Anthony Ezenwa[ac*], Anthony Whiteing[a], Daniel Johnson, Akunna Oledinma[b], and Ejem A. Ejem[c]

[a]*Institute for Transport Studies, University of Leeds, United Kingdom,* [b]*Warwick Business School, University of Warwick, United Kingdom, and* [c]*Department of Transport Management Technology, Federal University of Technology, Owerri, Nigeria*

Corresponding Author: Anthony Ezenwa (anthonyezenwa@ymial.com)

Biographical notes

Anthony Ezenwa

Dr Anthony Ezenwa is a Lecturer at the Department of Transport and Logistics Management Technology, Federal University of Technology Owerri, Nigeria. He has a PhD in supply chain technology and systems at the University of Leeds, UK, obtained both MSc and BTech in transport and logistics management at the Federal University of Technology Owerri. His research interest focuses primarily on technology innovations and applications in transport, logistics and supply chain management. Recent engagements include: i) An expert member at Intelligent Speed Assistant (ISA) study, European Transport Safety Council Project. ii) Project Assistant, Living Lab Project, University of Leeds. iii) Teaching Assistant at the Institute for Transport Studies, Business School, Geography Department, University of Leeds, United Kingdom.

Anthony Whiteing (a.e.whiteing@its.leeds.ac.uk)

Dr Whiteing is Senior Lecturer and former Director of Student Education at the Institute for Transport Studies (ITS), University of Leeds, United Kingdom (UK). With a background in economics, he has an MA in Transport Economics and a PhD, both from the University of Leeds. With forty years of experience in academic research and teaching across economics, freight transport, logistics and supply chain management, much of his recent work has focused on understanding and improving the environmental performance and sustainability of freight transport and logistics across the range of scales from global to local.

Daniel Johnson (d.h.johnson@its.leeds.ac.uk)

Daniel Johnson is Senior Research Fellow and Director, Postgraduate Research at Institute for Transport Studies, the University of Leeds. He obtained BSc, MA, and Mphil in Economics. His areas of expertise include transport economics, econometrics, wider economic impacts, and public

transport. His current research projects and experience include Project coordinator, SmaRTE. It is EU/Shift2Rail project investigating the scope for enhancing rail users experience and vehicle maintenance procedures. He is also engaged in XCYCLE project. It is EU project for appraising the value of on-bike safety enhancement.

Akunna Oledinma (akunna.oledinma@wbs.ac.uk)

Dr Akunna Oledinma is Research Fellow at Warwick Business within the Entrepreneurship and Innovation stream. Her work focuses mainly on Entrepreneurship and Innovation in SMEs. She has a PhD in Transport and Sustainability, an MSc in Energy Studies and a BSc in Transport Economics. Her research focused mainly on systems and structure surrounding policy development particularly in the food and drink sector; the interaction between stakeholders, citizens and government in policy formulation and implementation; and the economics of infrastructure development.

Ejem A. Ejem (ejemflagospel@yahoo.com)

Dr. Ejem A. Ejem is currently a Senior Lecturer in the Department of Transport Management Technology, Federal University of Technology Owerri, Nigeria. He got his B.Tech. M.Sc. and Ph.D in Transport Technology. He has high proficiency in modelling transport behaviours and quantitative applications in transport planning and logistics. He has contributed immensely in topical issues in transport and logistics in Nigeria which has earned him a pride of place in the transport and logistics industry. His recent project in designing the most sustainable and innovative logistics service in agricultural produce cold chain logistics techniques and technologies will revolutionize cold-chain management in Nigeria and West African countries.

Development of strategies to improve Information Communication Technology diffusion in Nigeria's logistics and transport industry: Adaptation of Structure-Process -Outcome Model

Abstract

Information and Communication Technology (ICT) applications in logistics and supply chain management (SCM), which aim to improve competitive advantage and logistics performance are lacking in Nigeria's logistics industry. In this study, factors influencing ICT uptake across four distinct industries in Nigeria were sought, using systematic multiple case studies of nine selected local third-party logistics operators, across four distinct industries in Nigeria. Using the Donabedian structure-process-outcome model as a theoretical lens, we explored/explained the business environment of the application of ICT in logistics. We found that lack of infrastructure and security concerns are the significant constraints of ICT uptake across industries, while supply chain integration and individual difference factors are the differentiating factors. With the identified generic constraints, none of the case firms was able to achieve high logistics performance. We recommend that the primary strategy should be channelled towards improving the business enabling environment in the region, while the secondary strategy should concentrate on raising awareness of the benefits and prioritization of the application of advanced ICT resources amongst the local logistics operators. The study concludes that these can be achieved through collaborative policies and regulations in the local logistics industry.

Keywords: ICT diffusion; strategies; Nigerian transport and logistics industry; infrastructure

1. Introduction

Information and Communication Technology (ICT) facilitates supply chain system efficiency in a number of ways including through the provision of real-time data (Tiwari et al., 2018; Harris et al., 2015; Chen and Paulraj, 2004). Lieb and Schwarz (2002) ranked information-based outsourced logistics services as follows: freight payment/accounting (45%); transport planning/optimisation (45%); warehouse management systems (27%); shipment tracking (18%); international documentation (18%); supply chain planning/scheduling (6%); order management (6%). However, local logistics operators face numerous ICT adoption challenges (Ezenwa et al., 2020; Tob-Ogu et al., 2018; Evangelista, 2011; Gunasekaran and

Ngai, 2003; Pokharel, 2005; Kilpala et al., 2005), particularly in developing logistics markets (Tob-Ogu et al., 2018; Ezenwa et al., 2020). Factors influencing ICT adoption are generally caused by the interplay of technological, organisational, and environmental factors (Tornatzky and Fleischer, 1990). Local evolved factors such as institutional (25%), structural (39%), and operational (36%) challenges have been also recognised as fundamental issues inhibiting ICT adoption in developing logistics markets (Ezenwa et al., 2020). These factors limit both the usefulness and ease of use of the ICT resources, and ultimately stall ICT adoption readiness, the scope of business of the local logistics operators (Ezenwa et al., 2018), as well as their logistics performance (World Bank, 2013, 2018).

Depending on the objectives of individual logistics firms, outsourcing organisation and customers, several measures are being used to mitigate ICT adoption challenges. Examples of such measures include the shift from acquisition of physical to information-based assets to support collaborative decision-making and visibility of supply chain processes (Papetti et al., 2019; Alloui et al., 2019). Although ICT adoption improvement measures differ in their effectiveness in meeting specific objectives across various levels of supply chain operations (Konovalenko and Ludwig, 2019; Banchuen et al., 2017), their implementation is typically informed by firm/industry backgrounds (Grant, 1991). With the growing interest in global supply chain integration and collaboration, a variety of approaches have emerged to improve the rate of ICT diffusion across different logistics markets to inform better measures that are environmentally credible (McKinnon, 2012), socially acceptable (Grimm et al., 2008), economically affordable (Rheddy and Rheddy, 2002; Hugos, 2002), and legally valid (Carter et al., 2017). These factors focus on ways to improve information sharing (e.g., trust-building); facilitate information transfer (e.g., adequate infrastructure), and processing and utilisation (e.g., firms' capacity and background) (Konovalenko and Ludwig, 2019; Banchuen et al., 2017). The choice of a particular focus area can depend on many factors, including the aim of the study, in terms of policy and decision-making context, the strength and limitations of specific logistics operators, and industry/logistics market at stake and other pragmatic reasons such recommendations of the relevant stakeholders, data availability and expertise (Dunford et al., 2018).

Although several studies have highlighted factors influencing ICT adoption among local logistics operators (Ezenwa et al., 2020; Tob-Ogu et al., 2018; Evangelista, 2011; Gunasekaran and Ngai, 2003; Pokharel, 2005; Kilpala et al., 2005), what is lacking are comprehensive guidelines for identifying and understanding how the combination of the

industry/firm background inform ICT adoption process/prioritisation, as well as the logistics performance of the operators (Evangelista and Sweeney, 2006). The multiple case study approach adopted in this study implies engaging relevant firms in ways that enable legitimacy, validation, knowledge integration, regarding factors influencing ICT uptake among the local logistics operators in a developing market such as Nigeria. This aligns with the need to help policy-makers and other relevant stakeholders to better assess where, and in what context locally evolved factors influence rate of ICT uptake among the local logistics operators, and, in turn, their logistics performance. Besides, guidance is needed to enhance the capacity of the local logistics firms to be able to select, combine, and apply most beneficial ICT resources that cater for their operational needs and constraints, and are sustainable in terms of enhancing the environmental status of the study site on a long-term basis. This demand for guidance has been recognised on the broader sustainability assessment domain, especially among the road freight operators (McKinnon, 2012).

