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PORT PERFORMANCE AND CRUDE OIL EXPORT

LOGISTICS SYSTEM DISTRIBUTION IN NIGERIA

by

ISHAKA AL-MUSTAPHA SHITU

A thesis submitted to the University of Plymouth in partial fulfilment for the degree of

DOCTOR OF PHILOSPHY

Plymouth Business School

May 2021

Dedication

I dedicate this thesis to my great country, Nigeria, which gave me a rare privilege to study at a doctoral level; its impact appears to be critical for Nigeria's cash cow industry sustainability towards a fairer and prosperous nation. More importantly, and to my beautiful daughters Aisha and Asia that missed me while in the UK, and later joined me, helping me to settle down to study. In addition, new baby boy arrival gladdens my heart. God Almighty Lord of creations has been wonderful.

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- During this research, I collaborated with key Nigerian agencies: Nigerian National Petroleum Corporation, Department of Petroleum Resources (DPR), and Nigerian Ports Authority. Major and indigenous Oil Companies in Nigeria. Further, Oil Companies International Marine forum (OCIMF), London technical team. Special thanks to all the members of staff that volunteered their time for data collection purposes.
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- To my external examiner, Prof D John Mangan, School of Engineering, University of Newcastle, UK. Thank you so much and God bless.
- I cannot mention all but I am using this medium to say thank you very much to all those that made it happen.

Author's Declaration

At no time during the registration for the research degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Doctoral College Quality Sub-committee.

Work submitted for this research degree at the University of Plymouth has not formed part of any other degree either at the University or at another establishment.

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- Shitu, I., (2017). Empirical evidence of scoping stage of some strategies of port performance in crude oil export logistics system distribution in Nigeria. Presented at 2nd student Conference in Sustainable Operations, Logistics and Supply Chains Management, University of Sheffield, 10 March 2017
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- 8. Shitu, I. (2018), "*The importance of information flow in port performance logistics system.* Presentation of findings in Three Minute

Thesis Competition to non-specialist audience, 11th May, 2018 University of Plymouth

- 9. Shitu, I. (2018). *Prioritising some strategies for port performance and crude oil export logistics system distribution in Nigeria* University of Plymouth Faculty of Business Doctoral Conference, 25 June 2018
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- 11. Shitu, I. (2020). Assessing role of Private Maritime Security Companies in Port performance and crude oil export logistics system distribution in Nigeria. Research Showcase in University of Plymouth, 11 Mar. 20

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Signed: ...Ishaka Shitu.....

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Abstract

Port Performance and Crude Oil Export Logistics System Distribution in Nigeria.

Crude oil export is a resource that provides essential building blocks for economic development and prosperity for Crude oil exporting countries (COECs). Previous research found information flow been significant for logistics and supply chains sustainability. In the current low price environment, key COECs experienced recession, especially brought by the 2014 oil price crash. Obviously, performance of export terminals is vital to maintain competitive advantage. Nigeria's reputation in the global oil market suffers due to avoidable delay arising because cargoes for tankers are occasionally disrupted through shutdown due to pipeline leaks or sabotage. In addition, when prices are relatively high an evolving energy transition scenario reveals a global shift in demand away from traditional fossil fuel to gas, and increasingly, reducing global demand for fossil fuels.

The study was guided by a pragmatic philosophy, commencing with scoping interviews and mixed methods that embraced different analytical techniques. First, a model of key strategies to model port performance. Supply chain management (SCM) concepts were not fully understood by low-cost producers' and the Nigerian National Petroleum Corporation (NNPC). International oil companies (IOCs operate more effectively than Indigenous companies and NNPC needs to review its business model. Analytical Hierarchy Process (AHP) group decision makers scored the information sharing and synergy between supply chain actors' strategy to be highest at

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22.85%. Investment and security are topical in Nigeria because of inadequate investment in the pipeline automation security system, dredging, security platform and capability, metering systems and information communication technology. Improved port security encompass anti-piracy laws, private maritime security companies. The Petroleum Industry Bill (PIB) remains a key concern for all stakeholders, particularly concerning investment and information sharing networks. Policy contribution includes the use of reliable and accurate metering systems for bill of lading figure. Theoretical contribution revealed template analysis being a rare technique. In addition, weather friendliness has been found to be effective for seamless logistics operations as a resource base view strategy for Nigeria.

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List of publications produced during period of study

Presentations at International conferences

- Shitu, I., (2017). Empirical evidence of scoping stage of some strategies of port performance in crude oil export logistics system distribution in Nigeria. Presented at 2nd student Conference in Sustainable Operations, Logistics and Supply Chains Management, University of Sheffield, 10 March 2017
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- 14. Shitu, I. (2017), Analysing measure of port performance and crude oil export logistics system distribution in Nigeria. University of Plymouth Doctoral Colloquium (UKPDC), 6th – 7th June, 2017
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- 22. Shitu, I. (2020). Assessing role of Private Maritime Security Companies in Port performance and crude oil export logistics system distribution in Nigeria. Research Showcase in University of Plymouth, 11 Mar. 20

AHP	Analytic Hierarchy Process
ARS	Addictive Ratio Assessment
Berth	To bring a ship to a berth where it docks
Bpd	Barrel Per Day
BOL	Bill of Lading
BT	Blockchain Technology
BS&W	Basic Sediment and Water
CA	Competitive Advantage
CAPEX	Capital Expenditure
CIF	Cost Insurance & Freight
CQ	Certificate of Quantity
CS	Certificate of Sample
CT	Custody Transfer
	Crude Oil Marketing Department
COEC	Crude Oil Exporting Countries
CSCMP	Council of Supply Chain Management Professionals
CR	Consistency Ratio
CST	Crude Oil Shipping and Terminal
DFD	Data Flow Diagram
DI	Documentary Instruction
DM	Decision Maker
DPR	Department of Petroleum Resources
DWT	Deadweight tonnage
ECA	Ethnographic Content Analysis
ECOWAS	Economic Community of West African States
EEZ	Exclusive Economic Zone
EIA	Energy Information Administration
EMS	Environmental Management System
E&P	Exploration and Production
EP	Export Permit
F-RTG	Electric Rubber Tyred Gantry Crane
FU	Furopean Union
FSPO	European Sea Port Organisation
EVM	Eigen Vector Method
FOB	Free On Board
FLT	Federal Lighter Terminal
FOT	Federal Ocean Terminal
FPSO	Floating Production Storage and Offloading
FTA	Free Trade Agreement
FT7	Free Trade Zone
GHG	Greenhouse Gas
GT	Gross Tonnage
GT	Grounded theory
	Human Frror Assessment and Reduction Technique
HEART	Human Error Assessment and Reduction Technique

Glossary of abbreviations and acronyms

HEP	Human Error Probability
HYSON	Hydrocarbon Services Nigeria Limited
ICOL	Indigenous Crude oil Lifters
ICOTC	Indigenous Crude Oil Trading Company
IICC	Inadequate Information Infrastructure Capability
IMO	International Maritime Organisation
IOC	International Oil Companies
IOPC	International Oil Pollution Compensation Fund
IDOC	Indigenous Oil Companies
ISO	International Standard Organisation
JOA	Joint Venture Agreement
JVC	Joint Venture Contract
Kbd	Thousand Barrel Day
KM	Knowledge Management
KRPC	Kaduna Refinery and Petrochemical Company
	Limited
kwh	Kilo Watt's Hour
LACT	Least Custody Transfer Unit
UNIT	
LO	License to Operate
LSCI	Liner Shipping Connectivity Index
LNG	Liquefied Natural Gas
MEG	Middle East Gulf Countries
MCDM	Multi Criteria Decision Making
Mmt	Millions Metric Tonnes
MRCM	Multiplicative Reciprocal Comparism Matrix
MPNU	Mobil Producing Nigeria Unlimited
MPMS	Manual of Petroleum Measurement System
MPR	Ministry of Petroleum Resources
NAOC	Nigerian Agip Oil Company Limited
NOR	Notice of Readiness
NETCO	National Engineering and Technical Company
NGC	Nigerian Gas Company
NNPC	Nigerian National Petroleum Corporation
NIMASA	Nigerian Maritime Administration Safety
	Administration
NPA	Nigerian Ports Authority
NPDC	Nigerian Petroleum Development Company
NOC	National Oil Company
ODS	Onshore Distribution Storage
OPEC	Organisation of petroleum exporting countries
OPL	Oil Prospecting Licence
OGIC	Oil and Gas Sector Reform Implementation
	Committee
OCIMF	Oil Companies' International Marine Forum
OSPS	Oil Selling Price
PHRC	Port Harcourt Refining Company
PIB	Petroleum Industry Bill
PPT	Petroleum Profit Tax

PPMC	Products and Pipeline Marketing Company
PSC	Production Sharing Contract
PSMC	Private Security Maritime Company
QRA	Quantitative Risk Analysis
RMB	Its official currency of people of China
RTG	Rubber Tyred Gantry Crane
RMG	Rail Mounted Gantry Crane
SBM	Single Buoy Mooring
SCM	Supply Chain Management
SPDC	Shell Petroleum Development Company
SLR	Systematic Literature Review
SOLAS	Safety of Life at Sea
SPR	Strategic Petroleum Reserves
SQA	Ship Quality Assurance
SCF	Standard Cubic Foot
SWOT	Strength, Weakness, Opportunities and Threat
ТА	Template Analysis
TCE	Transport Cost Economy
TICP	Tin Can Port Complex
TEP	Trans Export Pipeline
THA	Thematic Analysis
tonne	Another term for metric ton
UNCTAD	United Nations Conference on Trade and
	Development
VCM	Vector Correction Model
VLCC	Very Large Crude Carriers
VC	Vessel clearance
WAF	West Africa
WRPC	Warri Refinery and Petrochemical
WTO	World Trade Organisation

CHAPTER ONE: INTRODUCTION

1.1 Chapter One Overview

This chapter presents an overview of this study: Port performance and crude oil export logistics system distribution. This chapter begins with a general background regarding the importance of crude oil exports as an energy source in the global economy with a specific focus on the Nigerian context. The research problem is framed, aim and objectives defined, rationale and summary outlined. In addition, the research gap is introduced. The main research question and objectives guided the direction of this study and the research methodology outlines how the research objectives are accomplished. This chapter concludes with an outline of the research report of the whole thesis and a brief description of each chapter.

