. Experience will marshal out a good standard procedure which would enable new employee to quickly adapt to the system, even in a technology inclined firm. Then, finally experience brings wealth of knowledge in the industry is a proof of experience leaders. Accordingly, they said that knowledge is power, it makes the industry dynamic, it makes the progression successful, even if the mentor is not there, and the upcoming professional can que and support what has already been down.

R8. The issues of integrating the supply chain operations in Nigeria should be help paramount. It can be achieved without employing the capable and professional hands in the industry. We should look beyond nepotism and political gratifications/settlements while appoint transport executives in the transport and logistics ministries. For example, the current dispensation of leadership in Nigeria showed that they regard transport positions as anybody's affair as they appointed personnel who do not know anything about transport. How do you expect the desired in this circumstance?

R3: The key for your wealth is ICT, it is knowledge, it is opportunities, and it is ability to unlock these opportunities will create us a better height. I know a lot of 3PL that are set up with zero based capital. That's why I wonder when you say something about government, banks, and those ones. It is all about looking inward, what are the services you have to offer; look at your clients, your potential clients, their need, if you are matching up with their needs that will determine why you want to set up that kind of business.

q.8. Interactive effects of the IV on MVs

Q.3. How do the interactive effects of the IVs influence PU and PEOU of ICT respectively?

R9: The epileptic electricity supply and the unreliability of the ICT service providers limits the extent of ICT adoption by the SMEs as they may not be useful or difficult to use

q.9. Initiative to mitigate ICT diffusion challenges

Q. (i) what range of initiatives has been deployed or need to be developed to address ICT diffusion challenges in LSN?

R5: Sure (2x), just like I cited that the central bank has made it mandatory that every freight forwarder must have an internet based facility log-on to the customs portal for all their duty assessment, all their import application, all the pre-arrival assessment report; it is done right in the office; you don't need to go and source it manually again.

R3: Just to expand some point they have actually mentioned, the problem is not more of the policy but more of implementation. And that remains the key. Whether embracing, acquisition, accessibility or whatever, you get ready to things you are committed to. Political will is the missing link here. You see, one policy implementation can change the whole thing. We can see that in the transport sector for example in the maritime, mostly we use the best practice approach, but when we to implementing +1ssp code, it is just one policy declaration and everything user port user operator complied. So the issue lies on the capability to enforce the policies in other modes of transport.

R3, r7: Another thing is the issue of integrity. Em (2x). I think we have discussed the issue of integrity, because when you talk about issue of ICT, people are kind of worried about their sensitivity of their data and you know, Nigeria does not have a good data base management, you will be worried, let these guy don't go and take my pin number and use in the ATM. That aspect of confidentiality should be taken seriously. It actually boost the confidence of people to accept an outright trust and the last of the issue is the issue of ethics, ethical morals, so that it guides the whole operations, because there is always known that when you are talking about ICT, you are talking about privacy, how to code and decode whatever kind of system protective software you are going to put into the system as an input. I think that you should be looked into by all operators in a simplified way, looking all their budget constraints, looking at their viability of their purse; the visibility of the geographical location where they are covering. I think they should think carefully about customer demand tailor made their operations in a way that they may be able to serve better. I think that is my contribution.

R5, r6: Em (2x), that should be government; government commitment to enforce policies in this direction. Look at what happened in SIRILANKA after the civil war, the government policy makes it possible for small scale operators' enterprises to plunge back to their business, providing enabling environment for their businesses. After sometimes, the government takes their money, it is like a form of encouragement. Look like Nigeria recession – a recession economy, what will plunge back the economy is government participation, we know that the government cannot do everything, but to large extent, they partner with commercial banks to banks to give credit (loan) facility to SMEs and in that note, you will see that the industry will come back to what is supposed to be; there would be orderliness, people will do business in right conformity with government ethics and values but when this things are not there; government are not there, of course you know that fund is difficult to access, the banks will ask for your collateral, the banks will ask for your Surtees, the minimum experience you have not gotten as a young professional (internship)as someone going into small scale business; you need enabling environment; you need these things to access these funds. There should be a follow up through government participation on private angle to see that the synergy between this sector should be in conformity to move a way forward. Otherwise, it would be difficult to access fund; how can you see the exchange rate, it very high. For you to into business that you will put these facilities, internet (enough internet) that would give you linkages overseas cost money, and then power (that is another thing), because all you are doing without electricity cannot do anything – virtually in most cities Nigeria here, there is epileptic power supply but when there is government participation either through commercial bank giving out credit facility to boost this sector, you see that you can acquire little generating set that can power your business. That is my take