In this paper, we aim to provide case study examples and insights from Nigeria's local logistics market to assist relevant stakeholders embarking on strategies to improve ICT diffusion in the local logistics market, where priorities are driven by practical end-user needs (i.e., local logistics firms). This study focused on four distinct industries/supply chains (Apapa-Wharf, Food/beverages, Health, and Auto-parts/accessories) across Nigeria. It applied the structure-process-outcome model (Donabedian, 1988) to assess the effects of firm/industry background on the ICT adoption process/prioritisation, and, in turn, performance of the local logistics operations of the local logistics firms. The World Bank logistics performance index ranks Nigerian logistics services low, focusing on timeliness of deliveries, logistics competence, tracking/tracing, shipments, and customs clearance/procedure (Word Bank 2013, 2018). In particular, the structure-process-model was framed as a context-specific, problem-focused assessment of ICT adoption challenges and their mitigation options, driving from by industry/firm backgrounds of the nine case firms across the four distinct industries and supply chains. As such, this study offers empirical context through which to understand how ICT diffusion can be improved in the local logistics market, as well as facilitates stakeholders' acceptance of relevant improvement measures. The following research questions guide the study:

- How do the company background and industry environment feature in the ICT adoption process of the local logistics operators?

- 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?

The subsequent sections set out the theoretical framework and briefly discuss the literature around the structure-process-outcome model, followed by the methodological approach, highlighting the tools and case studies of the nine case studies, covering four selected distinct industries in the local logistics market. We then provide our results showing intra/inter-industry background and ICT adoption process, as well the predetermined logistics performance comparisons. These involve mapping out the ICT tools the local logistics operators prioritise and the reasons they prioritise those tools, and key activities carried out in relation to achieving predetermined logistics performance. We also describe which attributes of the ICT tools help to characterise the strength and weakness of the sampled firms (quality of logistics services offered by the sample firms) and how they differ from each other, as well as how the ICT tools that are best suited for the selected distinct industries to aid logistics performance. Further, we present the discussion/conclusion section of the paper, guided by the corresponding research questions. Specifically, this section helps to understand how different ICT tools might work together to capture different user demands and decision-making contexts, and explain why it matters to improve the existing structure (industry/firm backgrounds).

2. Theoretical framework

The structure-Process-Outcome (S-P-O) model was developed by Donabedian (1988) initially, examining the delivery of quality care. This was based on: i) personal characteristics and environment where health services are delivered (structure); ii) the activities surrounding healthcare service deliveries, including technical, scientific applications, and interpersonal relations (process); and how much the predetermined objectives are achieved (Ammenwerth et al., 2007, Kunkel et al., 2007, Ransom et al., 2005). In the field of supply chain management (SCM) and small and medium enterprise (SMEs), analysis related to management information system (MIS) has developed in the recent years, focusing on quantitative analysis (Evangelista 2011) and recent attempts to strengthen theoretical debates (Awa et al., 2015). However, assessment of factors influencing ICT adoption among the local

small and medium third-party logistics operators remain inadequate (Evangelista 2011; Gunasekaran and Ngai, 2003). ICT adoption measures have not been clearly translated into a clear objective for the local logistics firms, policymakers, and other stakeholders to aim towards (Ezenwa et al., 2020). Although a few studies have provided evidence relating to factors affecting efficient ICT adoption among logistics firms, there are still many areas to develop within the research field. For example, many studies have explored the relationship between the scope of business and rate of ICT uptake due to the lack of application of advanced ICT tools, and they have generally used diverging indicators. However, it is argued that the firm/industry background could still influence the ICT adoption process/prioritisation and logistics performance of the local logistics operators. Second, an approach based on quantitative analysis of questionnaire survey might not be sufficient to capture process and behavioural data (Denzin and Lincoln, 2000).

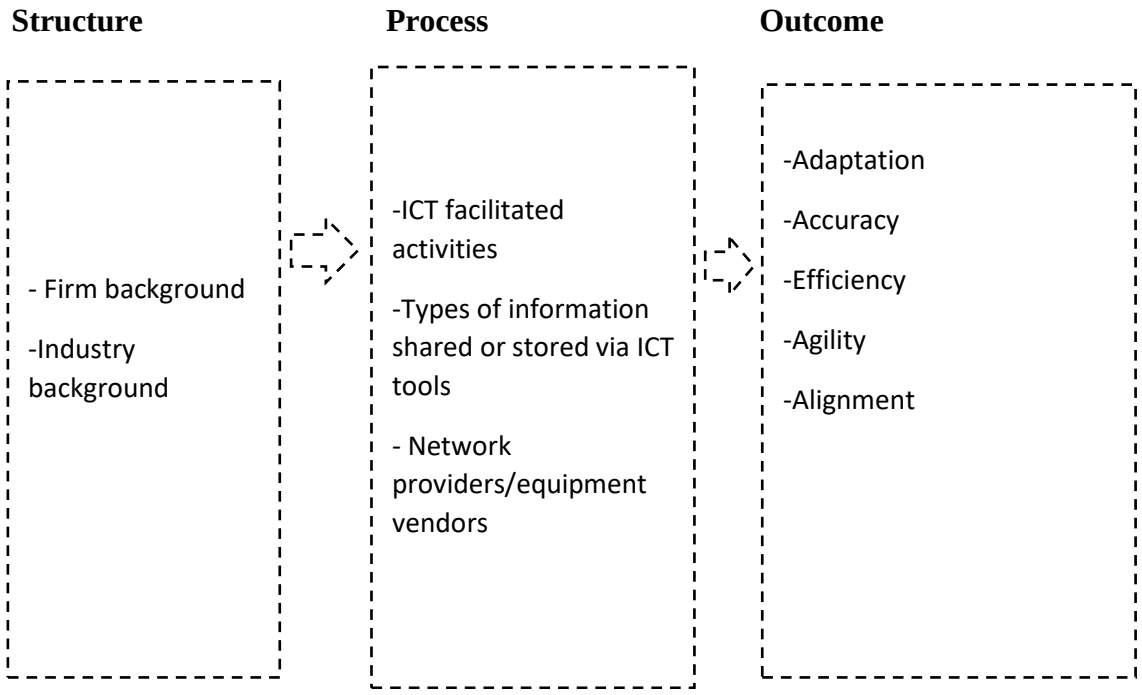

Figure 1 Theoretical framework (Adapted, Donabedian, 1988)

We adapted S-P-O model in this study to help evaluate whether ICT adoption processes/prioritisation and the associated logistics performance of the local logistics operators are being propelled by their backgrounds and scopes of business (World Bank 2018, 2013). This aligns with the notion that constant advancements in technologies have necessitated process deviation to save time and associated costs. Konovalenko and Ludwig (2019) for example conclude that event-based-systems (EBM) system have made their way

into the field of SCM and lay the groundwork for real decision making (DM) and business process management (BPM). Only a few studies have tried to apply S-P-O model empirically. For example, Xie and Breen (2018) used S-P-O as a threshold with which to assess: i) various factors underlying the use of ICT-enabled e-business in managing medical devices in the UK; ii) current scale and use of ICT for managing medical devices, and the associated opportunities and challenges; iii) the impact of ICT use on the performances of managing medical devices. The outcome of the empirical case study suggests that: i) factors influencing ICT adoption include business needs such as needs to keep accurate and accessible records of medical devices; ii) there is a sufficiently robust ICT infrastructure and supply chain network to support the successful supply of hospital devices and services; Impacts of ICT on SC systems include improved efficiency/effectiveness; accuracy; reduced waste/cost; improved quality of care. However, it is acknowledged that evidence relating to industry/regional-specific issues affecting efficient utilisation of ICT resources among the local logistics operators remain scarce due to lack of theoretical studies in the logistics and supply context (Evangelista, 2011).

In order to measure local logistics performance using S-P-O model, the key concepts adopted in this study are structure (firm/industry background); process (ICT adoption process and prioritisations); and outcome (logistics performance) (see Ezenwa, 2019). Lambert and Cooper (2000) argue that SC structure represents all the activities of supply chain practitioners and actors who are involved in provision of goods/services resources, knowledge, and assets to achieve value creation. SC network focuses on the number of tiers and actors involved in a specific SC, while SC business processes comprise all the structured and interrelated functions that feature in both downstream and upstream SC activities. According to the process view, SC activities commence with product development and commercialisation, followed by procurement, manufacturing flow management, order fulfilment, demand/customer service management (Cooper et al., 1997). Lambert et al. (1998) observed that SCM involves the management of SC components (e.g., physical/technical and managerial/behavioural, as well as information flows) in an integrated manner. The combinations of these characterise the visibility, tangibility, and measurability, and leadership of SC processes and integrations. Supply chain performance relates to the measurement of application processes to create a consistent relationship between SC strategy, planning, implementation, and control. These include issues related to information exchange in the SC, which is presupposed to be enabled by the digitalisation of SC processes and

mechanisms. The current paper discusses some of these issues through the S-P-O model lenses.