1.2 Research Background

No industry is as important to the human condition and development as energy. Its functions the span fuelling of cars, lighting homes and powering businesses to mention a few. The challenge to ensuring access to sustainable, affordable, sources of energy for billions of people in the world is critical. Hence the performance of crude oil export logistics systems distribution is of utmost importance for a safe, secure and sustainable energy source for the global economic development. First, crude oil logistics involves exploration, production, refining, distribution, marketing and sales (Chima, 2007, p.28 and Joshi eta al., 2017, p.1853). Crude oil exports have been a vital global energy source and supply chains are critical assets for society. Disruption has profound economic impacts on producing companies, nations, customers, and all those engaged in the supply chains (Halldorsson and Svanberg, 2013). Further, oil freight flows vary with supply and demand for crude oil and its products, which generate transport demands dependant on GDP (Dinwoodie et al., 2013, p.554). In 2018, global oil demand was projected to expand by a steady 1.5% to reach 99.0m (Clarkson's Research, 2018, p.2). More importantly, this comes with ease of international trade and the inflexibility involved in the petroleum industry's supply chain that make its management more complex and challenging (Coia, 1999; Morton, 2003). In recent times, Joshi et al., (2017, p.1852) acknowledged complexity and interdependency of oil supply chain that makes it possible to be susceptible to risk such as fluctuation in supply, demand and price and uncertainty. More importantly, to attain a competitive advantage and sustainable supply chain, it is essential to focus on innovation, which in turn impacts on customer

satisfaction, optimising inventories and total cost (Joshi et al., 2017, p.1853). Essentially, ensuring a cost effective crude oil supply is of paramount importance because key transport sectors continue to be dominated by oil, despite increasing penetration of alternative fuels, particularly natural gas and electricity (BP, 2018, 2019). Crude oil production and transportation take place only in regions such as the top ten countries with crude oil reserves. In billion barrels (Bb), reserves include: Venezuela (302.81), Saudi Arabia (266.26), Iran (155.60), Iraq (147.22), Kuwait (101.50), UAE (97.80), Libya (48.36), Nigeria (37.45), Qatar (25.24) and Algeria (12.20), according to OPEC Annual Statistical Bulletin 2018. Furthermore, supply chains of petroleum appear complex compared to other industries because they include two segments: upstream and downstream. In this study the upstream sector is the main area of concern which includes exploration, forecasting, production, and logistics management of delivering crude oil from remote oil wells to refineries. It is significant that improved supply chain performance affords cost savings, time savings and reliability in the value chains for effective customer satisfaction; hence COECs must adopt and maintain best practices.

Nigeria has 36.962 billion barrels of proven crude oil reserves and produces 2.1 million barrels per day (Mbpd) (OPEC, 2019). Oil contributes 35% of GDP, 90% of government revenue. Nigeria's cargo flow to feed oil tankers is occasionally shut down due to pipeline leakage or sabotage, which leads to supply disruptions where militants' action continues to impact export infrastructure (Lloyd's list, 2016, p.1). This led to a 30-year low in total crude oil production according to International Energy Agency (EIA, 2016).

Additionally, the World Trade Organisation (WTO) found that delays and other costs of moving goods in developing economies including Nigeria were equivalent to a 219% tariff. This invariably affects crude oil export logistics systems. "One day lost because of some logistics error means millions of dollars lost... cost of logistics in countries like Nigeria could be as much as 30% of the cost of a project total" (Roxburgh et al., 2010, p.47). Further, there is an increasing perception of high costs of doing business in Nigeria, and an inability to explore competitive advantage, hence causing delay for effective and efficient SCM particularly in crude oil flows. Annual ease of doing business report (World Bank, 2016), said that Nigeria ranks 169 among 189 countries with Mauritius ranking 32 as the best port in Africa. Report indicators showed that concerning trading across borders, which is a measure of a country's port effectiveness; Nigeria ranked 182 out of 185 countries.

In recent times, stakeholders were concerned on how best to export Nigeria's crude oil to attract maximum benefit for Nigeria (The Nation, 2018). In the downturn in the crude oil market of 2014, oil companies' revenue fell as the oil price dropped from nearly \$100 to about \$63 per barrel in 2018 and it is still fluctuating. It is important for Nigeria and other COECs that depend largely on oil receipts to look inward on how best to maximise their crude oil commodity exports, with increasing competition and uncertainty arising from resumption of non-conventional sources of crude oil shales by the world's leading economy, the USA. Shale producers have seen a surge in drilling rigs after a slight increase in oil price in recent years. Therefore, this investment in oil shale has a great influence on the price of crude. Thus, an

"evolving transition (ET) scenario", implies a relatively slow shift away from fossil fuels. Research shows that over USD 3B and USD 19B was lost in 2016 and 2018 respectively to port inefficiencies according to Lagos Chamber of Commerce and Industry (LCCI, 2016, 2018). Bloomberg reported the same figure of USD 19B (Bloomberg, 2018). However, most of the research in port operations focused on non-oil exports due to the importance of Lagos maritime port, which processes more than 70% of Nigerian goods and services (LCCI, 2016, p.5). The good news is that there is increasing growth in global energy demand, which recently surged to 1.4Mbpd in 2018. Moreover, with these challenges and opportunities, it is imperative to look into port operations and management in the context of crude oil export logistic system.

1.3 Research problem

In the meantime, extant literature reviewed revealed limited work on port performance related to crude oil flows. Although, NNPC overrides everything from exploration, production, marketing, sales and limited transport respectively (NNPC, 2020). Thus, the author discovered that existent literature and existing empirical studies appeared to fail to establish any clear-cut evidence on port performance and crude oil export logistics system distribution in Nigerian context. Consequently, the gap in this context discovered. Key research objectives emerged. In this context, the author recognises the significance to narrow present study through application of appropriate techniques and procedures with clear and succinct objectives. In addition, the author involvement in initial fieldwork (scoping interviews) to better understand main issues (Hair et al., 2016, p.91). Furthermore, scoping interviews revealed preliminary themes and issues, which are mostly associated with state-owned oil firm, NNPC.

Essentially, scholarly publications that informed the present study. Firstly, Hull (2002, p.8) primarily focused on Alaskan North Slope Oil (ANS) supply chains. In addition, this appears similar to the current study that involves transportation of oil produced from fields through pipelines to ice-free port of Valdez on the South coast of Alaska which delivers to multiple pipelines. Furthermore, large storage tanks are loaded onto tankers for delivery to refineries on the West Coast, the Midwest or the Far East. Much attention was paid to operating the chain effectively and efficiently, as well as reducing cost. Thus, Hull (2002 p.18)'s primary focus was on the physical supply chain optimisation with much attention to operating a streamlined information

supply chain where by an example of British Petroleum (BP)-Amoco ANS supply chain is a vertical integrated push system movement of oil from the well to the customers. Furthermore, four information push characteristics were identified: Oil production, pipeline transportation, ship loading times and customer deliveries. More importantly, Hull (2002, p.22)'s findings include customer service which is paramount because of a need to get a low cost supply chain and assert that improvement in customer service exists with dramatic decrease in amount of information friction. Data flow diagram (DFD) offers a template for modelling any supply chain or logistics activity be it push, pull or hybrid. ANS supply chain provides a unique way of reducing distortion. Regrettably, the research gap here is that this work was been undertaken in developed country like the USA. Consequently, it is important to explore this study in the Nigerian context, being a crude oil producer and exporter in a developing country. Hull's (2002, p.22)'s findings influenced the current study because preliminary findings showed information sharing among government agencies as crucial for effective and efficient SCM. However, this work has given insight on the information flow problems in logistics of oil flows which can be tested in Nigerian context. More importantly, there appears no or limited work on port performance in oil flows in Nigeria. Evidence can be seen from how the author ensured appropriate search themes. See table 2.9 for SLR, which shows that the author fully understand present study background (Hair et al., 2016, p104). Furthermore, other recent scholarly publications focused on oil supply chain, primarily on management systems as a communication in oil and gas producing company (Wold and Laumann, 2014, p.23), which emphasised the importance of

safety management to regard it as not only a mere tool but as a communication that requires interpretation as a rather seen as media text and part of organisational internal communication. Further, this sheds more light on executive and worker relationships within management systems, in what (Wold and Laumann, 2014, p.29) referred to as "<u>distortion" or</u> <u>"misunderstanding</u>" which arises from a lack of equivalence between the two sides in communicative exchange. This appears to show misunderstanding amongst supply chain members because everyone sees it from a different perspective, thus leading to distortion.

Moreover, both scholarly publications presented the author with an insight into information flow challenges in the supply chains. In essence, the former literature focused on the significance of seamless information flow that appears vital to customer service satisfaction. Furthermore, the study focused more on the role of communication for effective safety management system at offshore installations on how different tasks should be performed by managers and operators. However, there is increasing interest in developing sustainable disruption strategies for energy supply chain operators particularly in conflict resource environment. However, researchers believe that disruption cannot be avoided, rather concerns should be centred on the enhancement of resilience capabilities to avoid disruption (Christopher and Peck, 2004; Rice et al., 2003; Sheffi, 2001, 2005).

Finally, Urciuoli et al., (2014, p. 46) focused on resilience of energy supply chains from a multiple case study approach on oil and gas supply chains to Europe. Key findings included portfolio diversification, flexible contracts, and transport capacity planning, flexible contract and safety stocks. The author

believes their studies combined key supply chain actors such as exporting and importing countries, suppliers and buyers; which revealed strategies. Urciuoli et al., (2014, p.55) stated the importance of information sharing and quick communication from respondents from company interview based on experience of terror attack in Nigeria, Iraq and Latin America. This revealed the importance of accessing information quickly to ensure that the best strategies are put in place promptly.
1.4 Research gap

Having enumerated limited key studies that influenced this present study in section 1.3. The author believes that the key issue appears in information sharing/information flow problem and that has been acknowledged as important in supply chain resilience (Hull, 2002, Wold and Laumann, 2014 and Urciuoli 2014). Thus, information flow considerations have been key to disruption to seamless and effective logistics flow of oil export from perspective of supply chain managers such as terminal operators, traders, government, suppliers etc. This impacts port performance to a great extent, which is regarded traditionally as a first point of call for a ship before leaving for a destination port. In summary, all the studies reviewed are undertaken in a developed country context. However, there appears little evidence presented on Nigeria in (Urciuoli, 2014, p.55)'s work on slowness of information sharing in the crude oil energy supply chains.