R5, r9: In my own lighter note, I think em(2x) that government has to really em(2x) be actively in the development of small-scale business, we can draw it from the policy-oriented approach (angle); there should be a defined policy that shall be actually encouraging small scale business. When you

talk about small scale business, a lot of policy from the angle of double taxation, it is even discouraging them. Government should give weavers. i.e task weavers with policies that would be encouraging them, stimulate them, create an enabling environment where they can surcease their talents, ie the major burden, ie to small scale business. And again em, the private sector, the private sector, the commercial bank should look at the areas of granting repayable loans when all necessary conditions are met, it will go a long way to sensitize our small-scale industry and economy. Thank you, my name is goodluck

R2: On a final note, until government takes intellectual property as a collateral, honestly, the private sector and the upcoming business who wants to thrive in the logistics industry, they cannot make a 'head way' . That is my final note. Because shall definitely ask you for all these things. As an upcoming business, your collateral, you need this, you need that and somebody is coming up new, what do you expect from him in that part of the world you are, if you have an idea, your idea is your collateral, bank can swing into action and see what you can have. Until government makes a deliberate policy that our intellectual property should be our collateral for upcoming entrepreneur, they cannot make a head way. Thanks very much, my name is Ekene Jacobs.

R1: I Think my last comment are 1: is advice and the way forward – one- education- two- education- three-education. Why am saying one, two, three education? ICT is a tool, for us to change whatever we want to change especially in the angle of 3PL providers. Now, you are saying government (3x) But I know that they have responsibility; we need to educate us on why they should use ICT as a toll on their business. Yes, the second one I said is education, I mean as a young people that are coming, I wrote a proposal to the NYSC to train corps members on logistics and transport. Somebody said logistics and transport? It is ease to set up 'now'. There is an aspect of logistics to set up; that is 3pl. I don't have vehicle, I don't have a ship, and I don't have a warehouse. My own is who owns the ship and find a demand for that and I can really set up from that angle. Now, young man really needs to know how to go about it. Thank God, this is the President for the young professional's forum and we are looking at changing things around and creating employment for our young professionals. Before they come into these things, they supposed to have an idea of what we are talking about, and secondly, mentorship, that is where chiefs (Good-luck) comes in because I know he is into 3p logistics. We would mentor young guys that would come in and we say look, this is how things are done. The main thing is in the field work o. It is like a school o (please check o). There are about 13 hurdles you must pass before you clear your goods. Note that one, but they will tell you, it is only thing we are passing (RS: chorus sure (3x)). Now that we are talking about education, we are talking how to educate ourselves. ICT is a good tool that I can set up (Cuts in – I have a friend of mine who is into a very good business as a third party logistics person, what he does, he looks for that needs buses and tell them that I have buses and they take it to him. So, what are we talking about? Apart from loans, I am talking about alternative we use better ourselves in the third-party, we can educate ourselves on good ways to raise fund to start business because the capital I used to start a third-party person is #7.00. The thing you need is to get a market, ones you get a market, and you look for people who has the vehicle and you just breach the gap. That's why mentioned about education. Thank God for your (work) research and I pray we get to see it and see on how to use it to secure an entrepreneurship program to alleviate the rate of unemployment in Nigeria.

q.10. Special considerations for 3PL SMEs in LSN

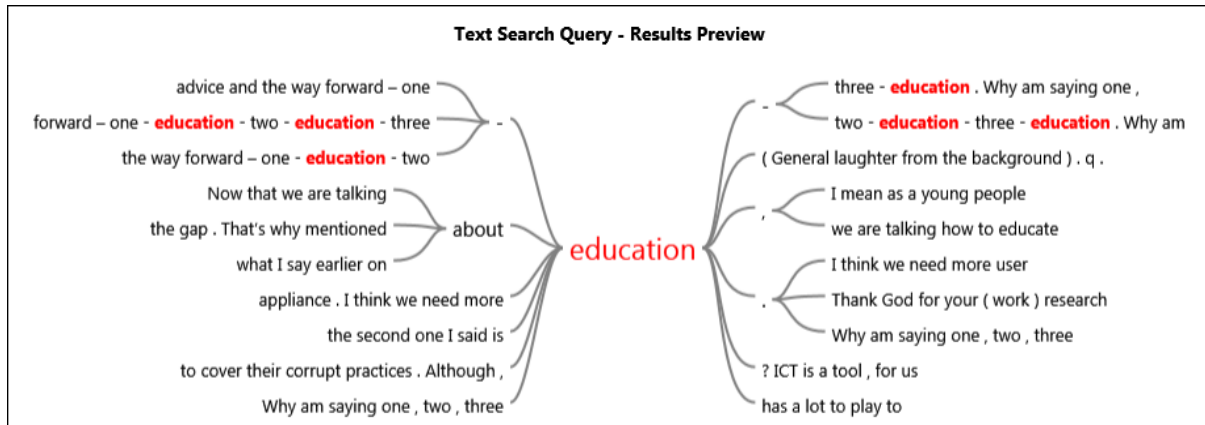
(ii) What considerations are needed to enable 3PL SMEs in LSN to integrate goals related to logistics and supply chain best practices?