3. Methodology

Using a multiple case studies approach (Yin, 2014), we designed structure-process-outcome inspired guiding questions (see Table 1) for the study to appraise factors influencing ICT adoption in four distinct industries (Apapa-Wharf, Health, Auto-parts, and Food/Beverage), in collaboration with nine local third-party logistics operators. The study which took place between March – July 2017 covered mainly Lagos State (eight firms) and Owerri, Imo State (one firm). The case firms include three from Apapa Wharf, and two each from the Health Sector, food/beverage, and auto-parts /accessories supply chains, respectively. The selection processes follow their levels of involvement in the earlier phases (scoping study and questionnaire survey) of a wider study (Ezenwa et al., 2018) and recommendations from the local stakeholders.

The three thematic areas of the guiding questions processes are an indicative rather than an exhaustive selection of factors influencing ICT adoption, and, in turn, logistics performance of the local logistics operators. To comprehensively evaluate the thematic guiding questions, we conducted the structured interview sessions at the firms' sites, involving at least two management staff who play key roles in deciding the extent of ICT uptake to: i) provide information on firm and industry background; ii) ICT adoption and prioritisation; iii) pre-determined logistics performance; iv) potential strategies to improve ICT uptake. Their managerial positions range from Managing Directors, General and Operations Managers to ICT consultants (16 males and 3 females). The structured interviews lasted averagely two hours with the help of two trained Field Assistants, supplemented with company tours for on-the-spot observations. Audio and photography were allowed during the interviews and field activities.

The structured interview data were analysed using the phenomenal qualitative data analysis approach (Giorgi, 1985). This involved an initial reading of the entire text after audio transcription to establish a basic understanding of the data. This was followed by identification of specific comments that appear relevant to the research and units of comparisons; abstracting of meanings of relevant units, discussions, and reaching consensus by the authors.

Table 1 Research themes and guiding questions

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 portend SC risks?
ICT adoption processes/prioritisation	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?

Where necessary, interviewees were re-contacted to provide additional details or to clarify uncertainties. Finally, we categorised and summarised the abstracted data, focusing on developing the logic of comparing two or more contrasting case items for the understanding of the research phenomena (Bryman and Belle, 2003).

4. Results

4.1. Intra/inter-industry background comparisons

4.1.1. Intra-industry comparisons

The multiple case study findings showed a range of intra/inter disparities in industry backgrounds, across the selected case firms, as well as their related industries (supply chains). Here, we commenced with intra industry comparisons using nine specific units of comparisons: i) ICT profile; ii) staff strength; iii) fleet size; iv) years of establishment; v) ICT

experience and education status of the management staff; vi) scope of business; vii) firm status; viii) entry and exit rules; ix) facilitating conditions (necessary transport and ICT infrastructure).

ICT profile is subdivided into use, plans to use, no plans and undecided (neutral) categories to capture the extent of ICT uptake (high, medium, and low). The size of the employees underpins staff strength. The fleet profile is categorised as light and heavy commercial vehicles (Anderson 2006). ICT experience and education status of the management staff (respondents) are also rated as high, medium, and low. Their scopes of business are considered based on full haulage, basic, and advanced logistics scales (Evangelista 2011). Considerations for the firms' status included whether they are public/limited companies or otherwise. The entry and exit rules underscore the possible existence of regulatory frameworks that map entry, exit, and broader operations of the local logistics operators among the selected industries (supply chains) for the study. Likewise, facilitating conditions highlight the potential effects of environmental factors on the quality of ICT uptake among the local logistics operators.

As indicated in Table 2, the intra-industry comparisons of the three selected case firms at Apapa Wharf indicate as follows: There is a disparity in the ICT profile (rows 2-14) as the 3 case firms utilised 6 - 46%, 1- 8%, and 5- 38% of the enlisted ICT resources, while they plan to adopt 6 - 46%, 9 - 69%, and 5- 38% of other categories (e.g., automatic warehouse system -AWS, radio frequency identification -RFID, enterprise resource planning -ERP, and customer relationship management - CRM) in future. On the other hand, they had no intention to adopt 1-8%, 2-15%, and 2-15% of the enlisted ICT tools. Similarly, firm 2 and 3 are undecided to adopt 1-8% of the sampled ICT tools, respectively. ii) 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), ICT profile ranking (medium, low, low) and scope of business (basic logistics, full haulage, and basic logistics). 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). Last, all the case firms confirmed the lack of basic infrastructure as the primary inhibitor of ICT adoption.

Table 2 Intra industry comparisons - Apapa-Wharf

Firms	1				2				3			
ICT tools	U 1	P	N	U 2	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	6 (46)	6 (46)	1 (8)	0	1 (8)	9 (69)	2 (15)	1 (8)	5 (38)	5 (38)	2 (15)	1 (8)
Staffing	55				25				15			
Fleet size	45 (HGV1 and HGV2)				22 (HGV1 and HGV2)				Nil			
Year of establishment	1976				2010				2004			
ICT experience/education	High				Medium				High			
Company sites	Lagos Island				Lagos mainland				Lagos Island			
Scope of business	Basic logistics				Full haulage				Basic logistics			
Restricted operations	No				No				No			
Company status	LLC				LLC				LLC			
ICT profile	Medium				Low				Low			
Transport infrastructure	Poor				Poor				Poor			
Supply chain risk	Yes				Yes				Yes			

Note: i) U1 = Use, P = Plan to use, N = No plan to use, U2 = undecided; ii) N/A = Not available; iii) LLC = Limited Liability Company; iv) Decision rule for the ICT profile: ≤40% = Low; ≤59 = medium; ≥ 60% = High; v) Values in brackets are percentages of the ICT profile scores; vi) HCV1- heavy commercial vehicle, weighing up to 12 tonnes; vii) HCV2- heavy commercial vehicle, weighing above 12 tonnes.

Two case firms (4,5) were selected from the health sector to examine intra-industry characteristics of the local third-party logistics operators in the sector. Table 3 gives a summary of the comparative analysis. In terms of the ICT profile (rows 1-16), firm 4 appears less disposed to adopt the available ICT tools than their firm 5 counterparts (4-31%; 8-62%). Both firms had the intention to acquire relevant ICT tools in the future (6-46%; 3-23%), mainly in terms of RFID, ERP, CRM, and E-routing for tracking, transactions and customer relationship, and optimisation functions. Firm 4 appears to have no plans to acquire AWS and RFID in the future (2-15%). There are also differences in their staff strengths (35, 25), fleet size (30, nil), years of establishments (1974, 1980), company status (Non-LLC, LLC), and ICT profile ranking (low, high). On the other hand, both case firms share similar characteristics/revelations as follows: company location (Lagos Mainland), restricted entry into the industry, lack of necessary infrastructure as the primary operational challenge, and insecurity as the main cause of SC risk.

Similarly, the comparative analysis of case firms 6 and 7 from the food/beverage industry reveals as follows: Both firms are most concerned about adopting primary ICT tools (e.g., telephone, email, and internet) (3-23%; 4-31%). In relation to plan to use, it appears that firm 7 is more likely to improve their ICT profile in the future than firm 6 (4-31%; 9-69%), particularly website, global positioning system (GPS), AWS, RFID, and ERP. Also, firm 6 expressed indecision to adopt 6 (46%) of the enlisted ICT tools, for example, electronic data interchange (EDI), CRM, AWS, land area network (LAN), and RFID.

Other differentiating attributes include staffing (125, 90), fleet size (110, 80), and years of establishment (2000, 1980). ICT experiences and education status of the respondents were also rated low; company cites (Lagos Mainland); the scope of business (full haulage); less or no entry and exit restrictions; overall ICT profile ranked low. Both also reveal that infrastructural deficits and lack of security are the primary sources of SC risks (see Table4).

Table 3: 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 (31)	6 (46)	2 (15)	1 (8)	8 (62)	3 (23)	0	2 (15)
Staffing	35				25			
Fleet size	30 (LCV1/LVC2)				Nil			
Year of establishment	1974				1980			
ICT experience/education	High				High			
Company sites	Lagos Mainland				Lagos mainland			
Scope of business	Basic logistics				Full haulage			
Restricted operations	Yes				Yes			
Company status	Non-LLC				LLC			
ICT profile	Low				High			
Transport infrastructure	Poor				Poor			
Supply chain risk	Yes				Yes			

Note: i) U1 = Use; P = Plan to use; N = No plan to use; U2 = Undecided; ii) N/A = Not available; iii) LLC = Limited Liability Company; iv) Decision rule for the ICT profile: ≤40% = Low, ≤59 = Medium, ≥ 60% = High; v) Values in brackets are percentages of the ICT profile scores; vi) LCV1: light commercial vehicle, weighing between 1.8-2.6 tonnes; ii) LCV2: light commercial vehicle, weighing between 2.6-3.5tonnes.