Many studies focused on Nigeria's oil industry in different perspectives that spans improvement in revenue from oil receipts (Musawa, 2016), impact of technological artefact as a relevant resource in the work organisation in the context of Port Harcourt refineries (Nwuche, 1993), domestication of oil and gas insurance in Nigeria (Abraham, 2018), and the potential of indigenous people's right to self-determination as a framework for accommodating the Niger Delta communities' demands for self-determination within the sovereignty of Nigeria (Samuel, 2015). In addition, crude oil pipeline vandalism and its causes and consequences in the Niger delta were studied using confirmatory factor analysis (Umar et al., 2017). None of these studies focused on the logistics of crude oil flows in Nigeria. although recently

Doctoral study by Shiwoku (2018) in the University of Plymouth focused on SCM and logistical considerations in distributing crude oil from Nigeria to China. He found that both indigenous and IOCs that distribute crude oil from Nigeria ports/terminals were yet to adopt an integrated export logistics operation. However, the study basically focused on SCM theoretical frameworks of supply chain process to assess synergy of China's requirement for energy security and as well as Nigeria's crude oil supply capability. Moreover, another main gap here appears that the study only focused on China's demand requirement without considering holistic issues in port performance in crude oil export logistics systems and as well as, only used Delphi survey and archival sources. More importantly, most of the studies reviewed currently are quantitative in nature where qualitative method are underexplored. It is imperative to verify some of these findings through more in-depth research in the current study.

1.5 Research aims and objectives

The aim of this research is to explore a sustainable model of key strategies to model port performance and crude oil export logistics system distribution in Nigeria. Nigeria's pipeline for tankers is occasionally disrupted through shutdown due to pipeline leakage or sabotage. This work will unearth how Nigeria can maintain a strong position as a reliable, dependable and competitive exporter of crude oil to the international market. Nigeria, which raises 90% of government revenue from oil, has been hit by plunging global oil prices. Similarly, the research is prompted by the mid-2014 slump in oil prices which fell from nearly \$100 per barrel to as low as \$27 in early January 2016. This study is unique in adopting the perspective of port logistics efficiency and management in crude oil flows unlike most studies that focused on container terminals efficiency. This is achieved through setting the objectives below, which focus on whole supply chain components, which are not necessarily specific to ports. Data were obtained through SLR exploratory qualitative data from scoping interviews, and a series of semistructured and structured interviews, focus groups, surveys, observations and archival documentation. Finally, the study is important as it unearths key critical issues militating against effective and efficient SCM of crude oil export logistics in Nigeria; hence the need to develop a model of key sustainable management strategies.

RO1.To define the role of ports in crude oil export logistics system distribution in Nigeria

RO2.To analyse the characteristics of the port system in Nigeria's

logistics system

RO3.To analyse and measure the performance of port in crude oil

export logistics system distribution

RO4.To analyse the performance of the port crude oil export logistics

system in Nigeria

RO5. To recommend strategies or policies to optimise the crude oil

export logistics system

1.6 Nigerian case study

This study considered Nigeria's port performance and crude oil export logistics system as a social phenomenon in a natural setting using methods that span interviews, observation, archival resources, and surveys to obtain in-depth knowledge specifically focused on understanding the dynamics present in Nigeria (Eisenhardt 1989, p.534). Case research is one of the most powerful research methods in terminal operations and logistics management, particularly in the development of theory (Voss et al., 2002, p.195). Furthermore, detailed information obtained through an internship with Nigeria's oil industry regulator, the Department of Petroleum Resources (DPR) helped the author to uncover the complexity and particular nature of the research question, particularly on how to propose key strategies to improve the effectiveness and efficiency of the logistics system in crude oil flows. The author secured an internship with a terminal operator and gathered empirical evidence through observation from one of the onshore terminals operated by an IOC in late 2017 in Nigeria. In essence, this helped to critically understand the operational procedures and risk associated with this complex supply chain. Overall, Nigeria hosted up to 27 crude oil export terminals (Lloyd list, 2015, p 1), and key oil majors and many indigenous firms operate and maintain these terminals in JVC with NNPC. For instance, ExxonMobil operates crude oil export terminal Qua Iboe (onshore), Yoho (offshore), Erha (offshore) etc. (NNPC, 2019). The author consulted professionals engaged in the crude oil export value chains through the NNPC, DPR, crude traders, oil analyst and key IOCs and indigenous oil firms.

1.7 Research Methodology

This is an exploratory case study to investigate how Nigeria's port performance and crude oil export logistics system can be optimised (Yin, 2009, p.2). First, a theoretical framework was formed based on literature regarding port performance and crude oil export logistics system distribution with five RO. The conceptual model identified basic themes that are relevant in the value chain of crude oil transport logistics including stakeholders, professionals in the shipping and logistics industry; key themes include customs, cargo handling, service quality, contract type, exploration and production, environment, security, logistics development, safety stocks, transport capacity planning, tanker delay etc. The conceptual model constantly evolved as the research progressed and was derived using both deductive and inductive approaches.

First, a detailed literature review and SLR are the basis of this study. Additionally, explanatory knowledge was derived through a thorough understanding of the present status, opportunities and challenges to port performance in crude oil flows. The semi-structured and in-depth interviews formed a major source of primary data and involved both individual and group interviews (DiCicco-Bloom and Crabtree 2006).

Second, in March 2016, the author explored qualitative exploratory face-toface scoping interview with key actors in supply chains to assess viewpoints from both supplier and buyers. Ethnographic content analysis employed to derived issues of concern across the chains relevant to finding a sustainable logistics performance strategies. The interviews lasted from 15 minutes to

1hr 37 minutes. Third, inferences generated led to semi-structured interview questions for further in-depth data collection in 2017. Fourth, second stage of in-depth semi-structured interviews both in Nigeria and London. 14 key improvement strategies were found and later trimmed down to 7. The author decided to measure these strategies in terms of character and personality traits (Likert, 1932).

Fifth, the seven strategies were ranked in preference order of importance with use of AHP technique, generated preference order of importance that span operation such as information flows in all aspect of supply chains. Samples were drawn across the value chains for both Likert scale and AHP survey providing accurate, reliable and targeted results on which the researcher drew conclusions. In addition, in late 2018, the author used triangulation to analyse both quantitative and qualitative strategies found in this study to derive a model of port performance strategies for crude oil export logistics system in Nigeria. Furthermore, the author convened 23 semi-structured and in- depth interviews with four focus group interviews with professional engaged in the supply chains. Moreover, four focus group interviews with three different terminal operators including officials of NNPC and Nigerian six senior naval security officers to get consensus on two critical themes of security and investment in the logistics value chains, aimed to unravel particular issues in these themes through interactive discussion (Carson et al., 2001). Significantly, when response rate appeared poor, the author established reciprocity between the interviewer and participants through follow up questions based on the participants' response (Hardon et al. 2014, Rubin & Rubin 2005, and Polit & Beck 2010).

Finally, the author triangulated both quantitative and qualitative results to increase validity of this work. Further, challenges encountered were lack of cost data such as analysis of the cost of tanker demurrage, port terminals dues, cost of hire of service boats, supply vessels and cargo volume relied on access to BOL and vital shipping documents, most of which are confidential. Further, limitations arose where some members of the supply value chains declined to talk, near absence of cost data, and the study is limited to Nigeria. However, experts had international experience in other E&P countries around the globe.

1.8 Summary of Research Methodology

The study employed mixed methods that combined the use of qualitative and quantitative data collection techniques and analytical procedures. More importantly, this study could be described as a multi-method qualitative study based on data collected that includes semi-structured in-depth interviews, diaries and observations (Saunders et al., 2016, p.168). Mixed methods saw a combination of both qualitative and quantitative approaches. Further, use of analytical techniques such as TA, THA, and AHP appear rare in the context of port management logistics of crude oil flows.

1.9 Summary of Chapter One

In this chapter, the research question and research objectives were introduced, and the outline of the thesis was presented. COECs roles are critical in energy security to the global oil market and Nigeria plays a vital role in this regard. Previous research revealed information sharing is significant to crude oil supply chain sustainability and its impact on port performance. Nonetheless this is mainly prevalent in a developed country like the USA. Hence the research gap revealed and the rationale for this present study. In the next chapter, a literature review considered the need for SLR and how it was carried out including key words for searches. Reviews include port performance and supply chains, some published measures of port logistics efficiency particularly in container terminals and some oil related transport logistics. In addition, Nigerian port systems and role of privatization in increasing competitiveness and customer satisfaction for increased government revenue. The author will discuss key physical and non-physical port performance indicators, port logistics performance measures of port logistics efficiency using AHP techniques. Finally, Key business models in oil industry will be analysed and a need for review of Nigeria's business model was strongly recommended.

1.10 Summary outline of the Structure and Organisation of Research

First, refer to section 1.10 for a summary of chapter one. Second, Chapter two presents a Systematic literature review (SLR) and a detailed literature review focused on port performance management in crude oil export logistics system distribution. The author explored SLR to demonstrate awareness of current knowledge and its limitations for the overall research context (Thomson, 2015). Findings revealed numerous published measures of port performance mainly relating to container terminals. Key issues include measures of port logistics performance, with a few on oil related maritime transport logistics such as unit logistics cost for optimal throughput level in unloading oil terminals (Feng et al., 2015), spatial aspects of tanker lay times (Mokia and Dinwoodie, 2002) and measurement of exports/metering systems. These measures of port performance are both physical (time, cost, throughput capacity) and non-physical (customer service/satisfaction, information flow and exogenous threat). Environmental measures appears common, this showed the significance of environmental sustainability in port management and maritime operations. Nigeria's major port complexes specifically, Onne port complex is an oil and gas Free trade zone (FTZ). Key issues specific to Nigerian ports appears more in container terminals especially Lagos and less on oil in Port Harcourt. Overall, Brooks and Pallis (2013, p.1) assert that advances in port logistics, organisational management, governance and performance, although significant in the past two decades, still represent a young field.