R1: In fact, how does it affect, it affects a great deal sir in the sense that you are not moving a bulk goods at the same time. Sometime it em (2x) let me borrow the term of air transport. ie people who do air transport, from an airline you paying for 20kg for an airline to come in, now if you pay it, it is going to expensive and it will cost money. But for people who are doing the business, it is fine, we can schedule and batch. When I get order from here, here, here, done deal, I have my full load, I can now move. Now, in terms of that, I can move it and say take this from either from either from Benji to Shangai, just using ICT to coordinate the movement and tracking them either using airway bill or bill of loading. Once you book them, you can hook somebody (please confirm) and I can say bring it to this cost

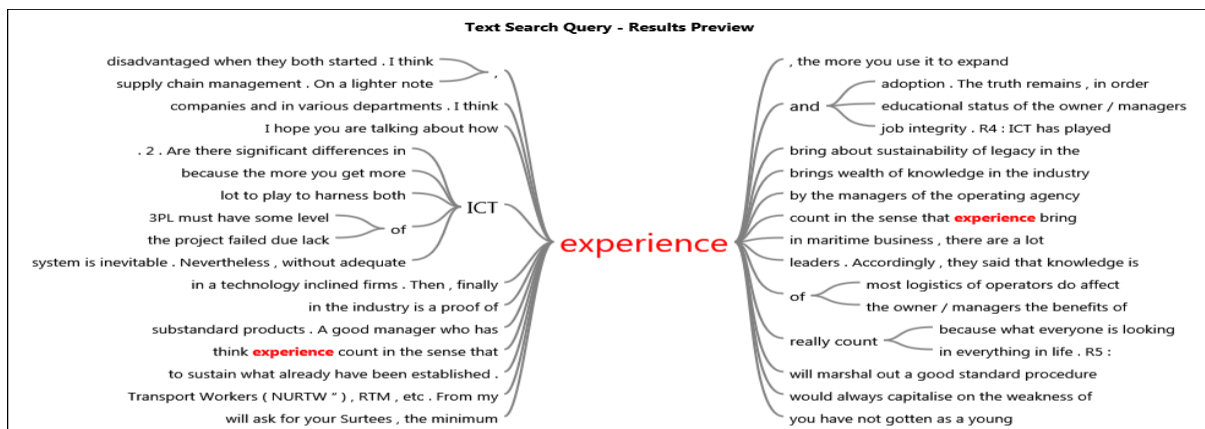
R5: (cuts in) let me support his point. ICT and e-commerce have brought or restored confidence on the side of the customers because you sit right in your office or house, and they would give you closed door deliveries (door to door services). Customers do not worry anymore about how to source their goods and services from retail stores with their busy schedules. The 3PL providers are bridging these gaps through e-commerce as payments are made online and they deliver right in your door steps. With this, the customers have the opportunity to assess the quality of their products and services before payment. Overall, it has boosted the conformability of their customers and the same tome increased business opportunities Typical example is what African Mall is doing now; they have a debit card; more for Africa; you can shop all over – US, UK and they give time lag – two weeks you see your goods in your door step.