Table 4: Intra sector comparisons – Food/beverage

Firms	6				7			
ICT tools	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	3 (23)	4 (31)	0	6 (46)	4 (31)	9 (69)	0	0
Staffing	125				90			
Fleet size	110 (HCVI/HCV2)				80 (HCV1/HCV2)			
Year of establishment	2000				1980			
ICT experience/education	Low				Low			
Company sites	Lagos Mainland				Lagos Mainland			
Scope of business	Fall haulage				Full haulage			
Restricted operations	No				No			
Coy status	LLC				LLC			
ICT profile	Low				Low			
Transport infrastructure	Poor				Poor			
Supply chain risks	Yes				Yes			

Note: i) U1 = Use; P = Plan to use; N = No plan to use; U2 = Undecided; ii) N/A = Not available; iii) LLC = Limited Liability Company; iv) Decision rule for the ICT profile: ≤40% = Low; ≤59 = medium; ≥ 60% = High; v) Values in brackets are corresponding percentages of the ICT profile scores; vi) HCV1: heavy commercial vehicle, weighing up to 12 tonnes; HCV2: heavy commercial vehicle, weighing above 12 tonnes.

Looking at the intra-industry differences (case firms 8 and 9) relating to the auto-parts/accessory supply chain, it was found that both firms have improved ICT uptake (11-85%; 12-92%), as well as positive intention to acquire other relevant ICT resources in the future (2-15%; 1-8%). Other units of comparisons include: i) staff strength (180; 120); ii) year of establishment (2000; 1980); iii) company locations (Lagos; Owerri); iv) ICT experience and education status of the owner-managers (high), scope of business (advanced logistics); v) regulation of operations; vi) supply chain risks (lack of basic infrastructure and insecurity) (see Table 5 for details).

Table 5: Intra sector comparisons – Auto parts/accessories

Firms	8				9			
ICT tools	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	11 (85)	2 (15)	0	0	12 (92)	1 (8)	0	0
Staffing	180				120			
Fleet size	150 (LCV2, HCVI, HCV2)				110 (All categories)			
Year of establishment	2000				1980			
ICT experience/education	High				High			
Company sites	Lagos Mainland				Owerri			
Scope of business	Advanced				Advanced			

Restricted operations	Partial	Partial
Coy status	LLC	LLC
ICT profile	Advance	Advance
Transport infrastructure	Poor	Poor
Supply chain risks	Yes	Yes

Note: i) U1 = Use, P = Plan to use, N = No plan to use, U2 = Undecided; ii) N/A = Not available; iii) LLC = Limited Liability Company; iv) Decision rule for the ICT profile: ≤40% = Low, ≤59 = medium, ≥ 60% = High; v) Values in brackets are corresponding percentages of the ICT profile scores; vi) LCV2: light commercial vehicle, weighing between 2.6-3.5tonne; vii) HCV1: heavy commercial vehicle, weighing up to 12 tonnes; viii) HCV2: heavy commercial vehicle, weighing above 12 tonnes

Similarly, there are interesting findings regarding the inter-industry multiple comparisons (see Table 7). Specifically, the results show that both firms from auto-parts industry emerged top, in terms of rates of ICT applications (11-85%; 12-92%), followed by case firm 5 - health sector (8-62%); case firm 2-Apapa Wharf (9-69%), while others recorded low ICT profile (≤ 40%). These suggest that quality of ICT uptake among the local logistics operators is less dependent on the industry background, except auto parts, where the two case firms appear to have greater propensity to adopt relevant ICT resources to improve their operations. 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.

Table 6: Summary of ICT profile

Firms/items	Firm 9	Firm 8	Firm 5	Firm 1	Firm 3	Firm 4	Firm 7	Firm 6	Firm 2	α (%)
Industries	Auto-parts	Auto-parts	Health sector	Apapa Wharf	Apapa Wharf	Health care	Food/beverages	Food/beverages	Apapa Wharf	
Use	12(92)	1 1(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	

Note: i) Decision rule, use: ≤40% = Low, ≤59 = medium, ≥ 60% = High; ii) Values in bracket are percentage scores; iii) Total number of ICT tools = 13; iv) α = proportion score.

The case firms that had no plans to use at least 15% of the enlisted ICT tools emerged from Apapa-Wharf (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) had 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 as follows: use (30.50%); plan to use (25.42%); no plans (3.39%), and undecided (6.77%).

The inter-industry comparisons also involve other background information, as presented in Table 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 Wharf and Health sector. The same applies to their fleet sizes. The data for their years of establishments indicates that the Apapa-Wharf 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). 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.

Table7: 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

Note: i) LLC = Limited Liability Company; ii) N/A = Not available

Moreover, the results indicate that there is little or no restriction of entry or exit of the local 3PL SMEs into Apapa-Wharf and food/beverage, whereas there are full and partial restrictions for the health sector and auto-parts/accessories, 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.

4.2. Intra/inter-industry ICT adoption process comparisons

The results are summarised in Table 8, 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). 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 the case firm 2 (Apapa Wharf), and the two-case firm (6 and 7) from the food/beverages, respectively. They also share GPS (56%). Specifically, the case firms' 1 and 3 (Apapa Wharf), case firm 4 (Health sector), and the two case firms (8 and 9) from Auto-parts and accessories share information through GPS devices. Also, the international shipments documents such as the bill of ladings are shared, especially by the case firm 3 (Apapa Wharf), and the two case firms 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 Wharf), 3(Apapa Wharf), 8(Auto-parts/accessories), and 9 (Auto-parts/accessories) score 100% in all the enlisted activities. Others in the list (in decreasing order) include case firms 5 and 4 - Health Sector (88.2%, 76.5%); case firms 7 and 6 - Food and Beverages supply chain (70.6%, 47.1%); case firm 2 - Apapa Port Wharf (17.6%).

Table 8: 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	Wharf		Health sector		Food/beverage		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
Service providers/ equipment	GSM network providers	✓		✓	✓	✓	✓	✓	✓	✓	80
	Email service providers	✓		✓	✓	✓	✓	✓	✓	✓	80
	Internet network providers	✓		✓	✓	✓	✓	✓	✓	✓	80
	EDI & RFDI service providers	✓		✓	✓	✓			✓	✓	56

vendors	Computer/ accessories vendors	✓			✓		✓	✓		✓			✓		✓	✓		✓	78
	Website hosting companies	✓			✓			✓							✓	✓			56
Mean score - Case firms		100											47.1					100	-
				17.6		100		76.5		88.2				70.6		100			
Mean score – Industries			72.5								82.4				58.9		100		

This study again shows that the case firms that represented the auto-parts/accessories supply chain adopted all the identified ICT tools, followed by their counterparts in the health sector (82.4%), Apapa Wharf (72.5%), and food/beverage (58.9%). Last, our assessment of the impact of the environmental factors on the services of the internet network providers and original equipment manufacturers reveals relatively adverse effects within and across the case firms.

4.3. The pre-determined logistics performance comparisons

The summary of the pre-determined logistics performance index is presented in Table 9. The ranking is guided by the World Bank (2018) report concerning the interactive effects of the industry environment (infrastructure) and the logistics competence (internal resources) 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

These depict that firms/industries that have both improved infrastructure and logistics competence are proposed to achieve high logistics performance. Those with less public infrastructure and high internal resources are proposed to achieve moderate logistics performance. Similarly, the case firms with medium internal resources are proposed to achieve low logistics performance. Last, the case firm with less infrastructure and low internal resources are proposed to achieve very low logistics performance. This classification aligns with the Chow and Henriksson (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.

Table 9: Logistics performance index

Industry/item	Apapa Wharf			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		

Note: Decision rule - i) Improves infrastructure + enhance logistics competence = High logistics performance; ii) Less infrastructure + enhance logistics competence = Moderate logistics performance; iii) Less infrastructure + Less logistics competence = Low logistics performance.

The internal resources referred here include the combination of ICT resources, requisite skills, and education (knowledge). Likewise, external factors cover lack of public infrastructure unstable electricity, dilapidated road network, lack of data management system, lack of adequate telecommunication platforms, irregular polices (Ezenwa et al., 2020). 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 improve a specific performance collaboratively. 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).

Results indicate that none of the firms achieved high logistics performance, based on the general lack of enabling environment across the selected industries. Most of the case firms achieved moderate logistics performance across industries, except food/beverage case firms that score very low logistics performance. Similarly, case firm two (Apapa Wharf) scores low logistics performance. All the case firms in both the Auto-part/accessories and the Health sector 3PL SMEs recorded moderate logistics performance (see Table 9).

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.

5. Discussion of research findings and conclusion

We have drawn on the multiple case studies of the nine local logistics operators, across four distinct industries (supply chains) in Nigeria's local market to: illustrate the combined effects of industry and firm background (structure) on the ICT adoption process/priorities (process), and, in turn, logistics performance (outcome) of the local logistics operators (Donabedian, 1988). In this discussion, we begin by identifying and discussing factors influencing ICT adoption at firm levels. Thereafter, we offer guidelines on how the local logistics operators prioritise the application of ICT resources, in line with their scope of operations and services. We provide an overview of the possible consequences of the interactions of the structural forces and ICT adoptions priorities of the sampled firms on their predetermined logistics performance.