Chapter three explains the significance of crude oil exports as a global energy source. COECs rely on oil receipts to sustain national budgets and Nigeria is OPEC's sixth largest crude oil producer (EIA, 2018). There has been a large rise in demand for oil despite the ET scenario (BP Energy Outlook, 2018, 2019). Further, the Business model of Nigeria's oil industry relies on JVC, Production sharing contract (PSC) and sole risk between state-owned oil company, NNPC, International Oil Companies (IOCs), Indigenous Oil Companies (IDOCs) and servicing oil firms engaged in the supply chains (NNPC, 2018). Consequently, ET is likely to reduce global oil demand, estimated as a nine million barrels-per day drop from today's level if electric vehicles make up one-third of the car market by 2040 (Koranyi, 2019, p.3). It is imperative to study sustainable strategies for crude oil flows in the Nigerian context. In addition, the author explained that oil block or terminal ownership is interlinked with agreement or contracts among stakeholders, and as well as domestic oil transport through pipelines showing ownership, diameter and length. Finally, empirical and archival data revealed that export terminals and/or ports are largely offshore and onshore with the former being stable, reliable and with less throughput capacity than the later.

Chapter four explains the research methodology and underpinning pragmatism philosophy. In summary, a flow chart of research methodology explains various techniques for data collection and analysis that span ethnographic content (ECA), thematic analysis (THA), template analysis (TA) and AHP used to analyse various qualitative and archival data that spans scoping and various semi-structured and focus group interviews. Furthermore, an initial conceptual model is grounded in the context of crude oil logistics flows in Nigeria which evolved as the study evolved (Miles and Huberman, 1994). In conclusion, mixed methods were adopted to guide exploration in the study as it engaged with complex phenomenon, hence necessitating qualitative and quantitative approaches.

Chapter five explains qualitative data analysis phases one and two respectively. First, nine scoping interviews and the significance of the study which identified key themes and issues that gives a preliminary findings on RO1, RO2, RO3 and RO5. Second, phase two of qualitative data analysed using TA which findings composed of both initial and final template of themes. Third, findings of four specific focus group on investment and security explored THA. Initial findings led to inferences that resulted in hypotheses which were explored using 23 semi-structured and 4 focus groups interviews.

Chapter six offers an overview of analysis results of all the qualitative data using TA including scoping and main data collection stages which showed themes/codes and their lateral relationships in Nigeria crude oil flows.

Furthermore, there are 26 templates of themes which are the fundamentals

drivers which impact port performance crude oil export logistics distributions in Nigeria but a selected few are presented in this chapter that relates to RQ and rest in appendix 24. The author presented detailed summaries of a final interpretation of the TA findings, triangulated with other research evidence based research question. The templates obviously answered RQ1 of this study as main fundamentals themes that impact port performance in crude oil flows. In conclusion, a model of key strategies to manage port performance and crude oil export logistics system distribution in Nigeria emerged.

Chapter seven show how key strategies for improvement were derived from qualitative data. Because the problem is complex, further analysis was undertaken using Multi-criteria decision making methods (MCDM). The author explored AHP techniques which allow prioritisation of decisions being made in an uncertain environment using the AHP model (Saaty, 1980). The AHP model presented a unique ranking of effective supply chain strategies and offered an innovative guide for decision makers.

In Chapter Eight, the author believes that the present study was carried out systematically and methodologically. First, convened scoping study, several interviews and as well as mixed method application. Thus, the study generated specific empirical port performance strategies on Nigeria's crude oil flows and revealed its contribution albeit theoretical through exploring several analytical techniques, particularly TA that derived key template of strategies with firm theoretical contribution as rare to port management in oil flows. Crude oil export ports or terminals around the globe faced similar challenges which are basically security and investment, and Nigeria is no exception. Nonetheless, some terminals fare better than others. Essentially,

port performance appears directly related to business model as research findings revealed outstanding effective and efficient IOCs operation in comparison to NNPC and smaller terminal operators. In the long-term, a comprehensive review of NNPC and the low-cost producers' business model is critical. The author believes that inappropriate business model impact port performance via cost, price and risk. It is evident that a <u>value proposition</u> which is interconnected with the <u>consumer</u> and as well as a critical component of Osterwalder and Pigneur 2010 model to be given special attention particularly in the adoption of sustainable financial mechanism for production cost and key SCM drivers such as security, investment in crude oil supply chains operation to be effective and efficient in crude oil export logistics system distribution in Nigeria. **Chapter Nine** discusses the result of the whole study by addressing each research objective. Nigeria's reputation in the international crude oil market appears poor in comparison to key COECs due to avoidable delays, particularly if a crude oil export line is not available due to circumstances, and usually force majeure is declared. Furthermore, if key members of supply value chains are expected to the load cargo, if the ship owner wants his money, the cargo buyer and receiver might be disappointed if they have scheduled orders to be exported this can be a problem that can be caused by the delay in export. The study discussed issues to make Nigerian cargo sustainable, and strategies have been proposed to improve port performance and crude oil export logistics system distribution in Nigeria. The study's contribution to the theory specifically in terms of the techniques deployed is explored, along with other contributions to policy, industry, limitations and finally recommendation for future research.



Figure 1.1 Thesis structure

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The SLR revealed extensive literature focused on container port performance which revealed many performance measures/indicators for measuring logistics and a SCM approach to port performance measurement (UNCTAD 1999, p.9). However, some are relevant in the current study, chiefly among them are port performance and supply chain measures which emphasised a need for an integrated logistics framework for customer satisfaction, and measures such as cost analysis, marketing and strategic planning (Bichou and Gray, 2004, p.46). Extant literature revealed limited studies on transport logistics efficiency with major ones centred on development of an international logistics hub in Northeast Asia for ports (Kim et al., 2011, p.73). Now, a port is recognised as a logistics centre. Further, port competition modelling has identified investment as a driving force to meet operational forecast, basic on major ports such as Rotterdam, North Sea, Bremen and Belgium. In addition, other studies are on logistics efficiency related to oil transport such as a need for infrastructure improvement in crude oil terminals specifically draft; others show how the price of oil-based product reflects in part the cost of tankers delayed in ports. Furthermore, non-physical measures of port logistics efficiency showed the role of effective and efficient information flows in ANS supply chains. Further, Quantitative Risk Analysis in the navigational aspects of terminal operations in oil logistics.

In conclusion, the author understands that there are few works published on port logistics performance used AHP for both container and oil related transport logistics. However, there is more work on port environment

management notably Greenhouse gas (GHG) emissions from maritime transport in the marine industry in general. The next chapter will discuss crude oil exports centred on demand and supply for energy supply chains in the global oil market.

2.2 Systematic Literature Review

The literature review findings identified with the SLR approach. More importantly, prior scoping study was conducted to assess whether other SLRs have already been published to determine the focus of the literature search (Saunders et al., 2016, p.108). A theoretical framework for data collection and analysis was accessed via screening; as this helps to identify them with great accuracy (Stock, 1995). Thus, this enabled the author to demonstrate awareness of the current state of knowledge in this study, and its limitations and how the research fits in wider context. The critical literature review showed numerous published measures of ports logistics efficiency in container terminal flows and a few related to oil transport (Wallace and Wray, 2011). Key journals explored for searches were: Energy Policy, Elsevier, Maritime Policy and Management, Transportation Research A, E and D, Transportation Planning and Technology, International Journal of Logistics and Research and Application, International Journal of Logistics Management, International Journal of Physical Distribution and Logistics Management, hence author used the following keywords:

- i. Port performance and logistics
- ii. Port logistics performance
- iii. Port performance and crude oil export logistics
- iv. Crude oil export port logistics performance

- v. Oil port logistics efficiency
- vi. Crude oil port logistics efficiency
- vii. Crude oil export logistics system
- viii. Port performance and crude oil export
- ix. Crude oil export terminal logistics efficiency
- x. Crude oil export terminal logistics performance

These keywords were chosen in strict relation to the purpose of the research question (Jesson et al., 2011; Transfied et al., 2003). Moreover, the results of searches were systematically screened starting with title first and then abstract. The ones selected are those with relevance to research question for deeper review and were eventually included in the theoretical framework (Jesson et al., 2011). Further, SLR offered a comprehensive pre-planned strategy to locate existing literature, evaluate the contribution, analyse, synthesise findings, and report evidence to allow conclusion to be reach about what is known and as well, what is unknown (Denyer and Transfield 2009). Unlike a traditional literature review, which is influenced by the familiarity or preferences of the reviewer, SLR allows the author to gather, analyse and interpret a comprehensive body of available literature in a thorough and unbiased manner (Wang and Notteboom, 2014, p.750). See appendix 1 for details of key of the SLR. It is important because it helps to develop a reliable body of knowledge from a pool of knowledge available across a broad range of studies (Gligor and Holcomb, 2012; Transfield et al., 2003) and explore the topic through a different perspective, and also offers a clear and succinct summary of an accumulated body of knowledge.

Key searches include thousands of academic papers displayed, a total of 111extant literature. Key variations across the study appears different in analytical technique such as DEA, SFA. In addition, focused on port measures such as logistics centre, intermodal transport, green port performance measures, and macroeconomic impact of port, LNG operations, and green house emission. A vast majority in container terminal related and limited in oil terminals particularly in total quality in SCM. The author excluded old studies that appears irrelevant to empirical findings, more emphasis on criteria such as recency, topic of RQs and reliability and validity. A total summary judgement of 28 literature showed themes/criteria, result and year of publications, which could be seen in appendix 1. In addition, see table 2.5 for detail of main themes generated from SLR in relation to RQ, this includes crude oil export, vessel voyages, information flow network and marine operation, environmental policy, port services and infrastructure etc. This SLR themes formed bulk of initial theoretical framework which guided the present study for in-depth literature review. See details in appendix one. One of the key limitations is that despite wide range of literature reviewed, the author believes that most of them are generic and appears limited to Nigerian context of crude oil export terminal performance. Hence, the SLR showed limited studies on Nigeria oil maritime transport logistics performance.