7.2 Text query outputs of the expert interview data with NNVIVO 12 software

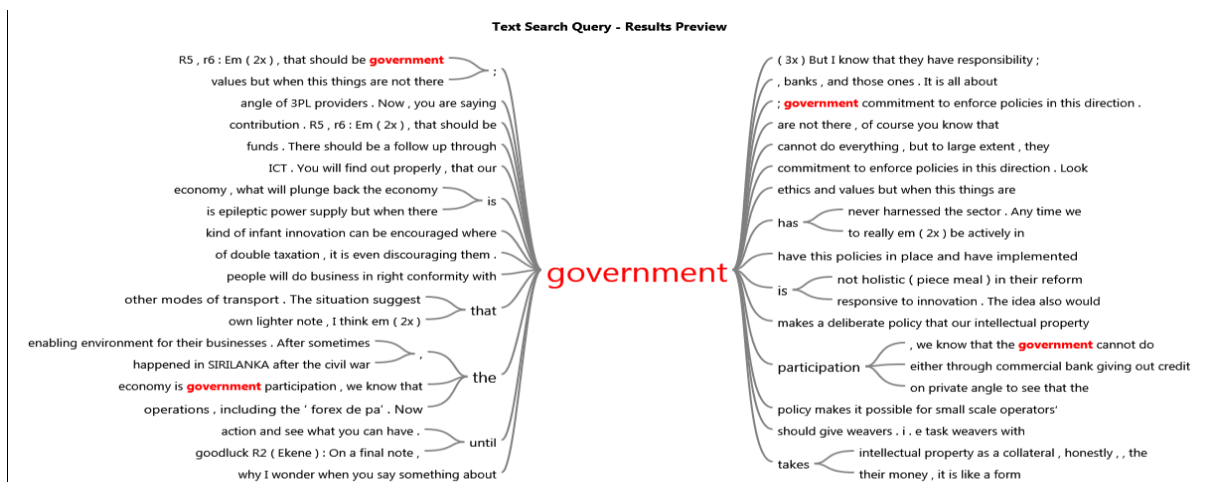
7.2.1 Education



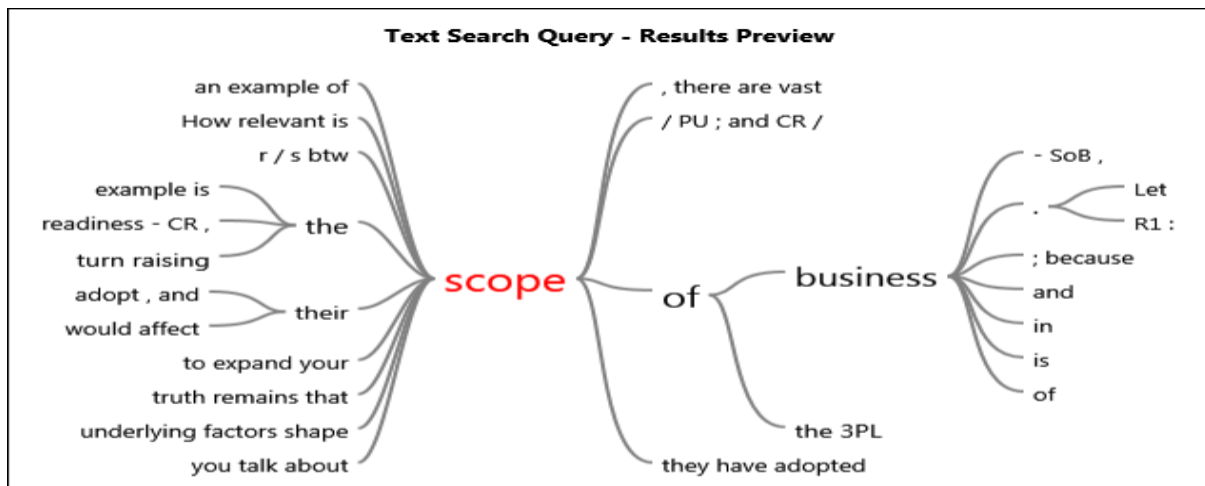
7.2.2 Experience



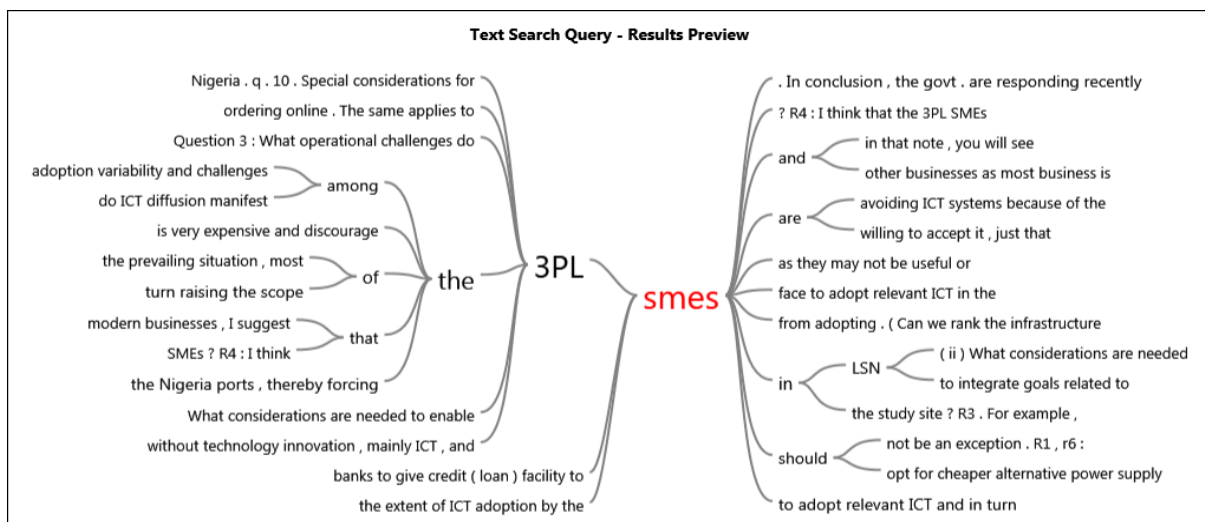
7.2.3 Government



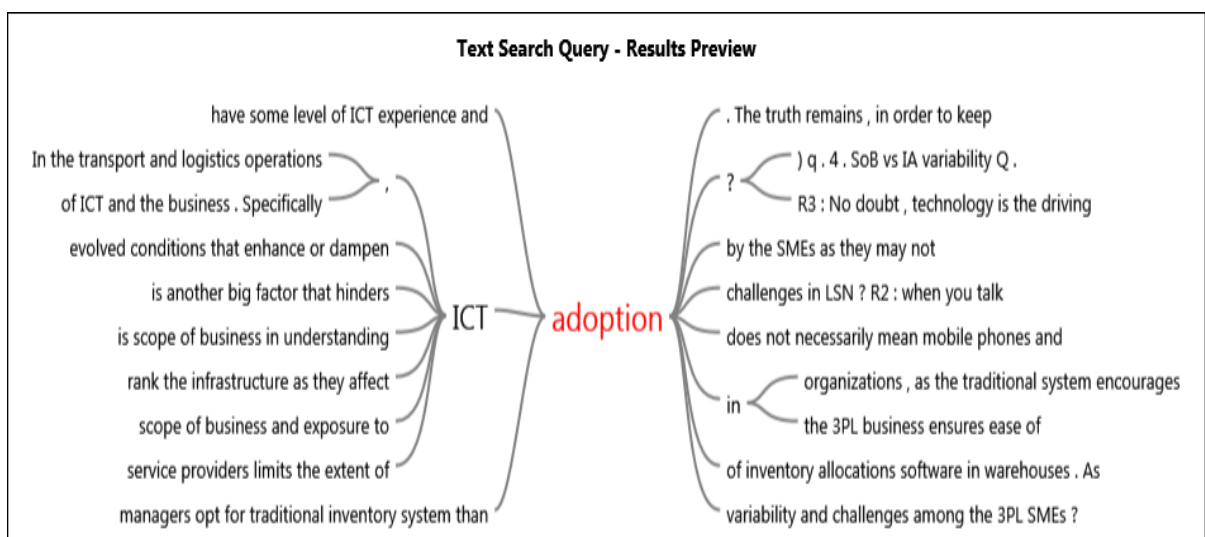
7.2.4 Scope of business



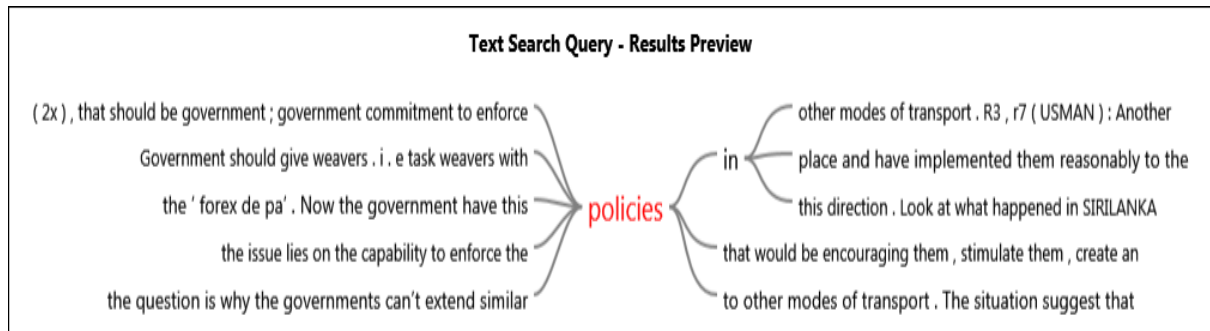
7.2.5 3PL SMEs



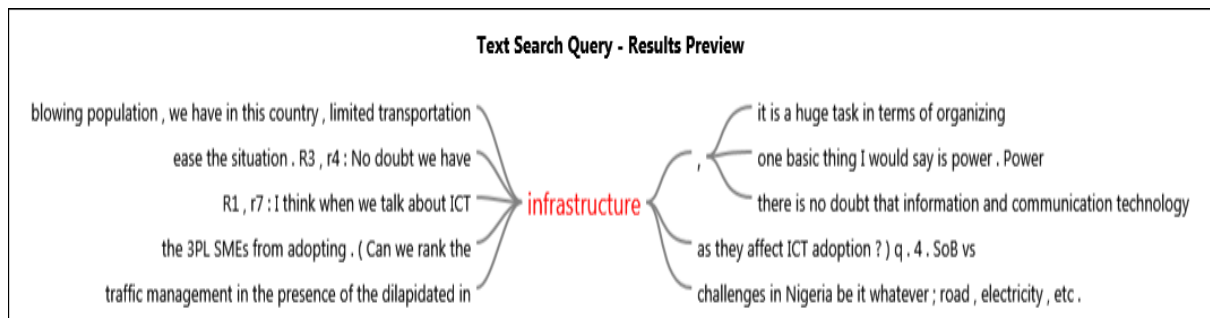
7.2.6 ICT adoption



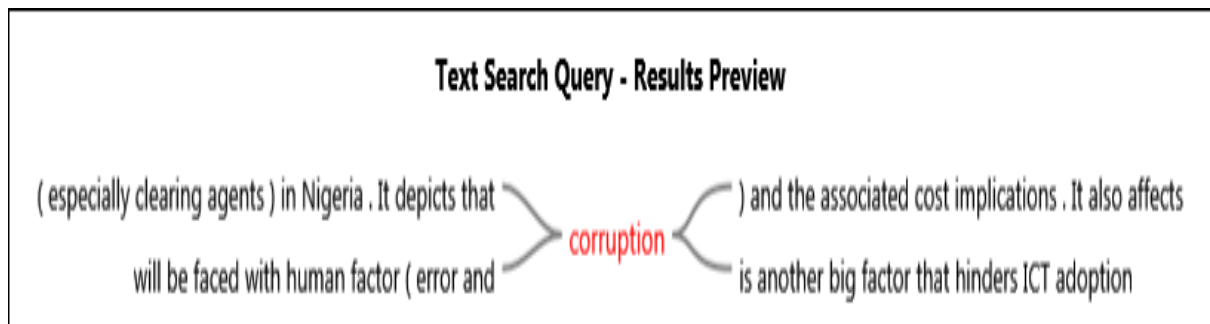
7.2.7 Section 6: Policies



7.2.8 Infrastructure



7.2.9 Corruption



7.3 Magnitude coding for the qualitative data analysis (QDA) for the Nigerian IT policy

Themes	Policy statements	Objectives	Strategies
Sectorial applications			
i). Governance	To embrace transparent governance through appropriation of government wide information system (GWIS) at all levels of government	-Digitalize all government activities to reduce bureaucracy and improve efficiency (Efficiency)	- Ratify data protection acts (DPA) to improve security of electronic documents and transactions (data security) -Establish intractable platforms to stimulate smooth exchange of information (Infrastructure) - Expand the IT skills of public servants through introduction of mandatory IT training and retraining (IT training)