5.1. How do the company background and industry environment feature in the ICT adoption process of the local logistics operators?

Various forms of factors (e.g., technological, organisational, and environmental) are influencing ICT adoption at the firm level (Tornatzky and Fleischer, 1990). Environmental factors such as industry/firm backgrounds have been identified as vital fundamental factors influencing ICT uptake within the context of developing logistics markets due to the potential dampening effects of prevalent institutional voids (Dayan & Ndubisi, In press; Ezenwa et al., 2020; Ezenwa et al., 2018). Therefore, this study is conceived to map how the combinations

of the local environmental forces are influencing ICT adoption among the local logistics operators, across prominent and distinct industries (supply chains) in the study site. According to the research findings, the selected case firms vary in their backgrounds, as well as their responses to ICT uptake, supporting findings from elsewhere in the literature (Ezenwa et al., 2020; Tob-Ogu et al., 2018; Evangelista, 2011; Gunasekaran and Ngai, 2003; Pokharel, 2005). Precisely, the selected case firm from the auto-parts/accessories and their counterparts in the health sector exhibited considerable logistics competence, supported by their high levels of ICT profile and skills, as well as advanced and business knowledge and collaborations. 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, possibly as the environmental conditions in the regions improve. These converged with the phase two study of the wider research project, in terms of the dampening effects of the lack facilitating condition on the ICT consumer readiness, the scope of business of the local logistics operators, as well as their causal relationships with perceived usefulness/ease of use of available ICT resources (Ezenwa et al., 2018).

With regards to the resilience and ICT adoption process of the local logistics operators in the presence of unfavourable environmental conditions (Ezenwa et al., 2020), most of them are found to concentrate on the applications of simple ICT resources such as mobile phones and emails for mainly electronic communications. Others rely on the inappropriate adaption mobile telecommunication devices as tracking devices for the safety and security of their consignments and field staff (Melville et al.,2004; Tob-Ogu et al.,2018). 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 Wharf, 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 Wharf. The results also show that local 3PL SMEs are engaging ICT resource providers on third-party bases, which is a step in the right direction as the modern information technologies in the field are increasingly web or cloud resourced (Neaga et al., 2015; Zage et al., 2013). We might expect this to go a long way towards addressing infrastructure-related challenges among the local 3PL SMEs, as such web and cloud

resources are less dependent on traditional infrastructure (ENABLE, 2010; Harris et al., 2015; O'Sullivan, 2007; Perego et al., 2011).

However, understanding the capabilities and functions of the case firms, across their distinct industries/supply chains can help to identify the actual ICT adoption challenges in a particular context, and, in turn, inform the development of appropriate strategies to address them accordingly. Our results suggest that the barriers to using ICT tools may be higher for the local logistics operators with low ICT experience and business knowledge (e.g., case firm 2 -Apapa Wharf; case firms 6 and 7-Food/Beverages) than their counterparts with reasonable technological competence and robust supply chain network (e.g., case firms 1 and 3 -Apapa Wharf and the rest at Health Sector and Auto-parts/accessories). These align with arguments in Castka and Balzarova (2008) and Symesa and Phillipson (2019) that development of specialised local ICT training centres for local logistics operators as an ICT diffusion strategy in the local industry can enhance the possibility for informed and creative ICT adoption. It may also involve the development of collaborative frameworks 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 (Neaga et al., 2015; Tob-Ogu et al., 2018). In this light, the outcome of this study can be further applied as a conceptual framework for understanding ways to improve ICT adoption strategies among the local logistics operators and wider local logistics industry, which represents the main objective of this study.

5.2. How do the company background and industry environment influence the prioritisation of ICT tools of the selected local 3PL SMEs?

Many of the case firms stressed several specific environmental considerations that influence their prioritisation of ICT tools (Harris et al., 2015; Tiwari et al., 2018). which can be summarised into the three categories of research questions: How do the environmental factors influence: i) ICT facilitated activities; ii) types of information shared via ICT tools; iii) services of the network providers/equipment vendors?

Evidence from the study reveals that ICT facilitated activities such as business communication, tracking/tracing, online transactions, business website, and data storage/sharing are common within and across industries, except firms with low ICT experience/scope of business (case firm 2 - Apapa Wharf; case firms 6 and 7-Food/Beverage) and restricted operations (e.g., case firms 4 and 5- Health Sector). Also, the

study shows that almost all the case firms use voice/video and text messages to share information, while the applications of advanced ICT resources such as GPS, EDI, and CRM to share information/data remain prominent amongst the intermediate and advanced local logistics operators. Reflections from the study also suggest that the unfavourable environmental effects on the low quality of internet services and original equipment manufacturers' services are generic across the case firms. Hence, this study argues that understanding what the prevailing environmental effects are for a particular firm/industry and identifying appropriate measures (Ezenwa et al., 2020) can inform the adoption of appropriate strategies to improve ICT diffusion in the local logistics industry (Berglund et al., 1999; Evangelista, 2014).

The outcome of the study shows (as other related literature – Ezenwa, 2019; Tob-Ogu et al., 2018; Evangelista, 2011; Gunasekaran and Ngai, 2003; Pokharel, 2005) that local ICT adoption strategies need to consider the combination of prevailing technological, organisational, and environmental (T-O-E) factors. These factors incorporate stakeholders' perceptions/views of the relevance of intelligent solutions in the modern industrial environment, as well as other structural (market forces), and operational issues. The technological component captures the measurable characteristics of individual ICT adoption measures that relevant theories/models seek to appraise, and may include perceived usefulness (PU), perceived ease of use (PEOU), perceived behavioural control (PBC), and perceived service quality (PBC) (Awa et al., 2015). Some of the identified technological issues are highly socio (behavioural)-economical inclined, combining different sets of determinants to operationalise the adoption of a new system. Organisational factors consider firm conditions/reconfigurations, including the scope of business, consumer readiness, administrative support, company culture and structure (Chatterjee, Grewal, & Sambamurthy, 2002), as well as firms' expertise (Jeyaraj et al., 2006; Sabherwal et al., 2006; Tornatzky & Fleischer, 1990). Also, the environmental factors encompass primarily external factors that influence the rate of ICT diffusion within an 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 et al., 2003). As such, it is crucial to settle both firm and industry-specific issues, required to improve ICT uptake across the specific industries and supply chains highlighted in this study.

Further, having a valuable knowledge base that can integrate the environmental factors (industry and firm backgrounds) and ICT adoption processes and prioritisation is necessary. Also necessary are the organisational factors required to implement specific ICT or combination of ICT resources (Chen and Paulraj, 2004). These align with the need to promote policy actions that can enhance the optimisation of relevant ICT resources (e.g., able to understand and appraise the dynamics and operational options of their affiliated industries and supply chains). We envisage that these can provide insight into different practical ways in which ICT adoption challenges among the local logistics operators and the wider local logistics industry can be mitigated (Harris et al., 2015; Tiwaria et al., 2018). However, confidence is gained as the study shows need-based and context-specific ICT utility among the local logistics operators, as well as several others who intend to acquire the ICT resources in the future to improve their logistics performance (Ezenwa, 2019; Tob-Ogu et al., 2018; Evangelista, 2011; Gunasekaran and Ngai, 2003; Pokharel, 2005).

5.3. 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?

The outcomes from the study show that the logistics performances of local logistics operators are not independent of the characteristics of the firm and industry backgrounds. The logistics performance highlighted in this study includes logistics efficiency, adaptations, agility, and alignment (Lee, 2004), as well as the accuracy of record keeping. They selected and applied a combination of ICT tools in different ways within and across case industries/supply chains. In most cases, logistics performance is achieved based on their levels of ICT experience and business knowledge. For example, case firms 1 and 3 (Apapa Wharf); 4and 5 (Health Sector); 8 and 9 (auto-parts/accessories) demonstrated advanced ICT applications and enhanced business knowledge/collaborations, and, in turn, achieved moderate logistics performance. Whilst the case firms at Apapa Wharf concentrated on achieving efficiency and alignment of their operations/services, their counterparts in the Health Sector emphasised accurate record-keeping and efficiency. Likewise, auto parts and accessories case firms focus on improving their adaptation, alignment, and agility capacities through the application of relevant ICT tools. Also, the predetermined logistics performance index reveals that none of the firms attained high logistics performance due to general lack of business facilitating conditions in the region (Ezenwa et al., 2020; Iheanacho, 2014; Oledinma, 2015). The practical limitations were, for examples, institutional voids (irregular intervention scheme/policies and political

corruption); structural problems (infrastructural deficits and poor bureaucratic processes) (Ezenwa et al., 2020).