2.3 Port performance Management and Supply Chain

Mentzer and Konrad (1991) define performance as an investigation of effectiveness and efficiency in the accomplishment of a given activity; it involves assessment carried out in relation to how well the objective has been met. There has been immense development in the governance, organization and performance of ports in recent years. However, Brooks and Pallis, (2012, p.1) were of the view that this is a young field, only coming into its own in the last previous decades. The maritime industry contributes to over 80% to global trade by volume. In addition, more than 70% by value is carried on ships, and handled by seaports worldwide; shipping is the most globalised and largest industry sector on the globe according to the United Nation Conference Trade and Development (UNCTAD, 2017, p.10). More importantly, there appears increasing prospect of world maritime trade by 2.6 per cent in 2019 and will continue to rise at a compound annual rate of 3.4 per cent over the period of 2019-2024 period (UNCTAD, 2019, p.17). Essentially, this includes both containerised and bulk trade, however this study focused on tanker trade particularly crude oil transport that appears to be impacted by crude oil shipment from the Atlantic basin to Asia expected to support tanker volume (UNCTAD, 2019, p.17).

The author believes performance of crude oil export terminals are critical for the effective and overall seamless flow of maritime trade, port and logistics performance. In addition, logistics and SCM approach to port performance is vital despite its increasing role as a logistics centre in recent years. Although, there still a debate on ideal the performance measures (Bichou and Gray,

2004, p.47). Nevertheless, UNCTAD, (199, p.9) identified two performance indicators: macro and micro indicators. The former is on the aggregate port impact on economic activity while the latter is on evaluating the input/output ratio measurement of port operations. In essence, both are relevant in crude oil flow port performance. For example, with regard to the evaluating economic impact of port in flows of various terminals in comparison with each other through obtaining statistical data of exporting rate and vessel handling efficiency. However, current study focused on improvement strategies for oil flows from port perspective. Finally, this raises gaps such as cost, analysis, strategic planning that are relevant in integrated logistics for customer services, total cost and/or trade off analysis.

Bichou and Gray's (2004) model of port performance measurement is significant to this study. However, it pays less attention to port security, contract terms and information sharing which are relevant to crude oil export logistics. In contrast, trade channels, which centred on sea accessibility of ports, do not incorporate other valuable functions, activities, supply chain partners and other interest groups. Therefore, there appears to be a need for a model that will cater for other institutions and functions of port logistics such as shipping lines, freight forwarders etc. In addition, major research gaps highlight a need to cover all aspects of logistics channels. More importantly, preference was on container terminals in contrast to the current study. Notwithstanding, it seems to offer an insight into the operational efficiency of oil port logistics, since the port is well recognised as a logistics centre by the stakeholders during the inquiry despite the fact that it appears that there was a methodological difficulty in linking supply chain performance

measurement to ports (Bichou and Gray 2006, p.60). The implication appears there are many productivity or efficiency indicators for measuring logistics and SCM approaches to port performance measurement. Although, the most important ones explored, appear not too integrated with other parts of the port logistics industry. Nevertheless, there is increasing awareness among experts about the evolving field of logistics despite difficulty involved in understanding the dynamics.

2.4 Non–Physical Published Measures of Ports Logistics Efficiency

Non-physical factors such as information flows in crude oil supply chains is strategic for an effective logistics system. Hull (2002, p.8) used a Data Flow Diagram (DFD) with a case study of its application to the ANS oil supply chains. Properties of DFD are push, pull and hybrid push/pull. The DFD approach used typical supply chain information flows, whereby scheduling and dispatching are interrelated, the importance of synchronisation and how operations and real world data can be incorporated depending on whether the chain is push or pull oriented. However, the generic DFD offers a template for modelling any supply chain or logistics, be it push/pull or hybrid. The DFD has wider application in management. For instance, seen in IT applications and aimed to minimize information effect of the bullwhip effect and, also to improve the key structure of supply chain, particularly the information flows structure that is central to reduction of distortion. This is shown by sequentially scheduling the links of chain from origin to destination with feedback loops so that upstream schedules can be modified as downstream schedules are developed. Finally, oil port logistics performance is an evolving field, however, the author has gained insight about all the physical factors such as cost, cargo throughput, time, and/or customer satisfaction.

Moreover, Ronza et al., (2006) discussed a Quantitative risk analysis (QRA) approach to port hydrocarbon logistics whereby QRA was applied in the navigational aspect and terminal operations of oil logistics. Further, proximity of the berths, tanker off-loading bulk hydrocarbons and bunkering operations

are significant variables that impact effectiveness and efficiency of port or export terminal operations in crude oil flows. The primary concern is about oil spills and accidents that occur during liquid bulk loading and unloading. A case study of the port of Barcelona was used, a list of scenarios such as major and minor Liquefied Natural Gas (LNG) spills from cargo tank rupture, and major and minor LNG arm failure, were given as examples. Importantly, the research *analysis covered tanker navigation through the port, tanker manoeuvring* appears to help to locate newly projected terminals, as well as to allow port authorities to build an objective basis for decision making about conditions to be required of hydrocarbon terminals dealers, in order to guarantee safety. The research throws more light on the associated incidents that can occur during oil export logistics especially during loading or unloading operations in the port. This appears to have a direct relationship with oil port logistics performance, as an accident would have an effect on the operation.

However, Cho (2014, p.193) focused on the determinants and effects of logistics cost in container ports by critically looking at the cost economics perspective through Transaction cost economies (TCE) by looking at the determinants and effects of logistics cost in container ports. Obviously, there is limited studies on the determinants of traffic volumes and competiveness of container ports. For instance, Pearson (1980) stated that confidence in port schedules, frequency of calling vessels, variety of shipping routes and accessibility of ports were vital factors to improve container port competitiveness, which is as a resultant effect of enhancing port logistics performances. In addition, hinterland access, navigation distance,

connectivity to ports, port facilities, availability of port, port tariff were also considered as container port traffic (Willingale, 1981). Further, data were collated through national maritime databases that showed the factors affecting the internal capabilities and external environments of logistics cost and traffic volumes in container ports and this was done based on the TCE. In essence, TCE is a good theoretical framework that could explored port capabilities, through the traffic volume and hence helping to decrease logistics cost in container port terminals.

Nevertheless, Feng et al., (2015)'s work on optimal throughput of crude oil terminals focused on infrastructure improvement. The author understands that there appears a correlation between these studies. Crucially, both shed more light on the cost of logistics in port operations but looking at different strategies. Furthermore, it presented broader functionalities such as *port infrastructure, port services, port accessibility, asset specificity, maritime uncertainty and the labour market.* Finally, one of the major gap is that the channel relationship between container transportation and export terminal performance is not considered, but interestingly all the above named factors appear to be relevant in oil logistics performance in any port considering the strategic role of port as an important nodal interface in oil logistics performance and SCM.





Source: (Adapted from Cho, 2014, p.205)

Yeo et al., (2008) considered competitiveness of container ports in Korea and China by evaluating available literature on port competition which includes regional survey of shipping lines. However, the research revealed extensively those factors affecting port competitiveness such as port service, hinterland condition, availability, convenience, logistics cost, and regional connectivityare important in the current study. In contrast, oil port logistics performance is the core area of interest, the study gives an insight into variables significant to port performance factors in a container port/terminal, which has implication to large extent in liquid bulk. The author believes that port competitiveness has shifted from the normal hardware and labour towards software and technology, which means that hinterland logistics must be efficient for any port to be competitive. Additionally, the major lesson learned here is that the study provides an excellent overview of what stakeholder should expect in port operations and management in an ideal situation such as container ports in China and Korea, and this has a relationship with functional networking of logistics port cities in Northeast Asia (Kim et al., 2011). Finally, findings and analysis showed that it appears that there is an aggressive plan to improve port logistics particularly in container terminals, which formed vast bulk of sea borne trade (Churchill and Lacobucci, 2002). Further, recent research show decrease in trade volume and number which is apparently 43.8 per cent of world's total (UNCTAD, 2019, p.16).

Similarly, a critical review from a developing countries perspective showed that UNCTAD's (2008) outcome meeting on the globalisation of port logistics explored the challenges and opportunities for developing countries. World trade and logistics development depend on factors such as ocean carriers,

sea locations, operating efficiency, political setting and good governance in selecting a port of call. Furthermore, others are rail and road infrastructure close to storage, production and distribution centres, and other challenges are green shipping, environmentally friendly operations and competition for the use of land and public-funds. In addition, logistics development factors considered are as follows :(1) long lead times from planning to construction (2) environmental safety and security requirement (3) landside connections (4) limited number of natural deep-water sites and lack of good governance in most of the developing world. In essence, an insight into the mitigating factors for port logistics in the developing nations, invites further research into any of the above factors.

However, the literature review has provided opportunities to understand port logistics performance and management to a great extent. It appears that most of the work done due to container handling cargo remains concentrated in certain major port with combined throughputs at the world's top 20 container terminals because of increased reach of 347.8 million TEUs in 2018 which account to 43.8 per cent of the world's total (UNCTAD, 2019, p.16). In contrast, crude oil is a captive cargo, due to its closeness to port and the sea while the container is the least captive cargo. Additionally, Thai et al., (2014) explained service quality in tramp shipping and the author formed a conceptual model with empirical evidence. Below is a table 2.1 showing various factors that shed more light on the issues around service quality in the maritime domain.

Indicators	Reference	Page
Total quality management: Customer orientation, process orientation and continuous improvement	Hill and Wilkinson (1995),	3
	Powell (1995), Garvin (1998)	
Quality award for total quality management programmes:	Ishikaw(1985)	4
1. Leadership system, impact on society, information and analysis, resources, customer management and satisfaction, people		
management, performance and management of suppliers' partners, and business result.		
ISO standards (ISO 9001); The eight quality management principles of ISO 9001 are customer focus leadership, involvement of people,	Avery(1994), Idris, McEwan	5
process approach, system approach to management, continuous improvement, factual approach to decision making and mutually beneficial	and Belavendram(1996)	
supplier relationship		
SERQUAL(service quality): Consist of technical quality of the process, corporate image	Gronroos (1978,1982,1984)	15
ROPMIS Model: compose of six dimensions such as resources, outcome, processes, management, Image/reputation and social	Thai (2008)	8
responsibility and 24 associated factors. This is regarded as generic and not specific to any particular sector of maritime industry.		