ii). Urban/rural development	To utilize of ICT tools for urban and rural development	-Appropriation of digital master plan (Sustainability) -Reduction of rural/urban migration (Settlement) -Promotion of environmentally clean cities and rural areas (Sustainability) -Generation of IT related jobs (Employment) for the Nigerian citizenry -Promote rural IT facility (Infrastructure)	- Establishment of environmental networks (Infrastructure) -Promotion/raising awareness for IT use in both urban and rural areas (Awareness) -Train and re- training of IT experts (IT training) in the sector -Establish rural telecommunication platforms (VSAT, satellite wireless, HF-radio and cellular technologies) to foster internet penetration in the area (Infrastructure).
iii). Trade/commerce	To establish enabling environment, particularly infrastructure for trade and commerce to bolster productivity and competitiveness	-Develop enabling environment (Infrastructure) that promote private sector business and investment in IT - Promote the culture of electronic commerce (IT training) to facilitate ease of doing business -To raise the visibility of Nigerian business enterprises, locally and internationally (wealth creation) -Create enabling environment for foreign investors (Wealth creation) - Creation of employment through private sector-led information technology services (Employment)	- Protection of intellectual property (legal) -Provision of information infrastructure (Infrastructure) through NITDA and private sector partnership -Subsidization of cost of internet services for the local SMEs to enhance their competitiveness (Competitiveness) -Promotion of use of advanced IT solutions (bar codes) in the sector -Establishment of regulatory body to monitor and sanitize online transactions (Regulation)
iv). Art, culture and tourism	To use IT to promote the image of Nigeria's arts, culture and tourism	-Preservation of cultural artefacts and manuscripts (Awareness) -Promote Nigerian natural heritage through the use of relevant IT tools (digital super highways) (Awareness)	-Use of website to promote Nigerian culture (Awareness) -Application of sophisticated ICT tools in the production process (Advanced IT application)