The logistics performance index helped to express the effects of the combination infrastructure (industry background) and logistics competence (firm background) (see Table 9). These imply that logistics performance in the region is driven by the individual efforts of the local logistics operators, as well as the surrounding local infrastructure. The predetermined logistics performance index is developed within the premise that both logistics/ICT infrastructure and the corresponding competency levels of the case firms build and complement each other in applying relevant ICT tools, and, in turn, achieving designated logistics performance. The outcome of the 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 status of the local logistics operators on the positive causal relationships between: i) scope of business and perceived usefulness of ICT; ii) consumer readiness and ICT acquisition (Ezenwa et al., 2018). Such revelation can be used to provide insight concerning the development of strategies to mitigate ICT adoption challenges among the local logistics operators, which often is of high priority to address lack of ICT skills and business competence among some of the case firms (e.g., case of firm 2 -Apapa Wharf and case firms' 6 and 7 - food/beverage).

Against this backdrop, we argue that the outcome of the multiple case studies demonstrates two categories of mitigation strategies: restoration (infrastructural deficits) and remediation (improvement of ICT skills), which suggest that there are different ways in which the identified ICT adoption challenges among the local logistics operators can be investigated and understood. Literature highlights that differentiating factors can be linked to historical background (scope of business) and to the extent of collaboration with international and local logistics outsourcing organisations. These suggest that those case firms with limited scopes of business and collaboration are more likely to be constrained to adopt relevant ICT resources than their counterparts with a broader scope of business and business collaborations. These indicate that the local logistics firms will draw from a range of different knowledge bases (e.g., their ICT skills/business knowledge and collaborating experience). For the ICT experience and business knowledge to contribute to addressing ICT adoption challenges among the local logistics operators, there is need for the relevant stakeholders to facilitate

discussion on trust-building to more robust business collaborations between the local operators and their logistics outsourcing firms (Banchuen et al., 2017).

Whilst improved ICT skills and business knowledge is required to boost the ICT adoptive capacities of the case firms, it is clear from the study outcomes that there is need for effective integration of the local logistics operators with their logistics outsourcing firms and customers (e.g., case firms 8 and 9 - auto parts and accessories supply chains) that have robust collaborative frameworks, particular with their international partners that usually sub-contract them for local last deliveries. Similarly, other case firms that scored moderate logistics performance (e.g., case firms 3 and 4) also shared stronger collaboration with their customers than their counterparts with weak collaboration. We argue that improved collaboration amongst supply chain partners can inform effective/efficient combination of relevant ICT tools and trust-building, which, can, in turn, foster logistics performance. As the individual industries/supply chains focus on different customers' demand, it is imperative to open engagement with different stakeholders in the local logistics industry to stimulate meaningful approach on how to improve logistics performance in the region through the proposed remediation/restoration options for enhancing ICT diffusion among the local logistics operators.

On the basis of methodological strength, the multiple case study achieved the following five goals: i) Provides deeper insights concerning industry and firm-specific issues that affect the efficient implementation of ICT resources by the local logistics operators. ii) Fosters triangulation of findings which may increase stakeholders' confidence in finding lasting solutions to mitigate ICT diffusion challenges among the local logistics operators. iii) Spurs follow up assessment of industry/geographical issues highlighted in the earlier phases of this study and elsewhere in the literature. iv) Facilitates responses to the identified priorities and challenges raised across various industries and supply chains raised in this study. v) Strengthen the level of robustness of supply chain integration in the local logistics market. These align with the notion that this study provides a medium for meeting different decision-making contexts with practical case studies across notable and distinct supply chains and industries in the study site. With these, this study offers the following ICT diffusion strategies, for example: i) Awareness raising concerning the importance of intelligent ICT tools in meeting modern supply demands. ii) Formulation of context-specific mitigation options, and (iii) developing settings to apply different options, with the associated decision-making. Accounting for these various settings can determine the extent to which lack of ICT

diffusion in the local logistics industry has impacted logistics performance in the region (World Bank, 2013, 2018).

Although logistics performance can be boosted when adequate ICT resources are applied, there are ranges of challenges that may arise when there are firm/industry-specific voids. These include: i) Firm constraints relating to lack of relevant expertise, data availability, and financial resources (Saarikoski et al., 2016). ii) Industry-specific constraints in terms of lack of platforms for effective integration of the local third-party logistics services with their logistics outsourcing organisations (Banchuen et al., 2017). (iii) Methodological constraints, regarding different units of measurement of values, scales, and units, across various levels of supply chains the local logistics operators patronise (European Commission, 2011; Symesa and Phillipson, 2019; Yawar and Seuring, 2015; Volchko et al., 2014), and (iv) Contradictions in findings, relating to factors influencing diffusion among the local logistics operators (Kilpala et al., 2005; Pokharel 2005). Practical evidence on how the multiple case studies have helped to facilitate the assessment of ICT adoption improvement measures draws on strengthening the local logistics operators' connection to different industries/options as well as making relevant policies that would address the above gaps. This study highlights the importance of creativity when dealing with improving ICT adoption strategies among local logistics operators. This highlights the importance of incorporating relevant stakeholders' engagement within all aspect of policy-making and research process (Ezenwa et al., 2020; Grimm et al., 2014).

5.4. Conclusion

This paper explored the mechanisms to improve ICT diffusion in Nigeria's transport and logistics industry, using nine case studies across four distinct industries/supply chains in the region. It revealed how different factors within the firm/industry backgrounds could inform ICT adoption process/prioritisation and logistics performance of the local logistics performance. Also important is the developed predetermined logistics performance index to understand different ways the local logistics performance can be measured. Important attributes of the firm/industry backgrounds, ICT adoption, and logistics performance were identified, encompassing technological, organisational, environmental (institutional), and socio-economic issues. Results presented show that there are significant intra/inter-industry differences, in terms of responses of the case firms to ICT adoption challenges in the region. Specifically, the case firms with sufficient technological know-how and enhanced scope of

business appear more likely to optimise the application of relevant tools. Hence, the willingness to adopt appropriate ICT tools depends on both firm and industry backgrounds that propel participatory deployment as witnessed among case firms 8,9 (Auto-parts/Accessories) that require the application of relevant ICT tools to remain in business. These indicate that efficient applications of ICT tools require that the local logistics operators first have a good understanding of how the local facilitating conditions fit into trading partners' readiness, competitive pressure, and trust-building (Ezenwa et al., 2018; Annosia et al., 2019).

It is beyond this paper to provide definite guidance on the strategies to accurately decide on the right ICT tools or how to integrate them across various levels of supply chain partners and customers as this depend on the specific case study context. As there is no one-size-fits-all mechanism for deciding types and extent of ICT adoption among the local logistics operators, guidance based on applying single ICT tools in isolation should recognise that modern ICT tools are not completely independent of each other. Hence, we recommend adoption of web and cloud technologies due to their universality in application. Also, they are less dependent on the traditional infrastructure, which may help to ameliorate the negative impacts of the perceived lack of facilitating conditions in the study site. This is especially so if the local logistics operators and their logistics outsourcing organisations and customers are keen to develop robust collaborative framework, with soft ICT adoption options such as web or cloud platforms. This aligns with the fact that sole ownership of advanced ICT resources is expensive and non-economical, which the local logistics operators may be incapable of acquiring without external supports and patronage.

In sum, the adoption of the structure-process-outcome model ((Donabedian, 1988)) in this study has improved our understanding of the impacts of the diverse firm/industry backgrounds on the ICT adoption process/prioritisation of ICT resources, as well as the predetermined logistics performance of the local logistics operators. Finally, these suggest that the right firm/industry backgrounds can stimulate valuable applications of ICT tools for sustainable logistics performance in the local logistics industry.

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References

Alokan, O. (1995). The road freight industry in Nigeria: new challenges in an era of structural adjustment. *Transport Reviews.* Vol. 15, No. 1, pp 27-41.

Alokan, O. (1988). An analysis of the spatial distribution of freight haulage firms in Nigeria. *Nigerian Journal of Economic and Social Studies. Vol. 30, No.* 1, pp. 241-260.

Allaoui, H., Guo, Y., and Sarkis, J. (2019). Decision support for collaboration planning in sustainable supply chains. *Journal of Cleaner Production.* Vol. 229**,** pp. 761-774.

Al-Qirim, N. (2006). The role of government and e-commerce adoption in small businesses in New Zealand. *International Journal of Internet and Enterprise Management.* Vol. 4**,** pp.293-313.

Ammenwerth, E., Ehlers, F., Hirsch, B., and Gratl, G. (2007). HIS-Monitor: An approach to assess the quality of information processing in hospitals. *International journal of medical informatics.* Vol. 76, No. 2-3, pp. 216-225.

Anderson, R. (2006). LCV scoping study 1: Review of published literature. *In:* Vallint, J. (ed.). *Report to DfT Logistics Policy Division ED06135.*

Annosia, C., M., Brunettab, F., Montic, A. and Natid, F. (2019). Is the trend your friend? An analysis of technology 4.0 investment decisions in agricultural SMEs. *Computers in Industry.* Vol.109, pp. 59-71.