Table 2.1: Factors considered for Service quality in Tramp Shipping

Source: (Adapted from Thai et al., 2014, p.22).

In addition, Thai et al., (2014, p.2) conducted factor analysis on a proposed model of service quality in tramp shipping in order to reduce the number of measurement items to a smaller manageable sets and consequently scale reliability test was conducted to identify an alpha coefficient for each factor. Specifically, they examined whether alpha is negatively affected by the deletion of some items and finally, 18 items were scaled and reduced into 6 factors, as seen in diagram below.



Figure 2.2: Perception of Tramp Shipping Service Quality Factors

Source :(Adapted from Thai et al., 2014, p.22)

The model was empirically validated through interviews and surveys with both tramp shippers and tramp service providers, through the process of factor analysis including reliability test of measurement scales, and the number of attributes was reduced to 18 items. Findings revealed that leadership dimensions changed to management outcomes factors perceived as the most important quality aspect in tramp shipping.

Felicio et al., (2015, p.494) discussed customer satisfaction by examining port and container terminal characteristics in accessing how they affect performance. Multivariate factors were used, questionnaires were sent to 12 container terminals managers in two European ports, and lastly a Structural modelling equation (SEM) confirmed the influence of ports and terminal characteristics on container terminal performance. The research contributed to the existing literature in three ways. First, it is linked to how port and container terminal characteristics are significant in aiding container terminal's success and performance. Second, it shows the significance of customer's satisfaction, activity and efficiency reflect on the performance of the container terminal. Third, a holistic approach that addresses port infrastructure both hard and soft factors - services, building a complete picture of the factors that affect a container terminal's success. In this present study, the author focus is on customer satisfaction segment of the characteristics that facilitates terminal or port performance. Furthermore, statistical analysis explored SEM that used linear models that establishes a relationship between observed and latent variables, as well as between endogenous and endogenous variables, whether latent or observed. Next figure 2.3 showed basic constructs that are

found to be highly significant in ensuring efficient terminal and customer satisfaction.



Figure 2.3: Basic Constructs for Effective Customer Satisfaction.

Source: (Adapted from Felicio et al., 2015, p.504).

In the past decades, governments in many countries have embarked on port privatisation to pursue different goals. This is seen as an attempt to devolve selected port services to the private sector by means of leasing facilities, licensing operations and granting concessions (De Monie, 1996; UCTAD, 1998). Nigeria privatised most of the sea ports due to fraught challenges such as delay, bureaucracy, infrastructure decay in 2006 (NPA, 2006). Further, several studies have been carried out to assess the performance of Nigerian ports, including port performance evaluation of Nigerian ports during pre and post-concessions era. Ndubisi (2016, p.4) found that there was a remarkable increase in inward and outward cargo movement during the post concession/privatisation era in comparison to the pre-concession era through use of Malmquist linear programming analysis (MLPA). Further, the paper recommended that government encourages public ownership and private sector operations of the port infrastructure in Nigeria. The present study focused on oil flows and empirical evidence showed that infrastructure in port operations, particularly security information is critical to facilitate information flow network for overall terminal efficiency before, during and after crude oil loading operation to the high sea by ocean going vessels.

Similarly, Nwanosike (2014, p.6) worked on evaluation of Nigerian ports post concession performance-Nigerian ports particularly container terminal privatised in 2006. The study reviewed 25 terminals awarded to terminal operators using quantitative data, findings revealed productive performance of the ports under consideration improved after transfer of the terminal operations to the private sector, though not all ports/terminals have really improved in efficiency. The study reviewed 12 years of Nigeria's port

performance evaluation in the pre and post-concession era. The author examines this using intertemporal analysis for port operations of six years before (2000-2005) and six years after (2006-2011) concessions. The main findings revealed an average technical efficiency score for the preconcession period of 79.5%. In order of technical efficiency operation for the period under review from highest to lowest results were: Port Harcourt (PH) (98.1%), Onne (98%), Tin Can port (TICP) with 69.3% with least Warri (44.7%). This gives an insight into benchmarking of these ports, for the current study, Onne and PH port is extremely important and strategic for oil logistics flow and while TCIP is a gateway to the Nigerian economy for inward container flows, and hence why the efficiency is high. Further, postconcessions, the technical efficiency measures were computed using the framework of the frontier functions which adopted Data envelopment analysis (DEA). Further, BCC showed Onne to have the highest technical efficiency score of 85.8%, efficiency value is 100%, Apapa (98.68%), PH (96.13%) while the least is Warri (69.3%). This study is unique and the methodology it used in different DEA models such as intertemporal, contemporaneous and window analysis models, hence giving its validity and credibility in the final findings that showed Onne port as most efficient, followed by PH while the least Warri and Calabar ports, and as well as port size has influence on the operational efficiency of ports. Moreover, these improvements came as a result of privatisation, however, some are best left as a public ports despite the impact of privatisation (Nwanosike 2014, p.238). The current study focused on general performance of crude oil export terminals which are already practicing a landlord model from the perspective of business model.
For detail, see table 3.2, NNPC JVC. More importantly, the current study focused more on qualitative rather than quantitative, nevertheless, it revealed gaps in the extant literature relating to limited study on port/terminal performance in crude oil flows despite various oil industry report.

2.5 Key Quantitative Port Performance Measures

The author finds it vital to define what logistics performance is in order to understand in detail key measures of port performance. Logistics performance is conceptually defined as a subset of the larger notion of firm or organisational performance. Therefore, in the context of this study, the author assumed (Rhea and Shrock, 1987)'s conceptualisation of logistics performance that defines physical distribution effectiveness as the extent in which distribution programmes satisfy customers (Rhea and Shock 1987, p.35). In essence, controlling cost and this appears to be incorporated into customer-oriented managerial philosophy that aimed to achieve long goal of profitability through providing customer needs and want satisfaction. Although, Chow et al., (1994, p.26) acknowledged that defining and measuring performance appears a difficult task for both managers and researchers despite presence of multiple designs such as factor analysis, DEA etc. More recently, the World Bank logistic performance index that appears to be updated year-on year – are interactive benchmarking tool created to help countries identify the challenges and opportunities they face in their performance on trade and logistics and what they can do to improve their performance, they composed of both qualitative and quantitative measures respectively (World Bank, 2018, p.1). In addition, there are 6 measures which are customs, infrastructure, international shipment, logistics quality and competence, tracking and tracing and finally, timeliness (World Bank, 2018).

Secondly, measuring port performance is critical and it appears directly linked to global trade, production processes and countries' economies

integration are heavily dependent on efficient port systems and supporting logistics (UNCTAD, 2018, p.66). The author believes that various performance measures span financial, operational, environmental and economic are central for either dry or bulk terminals in both developing and the developed world. It is imperative to discuss key indicators which relate to oil transport logistics. In essence, it is important to take a look at strategies in deriving quantitative strategies. In UNCTAD ad hoc meeting of experts on assessing port performance in 2012. Typically, Song, (2012, p.4) defined issues relating to port performance measurement - key among them are productivity, efficiency, effectiveness and logistics supply chain aspect. In addition, issues in port performance measurement include data such as cargo type, vessel type and port/terminal type. These data could be either input or outputs. For input, examples are land, labour, capital, equipment and port charges while output are throughput, profit, customer satisfaction, ship turnaround time and berth utilization. The author assumed to list key recent terminal/port performance measures which are pertinent to both container and bulk/oil transport terminals, for details see appendix 2B.

2.6 Nigerian Ports Systems

Nigeria has a total of six port complexes which include the Lagos port complex, Tin Can Island, Rivers (Port Harcourt), Delta, Calabar and Onne complex ports respectively (NPA, 2020). For further details, see figure 2.4. Nigerian seaports have been central for the handling of cargo movement in the north and central African sub-region according to Ship Technology Global. In addition, Lagos and Port Harcourt (PH) port complex both account for 75% of Nigerian shipping activities (NPA, 2004). Over the decades, basic constraints militating against efficiency are capacity and poor infrastructure, and also despite its huge navigable inland and coastal of over 8000km (Ship Technology Global, 2020). In a recent study, Akinyemi (2016, p.682) discussed Nigeria's port reform that evaluates efficiency and challenges. Firstly, six port complexes composed of 26 terminals, all concessioned to terminal operators with Lagos port complexes consist of eight terminals, Apapa terminal been operated by Apapa bulk terminal with concession duration of 25 years as well as Bullnose operated by Eko support services concessioned duration of five years. More importantly, oil related terminals are also privatised such as River, Onne, Delta, Calabar are been concessioned with Integrated logistics services (INTELS) managing four major terminals span Federal lighter terminal (FLT) B berth, Federal ocean terminal (FOT) A berth 1, concessioned for 25 years. In addition, the least concessioned appears to be 10 years for new terminal B, Calabar, Warri old terminal B respectively (Akinyemi, 2016, p.685). Most of the issues associated with Nigerian port systems prior to concession were weak exports from the country, high maritime tariff, poor port efficiency and long-

turnaround time which culminated in reduction in number of ships calls (Akinyemi, 2016, p.688). Moreover, the study excluded ports that handled petroleum such as Bonny, Okrika, FLT and FOT which is the main focus of the present study. Further, port measures used were single output and three input measures cargo throughput in each port. Input measures such as square metres, total berth length and waiting time. Although they used panel data from 108 observation that appears sufficient for parametric analysis with use of stochastic frontier analysis revealed relatively improvement from 59 per cent in 2000 to 75 per cent in 2011. Furthermore, increasing investment on infrastructure and cargo handling facilities. In general, despite privatization of these ports into several terminals, there are many issues that appears not resolved such as intra and inter port completion, port pricing and policy that relates to port and harbour. The author believes that (Akinyemi, 2016)'s study shed more light on the current situation in Nigeria ports and terminals post concession and revealed a major gap in container and oil related port/terminals which appears to be controlled by the OICs and a few indigenous firms in Nigeria. Importantly, this study show that access to monetary information to determine efficiency appears difficult.