		<ul style="list-style-type: none"> -Generate internal revenue through the promotion of business and tourist activities (Wealth creation) -Establish internet content in the region than being net recipient (Infrastructure) 	<ul style="list-style-type: none"> -Capitalize on the existing infrastructure (world-space digital FM broadcasting satellite) to develop the modern worldwide broadcasting stations (Infrastructure) - Establishing more schools for IT training and manpower development (IT education) -Strengthen transport and tourist infrastructure (Infrastructure)
v). National security /law enforcement	Protect and promote interests, assets and safety of Nigerians, locally and internationally.	<ul style="list-style-type: none"> -Protect life and property of Nigerian, both home and abroad (Safety and security) -Preserve the territorial integrity of the Nigerian borders and assets (Safety and security) -Create attractive job opportunities for Nigeria (Employment) 	<ul style="list-style-type: none"> -Using IT to tackle security threats associated with information technology (Safety and security) -Awareness and education of public security personnel regarding risks of IT environment (Security, education and awareness) -Ensure efficient manipulation of information infrastructure through enactment of appropriate legislation (legislation and infrastructure) -Frame appropriate legislation on: computer crime, digital signature, tele-medicine, tele-education, intellectual property/copy right, consumer protection, media convergence, and electronic commerce (Legislation)
vi). Health care	Invest in IT based health systems to ensure quality healthcare delivery	<ul style="list-style-type: none"> -Establish healthcare information system (Infrastructure) -Improve efficiency of healthcare delivery (Efficiency) -Use IT to educate citizens on health issues (Education) 	<ul style="list-style-type: none"> -Utilizing the existing IT infrastructure (free healthcare satelite) to source healthcare experts in the developing countries (Infrastructure) -Digitalize health institutions for ease sourcing and dissemination (sharing) of medical information (Big data) -Establish internet connectivity platforms across all levels of healthcare (Infrastructure) - Use IT to tackle healthcare threats such as HIV/Aids, leprosy and physical capabilities (Health security)
vii). Agriculture	To use IT tools to re-engineer agriculture to ensure food sufficiency, security and employment	<ul style="list-style-type: none"> -To utilize land use act for food production (Production) - To secure employment for the citizenry (Employment) - To lessen urban migration (Migration) -Promote sustainable agricultural environment 	<ul style="list-style-type: none"> -The use of sophisticated ICT tools (GIS) to scan and plan sustainable environmental usage (Environmental sustainability). - The use of ICT to facilitate planning, production,

		(Sustainability)	storage, and the distribution of agricultural produce (Logistics). -Promote the use of ICT among local farmers (IT training)
Other IT policy goals			
viii). Human resource development	To promote globally competitive IT manpower and related discipline	-To develop a framework that produces pool of IT technologists (IT training) - To create opportunities for a career development in the sector (Employment) - Promote local production of computers, accessories and software (local production)	-Make the use of IT mandatory in all levels of Nigerian schools; incorporate it in their curriculum and also establish distance learning centres (IT training) -Provide scholarship grants for deserving Nigerians at related discipline (Fund) -Develop train the trainer programme to improve ICT skill acquisition in the region (IT training) -Establish the necessary collaboration, locally and internationally to enhance quality of IT experts in the region (IT training)
ix). Government and private sector partnerships	Provide an enabling environment for private sector investment	-Provide enabling environment that accommodates private sector investment (Infrastructure) -Support the competitiveness of the Nigerian IT products with necessary fiscal policies (Competitiveness) -Bolster the development of IT training centres via the government and private programmes (IT training) -Joint partnership (government and private sector) for advisory standard and quality control (Enforcement and engagement) -Stabilize local capacity building through the development of IT driven markets (Capacity building)	-Establish IT free zones (IT parks) to attract IT investors (Infrastructure and investment) -Establish/ratify National IT Development Trust Fund (NITDEF) with the sole aim of attracting SMEs in the sector (Funding) - Promote IT driven national exhibition to drive export of IT resources (Competitiveness) -Ratify inconsistent power supply in the region for the efficient operations of the IT parks (Infrastructure) -Removal of unnecessary bureaucratic processes at the government institutions to ensure local capacity building (Capacity building)
x). Infrastructure	To establish reliable infrastructure that meets international standard	-Provide quality leadership direction for infrastructural development (Leadership and infrastructure) -Provide secured environment for e-commerce (Security and e-commerce) - Provide a reliable NII that would foster effective integration of SII, LII, and GII (Infrastructure)	Develop or ratify National Information Technology Development Agency (NITDA) to guide the development of IT in Nigeria (Leadership)

		<ul style="list-style-type: none"> -Promote private sector investment in information infrastructure (private sector and infrastructure) -Promote interoperability of information infrastructure (infrastructure and data sharing) -Provide enabling environment for e-commerce (e-commerce and infrastructure) -Bridging digital gap via infrastructural development (digital gap and infrastructure) -Empower and train Nigerian citizens to compete favourably in the international scene (IT training and competitiveness) 	
xi). Fiscal measures	Establish fiscal measures that stimulate investment and growth of IT sector	<ul style="list-style-type: none"> -Establish fiscal mechanism that respond to the global IT revolution (IT revolution) -Position the sector to attract capital flow and provide enabling environment for direct local and foreign investment (investment and infrastructure) -Establish tax free zones to attract investment in the sector (Tax free and investment) -Provide the framework for the global competitiveness of Nigeria's IT products and services through appropriate fiscal policies (Competitiveness) -Facilitate enactment of fiscal mechanisms that support SMEs' activities in the sector (SMEs) -Create employment opportunities through fiscal policies (Employment) 	<ul style="list-style-type: none"> -Promote efficient regulatory bodies in the sector (Regulatory body) -Provide enabling environment for local and international firms' partnerships (Infrastructure and collaboration) -Provide incentives for development actors that engage on IT education and training (IT training)
xii). Research and development	Promote IT sustainability , leapfrogging and competitiveness through research and development	<ul style="list-style-type: none"> - Foster Nigerian's competitiveness in the international market (competitiveness) -Promote sustainability of Nigeria's IT industry for economy industry (sustainability) -Promote local capacity building to enhance export of goods and services (capacity building) -Promote exchange programmes to facilitate technology transfer (technology transfer) 	<ul style="list-style-type: none"> -Provide enabling environment for local capacity building to stimulate technology adaptation (Infrastructure) -Fund research projects that are IT driven for national development (Funding) -Develop research and development centres across Nigeria (IT training and development) -Financial interventions for the local SMEs in the sector (Funding)
xiii). Legislation	Promote and protect right for	-To promote and protect electronic communication,	-Effective collaboration of NITDA and ministry of