Apulu, I. (2012). *Developing a framework for successful adoption and effective utilization of ICT by SMEs in developing countries: a case study of Nigeria.* University of Wolverhampton, Apulu - 2012 - wlv.openrepository.com (accessed 18.10. 2020).

Arvis, J.-F., Saslavsky, D., Ojala, L., Shepherd, B., Busch, C., and Raj, A. (2018). Connecting to compete 2018: Trade logistics in the global economy - the Logistics Performance Index and its indicators from World Bank: <https://openknowledge.worldbank.org/handle/10986/24598> (accessed 07.03.2020).

Awa, H., Ukoha, O. & Emecheta, B. (2015). Integrating TAM and TOE Framework and Expanding their Characteristics Constructs for E-Commerce Adoption by SMEs. *Journal of Science & Technology Policy Management.* Vol. 6**,** pp. 76-94.

Banomyong, R. (2017). International freight logistics in South East Asia: The Indonesia - Malaysia -Thailand Growth Triangle (IMT-GT). In A. Beresford and S. Pettit (Eds.), *International freight transport* (pp. 177-203). United Kingdom: Kogan Page.

Banchuen, P., Sadler, I., Shee, H. (2017) Supply chain collaboration aligns order-winning strategy with business outcomes. *IIMB Management Review*. Vol. 29, pp. 109–121

Berglund, M., van Laarhoven, P., Sharman, G., and Wandel, S. (1999). Third Party Logistics: is there a new future? *International Journal of Logistics Management.* Vol. 10. No. 1, pp. 59-70.

Bryman, A., and Belle, E. (2003). *Business Research Methods*. New York: Oxford University Press.

Busse, C., Schleper, M., Niu, M., and Wagner, S., M. (2016). Supplier development for sustainability: contextual barriers in global supply chains. *Int. J. Phys. Distrib. Logist. Manag* Vol 46, pp 442-468.

Carter, C., R., Rogers, D., S., Choi, T., Y. (2015). Toward the theory of the supply chain. *J. Supply Chain Management.* Vol. 51**,** pp. 89-97.

Castka, P., and Balzarova, M., A (2008). ISO 26000 and supply chains-On the diffusion of the social responsibility standard. *Int. J. Prod. Econ.* Vol 111, pp. 274-286.

Chen, I., and Paulraj, A. (2004). Towards a theory of supply chain management: The construct and measurements. *Journal of Operations Management*. Vol.22, No 2, pp. 119-150

Chow, G., Heaver, T., D., and Henkriksson, L., E. (1994). Logistics performance, definition and measurement *International Journal of Physical Distribution and Logistics Management, 24*(1), 17-28.

Chow, G., and Henriksson, L., E. (1993). *A Critique of Survey Research in Logistics*: University of British Columbia, Faculty of Commerce and Business Administration.

Cooper, M., C., Lambert, D., M., and Pagh, J., D. (1997) Supply chain management: more than a new name for logistics, Int. J. Logist. Manag. Vol. 8, pp 1–14. doi:http://dx.doi. org/10.1108/09574099710805556.

Cui, L., Su, S.-I., I., and Hertz, S. (2012). Logistics innovation in China. *Transport. J. Vol.*

51. No. 1, pp 98–117.

Dayan, M., and Ndubuisi, N., O. (In press). B2B service innovation and global industrial service management. *Industrial Marketing Management,* - (-), -.

Denzin, N., K., and Lincoln, Y., S. (2000). Introduction, the discipline and practice of qualitative research. *In:* Denzin, N., K., & Lincoln, Y., S. (eds.). *Handbook of qualitative research.* Thousand Oaks (CA), Sage.

DISCWISE. (2012). Discwise Guide to e-Business: Connecting SMEs to digital transport and logistics chain.

Donabedian, A. (1988). Quality assessment and assurance: Unity purpose, diversity of means. *Inquiry, 25*(1), 175-192.

Dunford, B., Harrison, P., Smith, A., Dick, J., Barton, D., Martin-Lopez, B., Kelemen, E., Jacobs, S., Saarikoski, H., Turkelboom, F., and Yli-Pelkonen, V. (2018). Integrating methods for ecosystem service assessment: experiences from real world situations. *Ecosyst. Serv.* Vol. 29, pp. 499 -514.

ENABLE. (2010). *Stimulate Sustainable Freight Transport Systems with Latin American countries.* [Online] http://www.enableproject.net/Outcomes/tabid/59/language/en-US/Default.aspx (accessed 26/05/2018).

Eniola, O., J., Njoku, I., Oluwatosin, F., A., And Enosko, O. (2014). Performance Evaluation of Nigeria Ports: Pre and Post Concession Era. *Civil and Environmental Research.* http://www.iiste.org/journals/index.php/CER/article/view/10841 (accessed 27.06.2019).

European Commission. (2011). *Land Transport Unit DG MOVE. Road Freight Transport Vademecum 2010 Report of the Road Haulage Sector, Land Transport Unit DG MOVE*. http://ec.europa.eu/transport/modes/road/doc/2010-road-freight-vademecum.pdf (accessed 18-03-2019).

Evangelista, P. (2011). *ICT diffusion in SMEs, an investigation into the Italian transport and logistics service industry*. Italian: Edizioni Scientifiche.

Evangelista, P. (2014). Environmental sustainability practices in the transport and logistics industry: An exploratory case study investigation *Res. Transp. Bus. Manag.* Vol. 12, pp 63-72.

Evangelista, P., and Sweeney, E. (2006). Technology usage in the Supply Chain: the case of small 3PLs. *International Journal of Logistics Management.* Vol 17, No. 1, pp 55-74.

Ezenwa, A., E. (2014). ICT adoption in logistics operations; an emerging trend for sustainable development and human capacity building in South-Eastern Nigeria Journal *of Emerging Trends in Engineering and Applied Sciences. Vol. 5, No.* 7, pp 24-28.

Ezenwa, A., E. (2019). *Investigating the mechanisms influencing Information and Communication Technology adoption amongst selected supply chains in Nigeria: a multiple case study*. Paper presented at the Proceedings of 51st Annual University Transport Study Group Conference.

Ezenwa, A., Whiteing, A., Daniel, J., and Oledimma, A. (2020). Factors influencing Information and Communication Technology Diffusion in Nigeria's transport logistics industry: an exploratory study. *International Journal of Integrated Supply Management.* Vol. 13, No.2/3), pp 252-276.

Ezenwa, A., Whiteing, A., Johnson, D., and Oledimma, A. (2018). *Investigating ICT diffusion dynamics among small and medium third-party logistics providers in Nigeria: An exploratory mixed-method study* Paper presented at the Proceedings of 2018 CILT-Logistics Research Network Conference

Giorgi, A. (1985). Sketch of a Psychological Phenomenological Method. In A. Giorgi (Ed.), *Phenomenology and Psychological Research: Essay*. Pittburgh: Duquesne University Press.

Grant, R. (1991). The Resource-based theory of competitive advantage: implications for strategy formulation. *Calif. Manag. Rev.* Vol 33**,** pp. 114-135.

Gualandris, J., Klassen, R., D., Vachon, S., and Kalchschmidt, M. (2015). Sustainable evaluation and verification in supply chains: aligning and leveraging accountability to stakeholders. *J. Oper. Manag.* Vol. 38, pp 1-13.

Gunasekaran, A., and Ngai, E., W., T. (2003). The successful management of a small logistics company. *International Journal of Physical Distribution and Logistics Management. Vol. 33*. No.9, pp 825-842.

Grimm, J., H., Hofstetter, J., S., and Sarkis, J. (2014). Critical factors for sub-supplier

management: A sustainable food supply chains perspective. *Int. J. Prod. Econ.* Vol. 152**,** pp. 159–173.

Harris, I., Wang, Y., and Wang, H. (2015). ICT in multimodal transport and technological trends: Unleashing potential for the future. *International Journal of Production Economics.* Vol. 159, pp 88-103.

Hugos, M., H. (2002). Essentials of Supply Chain Management. *Wiley, London, UK.*

Iheanacho, E., N. (2014). National Development Planning in Nigeria: An Endless Search for Appropriate Development Strategy. *International Journal of Economic Development Research and Investment.* Vol. 5, No..2, pp 49-60.

Jeyaraj, A., Rottman, J., and Lacity, M. (2006). A review of the predictors, linkages, and biases in IT innovation adoption research. *Journal of Information Technology*. Vol 21**,** pp. 1-23.

Jiang, B. (2009). The effects of interorganizational governance on supplier's compliance with SCC: an empirical examination of compliant and noncompliant suppliers. *J. Oper. Manag*. Vol. 27, No 4, 267-280.