Finally, port performance is work in progress which involved all stakeholders' engagement in terms of investment, policy input and reviews of concession terms and conditions over a long period of time.



Figure 2.4: Nigeria's Six Major Port Complexes

Source: (Adapted from The Who's who of the Global energy industry in Oil and Gas Year, 2011, p.170)

2.6.1 Nigerian Onne Port Complex

Onne port complex is situated on the Bonny river estuary along Ogu creek around latitude 40' 40' 57" North, 07' 09' 32" East, approximately 25km south of Port Harcourt, in time zone GMT+1 hour. It came into being in 1982, composed of two major FLT and FOT. It is operated as a public private partnership (PPP). NPA plays the supervisory role of monitoring of ships and cargo operations, provision of auxiliary services and collection of all dues on behalf of Government of Nigeria (NPA, 2020). The vision of the port is to facilitate shipment of raw and finished products to and from Eleme petrochemical complex, National fertilizer company of Nigeria, Enugu coal Mining Corporation and the Refineries. Onne port serves as a hub port for the West and Central African sub-regions, centre for oil and gas industry both onshore and offshore in Nigeria (NPA, 2020). The FLT accommodates lighter vessels, service boats and small ocean going vessels with draft not exceeding 5.5m, with quay length of 2,070 meters, stacking areas and transit sheds. However, the FOT was designed to berth vessels of 40,000 to 50,000 DWT capacities with a total of 2,140 meters' span of berth structures and additional 930 meters for future expansion.

It consist of FLT and FOT providing shore base and logistics services in Nigeria.	The facility is owned by government and managed by Intel's Nigeria, supporting offshore oil and gas exploration and production activities in the whole of Gulf of Guinea.		
Onne port is situated in the heart of Niger Delta, one of Nigeria's largest port and world biggest oil and gas free zone.			
Quayside (FOT), 2, 200 metres , draft (FOT), 12 metres. Quayside (FLT), 1800 metres, Draft (FLT) 10 metres.	There are approximately 150 companies taking advantage of the zone's tax concessions and minimal bureacracy. In addition, it accounts for over 65% of the export cargo through the Nigerian sea ports		

Figure 2.5: A Schematic representation of Onne Ports Complex and Free

Trade Zone

Source: (The who's who of the Global energy industry, Oil and Gas Year,

2011, 170).

2.7 Key published Measures of Ports Logistics Efficiency

Kim et al., (2011) worked on the functional networking of logistics port cities in Northeast Asia. The paper helps to show the comprehensive and cooperative development of logistics systems involving functional networking of port cities in Northeast Asia. It appears that various port cities that make up Northeast Asia have the potential to be developed into a single port logistics hub and have been spending unnecessarily due to competition within the region-these include Busan, Gwangyang, and Incheon in Korea, Tiajin, Qingdao, Dalian and Shanghai in China. Fukuoka, Kitakyushu, Kobe and Tokyo in Japan are gateways to each nation and region and have a potential role as a hub for international and short sea logistics. Basic findings were based on the potential of the entire hub in incorporating them into a functional network logistics hub for the whole region. The methodology used was SWOT analysis, which revealed each characteristic of the city ports. It was found that the strength of some of the hubs includes homogeneity of culture among the nations, increase in demand of intra-transport and weaknesses included inadequate facilities and difficulty in multimodal transport. Other opportunities include a high possibility of uniting all the nations together based on the port cities logistics indicators and this subsequently presents the region with high economic returns. However, threats involved unnecessary competition among the port cities, this remains a challenge owing to the fact that the majority of the investment in terms of infrastructure appears to be dedicated to one place.

The research revealed that the ports of Shanghai and Busan act as two international hubs in Northeast Asian and are on the trunk line to Europe and America. It appears that every port has its own strength and weakness and it is the factor considered during the evaluation of cooperative logistics network for an effective and sustainable function. It appears that vertical functional distribution of the port cities was quite efficient owing to the provision of international, regional and local hub ports but most importantly, in relation to oil port logistics performance. It appears that there are two hubs for crude oil port logistics, which are Dalian and Gwangyang ports. This shows that for a firm to achieve effective and efficient crude oil logistics, it appears that a dedicated port or export terminal with efficient added value logistics strategies is significant in order to provide a significant functional logistics through alliance of various hubs involved for a mutual relationship towards improved port performance in the whole supply chain and logistics processes.

The research gap focused on the overall interest on China and Japan rather than considering other places in the world and analysed issues which appears exploratory with use the SWOT analysis technique. It is evident that research is needed into these various results to ensure a smoother process within the logistics network and finally the port performance of the oil terminal needs consideration. However, Yang and Chang (2013) studied impact of electric rubber-tired gantries on green port performance. In essence, their research is focused on the container terminal that composed of gate, container yard, and ship side areas, aimed to reduce the operating cost, noise, exhaust pollution and to strengthen business competitiveness.

Evidence shown through a case study conversion of RTG to E-RTG and subsequently a comparison analysis on RTG, E-RTG and RMG based on information collected from personal interviews and file studies of several container terminal operators at port of Kaohsiung. Overall, E-RTG has a greater impact on the port logistics industry through energy saving cost that was witnessed by four shipping companies in the port of Kaohsiung by using the RTG operating models. For example, a total number of 61 RTGs, which consist of 22 units at APL, 19 units at Evergreen, 11 units at Hyundai. See table 2.2 showing energy savings statistics for RTGs and E-RTGs in 2010.

Item	E-RTGs	RTGs
Total number of moves	1,199,543	1,199,543
Total energy consumption (by	3,622,619	2,650,990
kWh or by litre).		
Energy cost per move	3.02	2.21
Energy expenses(TWD/kWh)	2.38	24.16
Energy cost per move (TWD)	7.16	53.43
Total energy cost (TWD)	8,621,833	64,047,918
Difference		55,526,085

Table 2.2: Energy savings statistics for RTGs and E-RTGs in 2010.Source: (Adapted from Yang and Chang, 2013, p.72).

Despite the use of E-RTG, findings revealed that container terminals and shipping lines can indeed justify conversion from diesel fuel to electric power in view of the resulting 86% energy savings and 67.79% of considerable reduction in C02 emission (Yang and Chang, 2013, p.72). The major research gap is that less attention given to the human physical aspect and appears lack of performance assessment on integrated container handling equipment from the perspective of carbon footprint in the recent green terminal literature. Hence, a review of the relevance of green port policy to oil port logistics performance shows much concern for a container port logistics performance, no emphasis on crude oil terminal but the overall research provided an insight into port governance, organisation and critical performance towards improving the logistics of port operations and management. Essentially, this helps the author to understand oil port logistics performance from the perspectives of energy measure consumption that is critical for effective port/terminal logistics operations. Further, providing a framework for an oil logistics port performance, which is environmentally friendly and energy cost saving in terms of handling of oil cargo for an effective and efficient service delivery.

Similarly, De Langen and Sharypova (2013, p.101) explored intermodal connectivity as a port performance indicator, they emphasised the importance of intermodal connectivity. Better and more efficient intermodal transport systems required a better connectivity between ports and intermodal terminals in the hinterland. In addition, port users have an increasing interest in port cost, reliability, transaction cost, environmental concern etc. Findings revealed that many ports have different port performance indicators which span *total cargo throughput, investment in port infrastructure, metric tonnes* etc. Connectivity of a network and accessibility of a node are both factors which facilitate easy connection of nodes to and from all part of the ports and hinterland. Hence, intermodal container connectivity has a great impact for seamless logistics operations. For instance, port of Vancouver's 2011 annual report showed that port

performance indicators explored are total *cargo throughput, investment in infrastructure, shower power connections, metric tonnes of GHG emissions* while other factors include rate of returns of port authority, evolution of real ports cost, occupational health and safety, which differ from one place to another. However, UNCTAD (2014) has developed a Liner Shipping Connectivity Index (LSCI) that is based on five components such as number of ships, the total container carrying capacity of the ships, and the maximum vessels sizes. In addition, the number of companies that deployed container ships on services from and to a country's ports, focused on the container terminal. De Langen and Sharypova (2013, p.101) developed an intermodal connectivity indicator based on data provided by individual ports. 26 ports provided data including annual throughput; which collectively handle 70% of European container volumes.

Country	Number of ports
Albania	1
Belgium	1
Estonia	1
Finland	2
France	3
Germany	3
Ireland	2
Italy	4
Latvia	1
Malta	1
Netherland	1
Portugal	1
Spain	3
Sweden	2
Total	26

Table 2.3: Table showing Geographical Distribution of European Container

Ports.

Name of column	Value
Number of ports provided data (sample size)	26
Number of observations	16
for rail connectivity	
Number of observations for the barge connectivity	4
Number of ports where the first rail services started in 2011	1
Number of ports where the first barge service started in 2011.	1

Table 2.4: Results of on-line survey of Intermodal Connectivity.

Source: (Adapted from De Langen and Sharypova, 2013, p.101)

In conclusion, research findings revealed that connectivity indicators have been developed to express maritime connectivity of ports that are relevant for increasing the efficiency and sustainability of transport operations. Thus, the implications of this work in current study is that focus was particularly on container terminals without any attention to liquid bulk such as crude oil transport. However, this gives an insight into the performance of port operations in relation to an important factor of intermodal connectivity, which is fast getting attention from all the major players in the industry due to the increase in growth prospect of market share and dealing with the challenges of inadequate infrastructure. Crucially, it needs to be expanded to the liquid bulks such as crude oil logistics efficiency which is vital to the energy security.