	information and use; privacy of users and upholding justice for all	governance and commerce (E-communication, governance and commerce) -Provide access to electronic information and protection of privacy (data security) -Protection of intellectual copy right (Intellectual copy right) -Provide legislation to harness culture and information technology differences (Culture)	justice to enact relevant regulations via review of existing laws accordingly (Law and regulation) -Train and retrain all judiciary personnel to be IT compliant (IT training) -Digitalization of all arms of law enforcement (Digitalization) -Encourage local production (Local production)
xiv). Global considerations	Promote international collaboration in IT knowledge sharing, investment and security	-Promote international collaboration in the application and development of IT (Collaboration) -Ensure that Nigeria remains a key player among information driven societies (Key player) -Promote ICT acquisition among Nigerian citizenry (IT training)	- Encourage professionalism in the industry (Professionalism) - Establish international relations department in the industry (Collaborations)
xv). IT popularization and awareness	Prove an enabling environment for cutting-edge information technology in the region	- Promote IT diffusion across various sectors of the Economy (IT diffusion) -Promote the use of IT across heads of three-tiered government in the region (IT training and awareness) - Encourage the integration of the private sector into the IT policy vision (Private sector partnership) -Localise the use of IT tools (e.g., transform into local language) (Localised ICT application) -Propagate gender equality towards enhancing IT diffusion (Gender equality)	-Encourage rural IT education through Department of Mobile Internet Unit (MIU) (IT education) -Encourage immediate acquisition of IT skills among various heads of government (IT training) - Establish interoperable platform for all key government departments and agencies (Infrastructure)
xvi). Policy implementation	Recognising IT as an agent for national development	-To establish an efficient infrastructure that provide access to both local and international networks and markets (Infrastructure) -Promote IT training in the region to produce pool of trained IT manpower that meets local and international needs (IT training) -Promote wide application of IT in governance (IT training and awareness) -Provide incentive for local and foreign IT investors (Business Inceptive) -Promote efficient management of the industry through the necessary regulatory agencies (professionalism)	- Establish a framework that promotes integration of local and international information structure by using advanced IT tools such as VSAT, fibre optic network, high-speed gateway, and broad/multimedia (Infrastructure) -Facilitate private sector inclusion by providing necessary incentives (Private sector and inceptives) -Deregulation of the IT industry (Deregulation) -Promote IT education at all levels of education in the region (IT training) -Protection of intellectual property (Intellectual)

		<ul style="list-style-type: none"> - Inclusion of the private sector in the IT policy initiatives s (Private sector) -Promote e-commerce in the region (e-commerce) 	<p>property)</p> <ul style="list-style-type: none"> -Establish data protection act (Data protection) -Providing mechanisms for funding the sector (Funding) -
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Appendix 8 – Personal reflection

8.1 Personal reflection

The 49 months of doctoral training has been an intense learning period which has immensely impacted my intellectual capacity, planning, attitude, and personal life. There was always challenges at every stage of the study ranging from literature review and defining gaps; field trips planning; data collection process/procedures; data analysis, and scholarly reports. All these were designed to be achieved within definite periods. Sometimes they seemed tasks without end. The rigours of mixed-method research had taught me how to conduct independent research and to stretch my analytical skills. I struggled to build arguments from my data analyses outcomes, but with consistency, patience, encouragements, and supports from my research supervisors, I was able to scale through. Now I have a better understanding of research processes, data analysis/triangulation, and scholarly reports. Overall, I am grateful to my supervisors for believing in me, even the trying moments. Apart from my research challenges, I encountered financial challenges, emotional challenges (when my elder brother died in late 2016), psychological (adaptations to foreign culture/way of life and integration with research colleagues with multi-ethnic/ cultural backgrounds), and triumphed by the magnanimous financial intervention of ITS and enabling environment of the institute.