Kilpala, H., Solvang, W., Widmark, J., Bagaeva, A., and Tuohinto, P. (2005). Analysis of ICT use in the Barents region: research findings from logistics service providers and forest industry. *Sustainable Transport in the Barents Region (STBR), Publication 11/2005*, ISBN 952-5549-86-6

Koberg, E., and Longoni, A. (2019). A systematic review of sustainable supply chain management in global supply chains. *Journal of Cleaner Production.* Vol. 207(-), pp 1084-1098.

Konovalenko, I., Ludwig., A. (2019). Event processing in supply chain management - The status quo and research outlook. *Computers in Industry.* Vol. 105, pp. 229-249.

Kowath, N., and Choon, T. (2001). Determinants of website development: A study of electronic commerce in Singapore. *Information and Management. Vol. 39, No.* 3, pp 227-242.

Kunkel, S., Rosenqvist, U., and Westerling, R. (2007). The structure of quality systems is important to the process and outcome, an empirical study of 386 hospital departments in Sweden. *BMC Health Services Research. Vol.7, No.* 1, pp 104 -120.

Lambert, D., M., and Cooper, M., C. (2000) Issues in supply chain management, *Ind. Mark. Manag*. Vol. 29, pp. 65–83. doi:http://dx.doi.org/10.1016/S0019-8501 (99) 00113-3.

Lambert, D., M., Cooper, M., C., and Pagh J.D. (1998) Supply chain management: Implementation issues and research opportunities, *Int. J. Logist. Manag*. Vol 9, pp. 1-20. doi:http://dx.doi.org/10.1108/09574099810805807.

Lau, K., and Huang, A. (2012). A Survey-Based Study on ICT Adoption in the Third-Party Logistics Industry. *International Journal of Information Systems and Supply Chain Management. Vol. 5, No.*4, pp 65-85.

Lee, H. (2004). The triple – a supply chain. *Harvard Business Review*. October, pp 102-112.

Lieb, R., and Schwarz, B. (2002). CEO perspective on the current status and future prospect of the third-party logistics industry in the U.S. *Supply Chain Forum. Vol.* 22**,** pp 36-44.

Macdonald, K. (2007). Globalizing justice within coffee supply chains? Fair Trade, Starbucks and the transformation of supply chain governance. *Third World Q.* Vol 28, pp 793-812.

Mckinnon, A. (2012). Environmental sustainability: a new priority for logistics managers. *In:* Mckinnon, A., Brown, B. & Whiteing, A. (eds.) *Improving the environmental sustainability of logistics.*

Melville, N., Kraemer, K., and Gurbaxani, V. (2004). Review: Information technology and organizational performance: An integrative model of IT business value. *MIS Q.* Vol 28, No 2, pp 283-322.

Neaga, I., Liu, S., Xu, L., Chen, H., and Hao, Y. (2015). *Cloud enabled big data business platform for logistics services: A research and development agenda.* Paper presented at the Decision Support Systems V - Big Data Analytics for Decision Making. Cham: Springer.

O'Sullivan, D. (2007). Software as a service: developments in supply chain IT. *Logist. Transp. Focus.* Vol. 9, No. 3, pp 30-33.

Olanrewaju, S., A (1987). Economies of scale in the road haulage system: some evidence from the Nigerian economy. *Transportation Research.* Vol. 12A, pp. 171-178.

Oledinma, A. (2015). The Institutional Framework Surrounding Agricultural Transportation Policy in Nigeria. *Journal of Transport Literature.* Vol. 9, No. 2, pp.50-54

Papetti, A., Marconi, M., Rossi, m., and Germani, M. (2019). Web-based platform for eco-sustainable supply chain management. *Sustainable Production and Consumption.* Vol. 17, pp. 215–228.

Perego, A., Perotti, S., and Mangiaracina, R. (2011). ICT for logistics and freight transportation: a literature review and research agenda. *Int. J. Phys. Distrib. Logist Manag.* Vol. 41, No. 5, pp. 457–483.

Pokharel, S. (2005). Perception on information and communication technology perspectives in logistics - A study of transportation and warehouses sectors in Singapore. *The Journal of Enterprise Information Management.* Vol. 18, No. 2, pp. 136-149.

Powell, W., B., and Sheffi, Y. (1983). The road planning problem of motor carriers: problem description and a proposed solution approach. *Transport Research.* Vol. 17A, pp. 471-480.

Reddy, R., and Reddy, S. (2001). Supply Chain to Virtual Integration. *McGraw-Hill, London, U.K.*

Saarikoski, H., Mustajoki, J., Barton, D.N., Geneletti, D., Langemeyer, J., GomezBaggethun, E., Marttunen, M., Antunes, P., Keune, H. (2016). Multi-criteria decision analysis and cost-benefit analysis: comparing alternative frameworks for integrated valuation of ecosystem services. *Ecosyst. Serv*. Vol. 22B, pp. 238–249.

Sancha, C., Gimenez, C., and Sierra, V. (2016). Achieving a socially responsible supply chain through assessment and collaboration. *J. Clean. Prod.* Vol. 112, pp. 1934-1947.

Scupola, A. (2009). SMEs' e-commerce adoption: Perspectives from Denmark and Australia. *Journal of Enterprise Information Management.* Vol. 22**,** pp 156-166.

Seuring, S. (2005). Case study research in supply chains - An outline and three examples. In H. Kotzab, M. Westhaus, S. Seuring, M. Muller and G. Reiner (Eds.), *Research methodologies in Supply Chain Management* (pp. 235-250). Heidelberg: Physica-Verglag.

Sweeney, E., and Bahr, W. (2019). The human chain in logistics and supply chain

management research and practice. *Journal of Supply Chain Management, Logistics and Procurement.* Vol 2, No. 1, pp. 72-83.

Sweeney, E., Grant, D., B., and Mangan, D. J. (2015). The implementation of supply chain management theory in practice; an empirical investigation. *Supply Chain Management: An International Journal.* Vol. 20, No. 1, pp. 56-70.

Sweeney, E., Grant, D., B., and Mangan, J. (2017). Strategic adoption of logistics and supply chain management. *International Journal of Operations and Production Management.* DOI: 10.1108/IJOPM-05-2016-0258.

Symesa, D., and Phillipson, J. (2019). A sea of troubles' (2): Brexit and the UK seafood supply chain. *Marine Policy.* Vol. 102, pp. 5-9.

Tiwari, S., Weeb, H., M., and Daryantob, Y. (2018). Big data analytics in supply chain management between 2010 and 2016: Insights to industries. *Computers and Industrial Engineering.* Vol. 115, pp. 319-330.

Tob-Ogu, A., Kumar, N., and Cullen, J. (2018). ICT adoption in road freight in Nigeria - A case study of the petroleum downstream sector. *Technological forecasting and social change.* Vol. 131, pp. 240-252.

Tornatzky, L., and Fleischer, M. (1990). *The process of technology innovation*. Lexington, M.A: Lexington Books.

Venkatesh, V., and Davis, F., D. (2000). A theoretical extension of the Technology Acceptance Model: Four longitudinal field studies. *Management Sciences. Vol. 46. No.* 2, pp.186-204.

Volchko, Y., Norrman, J., Rosen, L., Bergknut, M., Josefsson, S., Soderqvist, E., T., Norberg, T., Wiberg, K., Tysklind, M. (2014). Using soil function evaluation in multicriteria decision analysis for sustainability appraisal of remediation alternatives. *Sci. Total Environ*. Vol. 485–486, pp. 785–791.

World Bank (2013). International Monetary Fund: United Nations Conference on Trade and Development (UNCTAD) World Investment Report. https://unctad.org/en/ PublicationsLibrary/wir2013_en.pdf (accessed 25.10.2019).

World Bank (2018). Country Score Card: Nigeria 2018 | Logistics Performance Index.

https://lpi.worldbank.org/international/scorecard/radar/254/C/NGA/2018 (accessed 12.06. 2019).

World Bank. (2013). *International Monetary Fund: United Nations Conference on Trade and Development (UNCTAD) World Investment Report*.

World Bank. (2018). Country Score Card: Nigeria 2018 | Logistics Performance Index. Retrieved 12/06/2019:

Xie, Y., and Breen, L. (2018). *E-integrated healthcare supply chains: tracking and monitoring medical devices in the National Health Service (NHS), UK*. United Kingdom: Kogan Page.

Yawar, S., A., and Seuring, S. (2015). Management of social issues in supply chains: a literature review exploring social issues, actions and performance outcomes. *J. Bus. Ethics*, 1-23.

Yin, R. K. (2014). *Case study research: Design and methods* (Vol. 5th edition). London: Sage Publication.

Zage, D., Glass, K., and Colbaugh, R. (2013). *Improving supply chain security using big data.* Paper presented at the IEEE International Conference on Intelligence and Security Informatics (ISI).

Zhu, K., Kreamer, K. and Xu, C. (2003). Electronic business adoption by European firms: A cross-country assessment of the facilitators and inhibitors. *European Journal of Information Systems.* Vol.12**,** pp. 251-268.