2.8 Port Management and Supply chain

Bichou and Gray's (2004, p.56) interim model of port performance measurement appears significant to current study. However, less attention is given in terms of port security, contract terms and information sharing which are relevant to current study. Trade channels, which focused on sea accessibility of ports, does not incorporate other valuable functions, activities, supply chain partners and other interest groups. There appears a need for a model that will cater for other institutions and functions of port logistics such as shipping lines, freight forwarders etc. The major gap here appears need for the study to cover major aspects of logistics channels. Importantly, preference was on container terminals not on crude oil terminals,

Notwithstanding, it appears this presented the author with an insight into the operational efficiency of oil port logistics, since the port is well regarded as a logistics centre by the stakeholders during the inquiry, despite the fact that it appears that there may be a methodological difficulty in linking supply chain performance measurement to ports (Bichou and Gray 2007, p.60).The implication here is that there are many productivity or efficiency indicators for measuring logistics and SCM approach to port performance measurement. The most important ones used appear not too integrated with other parts of the port logistics industry. Nevertheless, there is a great awareness among experts about the evolving field of logistics despite difficulty involved in understanding the dynamism that is associated with the sector.

There is increasingly awareness and use of AHP in port strategy, development and management. Ugboma et al., (2007, p.251) applied the AHP methodology techniques to port selection decisions–empirical evidence

from Nigerian ports perspective. The objective of the study was to determine service characteristics that shippers considered important when selecting a port, and how these characteristics are prioritised according to their importance. They selected factors based on related literature survey; the following factors appears to have a significant impact on choice of ports among shippers in Nigeria such as frequency of ship visits, efficiency, adequacy of port infrastructure, location, competitive port charges, quick response to port users' needs and port reputation for cargo damage. In addition, data were collected through questionnaires and focus group interviews (Ugboma et al., 2007, p.252). Results showed that efficiency was attributed to have highest scored, 0.197, followed by frequency of ship visits (0.124) and third is adequate infrastructure (0.120), this means that Lagos port complex appears most preferred among Nigerian shippers, whereas Port Harcourt is the second most preferred and the next is Tin Island, and lastly is RORO port. These three performance criteria have significant importance in Nigeria, because empirical data showed that some of the terminals are less efficient than others. For example, offshore terminals appears to be more reliable and safe than onshore ones. Thus, improvement in investment in port security and port state control, less efficient terminals appears to need improvement. For instance, onshore terminals are susceptible to attacks and this is critical from the perspective of port performance and crude oil export logistics system distribution in Nigeria.

Additionally, important performance measures study is green performance criteria for sustainable ports operation. Lirn et al., (2013, p.427) studied green performance criteria for sustainable ports in three Asian countries of China,

Hong Kong and Taiwan. They adopted a brainstorming approach by selecting green related performance indicators of 17 green indicators, respondents were asked to evaluate the importance of these 17 indices on a five point Likert scale, where one indicated the least importance and 5 indicated the greatest importance.100 copies of the questionnaire were emailed to academics teaching maritime studies and environmental engineering field. Only 64 responded, eight were incomplete and 56 completed. Afterwards, descriptive statistics was used to analyse the completed questionnaire. For instance, if an average degree of importance of an indicator was perceived to be less than three, then the indicator was removed from the second stage of AHP survey. In the current study, the author used a Likert scale to measure respondents' attitudes, but the distinct difference is in descriptive statistical method, instead a summation approach whereby frequency of respondents who did not agree with each statement was considered; any instrument on which a respondent did not agree is not included in the calculation. Thus, an AHP questionnaire was formed from Likert result in which all the 17 green performance indicators were found to have an average degree of importance of more than 3, and thus, they were selected to be incorporated into the design of AHP survey. The strength of descriptive statistics is to avoid ranking reversal effect from removal of unimportant sub criteria in AHP survey result; this is the reason the author used only those respondents that did not agree. Thus, responses were not considered in the AHP survey for the current study. Lirn et al's (2012, p.433) major findings spans avoiding pollutant during cargo handling, port maintenance, noise control and sewage treatment.

Findings revealed that the port of Shanghai appears to have the highest number of critical indicators that needs improvement. To obtain the relative importance of these criteria, AHP techniques were considered in determining the weight or significance of hierarchically non-structured or particular hierarchical level criteria in respect of those belonging to a higher level. An AHP questionnaire survey was sent to 160 community leaders in major Asian cities such as Hong Kong, Shanghai, and Kaohsiung, and generated 137 replies to the survey. In addition, research results indicated that "air pollution management" was followed by liquid motion management" solid waste and the other pollutants management", liquid pollution management" aesthetic and noise control management and marine biology preservation.

In conclusion, despite being a study chiefly on non-oil export related, it presented a clear analytical technique of AHP, challenges inherent in using descriptive statistics for analysis such as Likert scale measurement, also is the increasing pressure for growth towards a greener world for sustainable development in 21st century in port and terminal transport logistics.

Service quality and customer satisfaction are critical performance measures. Both are interwoven in the context of logistics performance. Ugboma et al., (2007, p.331) worked on service quality and satisfaction measurements in Nigerian ports. The study explored key determinants of port service quality: this helps to determine quality of service offered by two ports in Nigeria using Servqual model and a customer satisfaction index to measure port users' level of satisfaction at these ports. Servqual model referred to service quality framework developed in the 80s by (Parasuraman et al., 1985, p.41), as a measuring scale, which is measured on 10 aspects of service quality:

reliability, responsiveness, competence, access, courtesy, communication, credibility, security, understanding the customer, and tangibles in order to measure gap between customer and expectations and experience. Although, these 10 components were later reduced to five dimensions of rates: reliability, tangibles and responsiveness, assurance and empathy.

More importantly, Ugboma et al., (2007) administered a questionnaire from data collected through literature review and focus group interviews and adopted a SERVQUAL model to reflect port activities. The questionnaire tested the ratings of expectation and perceptions of port users on service attributions. This questionnaire was validated through expert validation and pilot testing, thereby leading to the shortening of the instrument from 22 statements of service quality to 12. A 5-point Likert scale questionnaire was sent via email to licensed clearing agents registered with Nigerian Customs services. These samples case ports were basically Lagos and Port Harcourt (PH) port complexes. In addition, their findings revealed that both port complexes suggest that lower level of service quality due to poor management of factors influencing quality perception and this appears the basic reason some customers preferred neighbouring ports such as Contonou flourished at the expense of Lagos ports. Quality perception factors such as reliability, assurances and responsiveness are critical in assessing the quality of port which appears linked to employee performance in the industry. Employee service is key for efficient port systems either in container or crude oil. This study revealed relevance of port service quality dimension which all stakeholders need to invest more for prompt customer service delivery. Moreover, this appears to serve as a benchmark of how port

performed optimally by international standard. Finally, the author believes Servgual appears to be a tool proven reliable.

Further, Onwuegbucunam (2018, p.1) worked on assessing port governance, devolution and terminal performance with focus on Nigeria's major ports such are Apapa, Calabar, Onne, Tincan, Warri and Port Harcourt ports over the period from years 2000 to 2015, whereby UNCTAD metric and queuing model to measure performance in concessioned ports were explored. For the benefit of current study, the author looked at descriptive analysis indicators of output, service and utilization of relevant oil seaports/terminals.

Onwuegbucunam (2018, p.8)'s finding revealed that before concession, for example Apapa port recorded 11.7 million tonnes on average while Onne port handled a little below 7 million tonnes of cargo throughput. Despite concession policy of these oil relevant terminals/port such as Onne, Port Harcourt, and Warri ship turnaround time's performance are below optimum level, however, there appears improvement in cargo and vessel throughput (Onwuegbucunam 2018, p.9). Thus, this showed that concession alone do not guarantee effectiveness and efficiency in port or terminal. The landlord model of port governance adopted improved cargo and vessel throughputs in port under study. Nevertheless, this work is mostly container related, although, it revealed key performance indicators like ship-berth period, ship turnaround times, and role of investment in port infrastructure.

Additionally, Onwuegbucunam (2018, p.16)'s work had shed light from the current study perspectives that despite concession policy for improved performance and efficiency, there appears challenges around inadequate investment in operational and infrastructural aspect of port/terminal

operations and management which could be either bulk or dry cargo port. Similarly, Wanke et al., (2017, p.699) discussed efficiency of Nigerian ports which used handling imprecise data with a two-stage fuzzy approach. The rationale for this is due to vagueness in measurement of data in several African countries owing to poor quality of data (Jerven, 2013), which appeared common in Nigeria. In addition, this confirmed the author perspective during the data collection for current study. Additionally, the used of fuzzy-based method that allows researchers to handle imprecise data (Chao, 2017). The FDEA allowed vagueness in the data to be handled while computing efficiency (Wanke et al., (2017, p.711). The author could use this same method for current study to determine efficiency in vessel turnaround times, cost of production for a barrel, loading capacity and logistics cost in oil terminals for crude oil flows. Wanke et al., (2017, p.710)'s findings included aggregates managerial efficiency levels in Nigeria ports which appears to be decreasing over post private concession of port era. This produced a positive impact on efficiency levels in regard to asset utilization but fell short of addressing accessibility and service level issues.

Both above extant literature have similar findings in the port privatization policy in Nigerian context. In the light of efficiency of ports, there appears other operational procedures such as channel depth and average turnaround, port accessibility that might be associated with public or government level responsibility in a landlord model governance system like Nigeria. There is increasingly interest in efficiency of Nigerian seaports in post-privatization period which is evident in changes in terms of productivity. Nwanosike et al., (2016, p.798) adopted Malmquist productivity index to

measure productivity change in Nigerian seaports between two time period (pre-and post-concession). In addition, productivity changes analysis identified not only if productivity has deteriorated or progressed but underpins the source of inefficiency, since productivity is a relative term with many indicators. However, their findings revealed Calabar port with highest productivity growth, followed by Apapa and Onne been the lowest. Moreover, pre-concession period recorded a high increase in productivity than the postconcession period due to issues that spans technical change and catch up effect. They stressed the need for effective regulatory framework tied to investment scale of concessioned ports to avoid waste of investment on an unnecessary facilities from the perspective of government. In another study, (Cullinane and Song, 2010) used stochastic frontier model of the productive efficiency of Korean container terminals aimed at stimulating greater efficiency by engendering more competitive market and commercial approach to management. The stochastic methodology is been applied to cross sectional data such as panel data with Dickey and ADF test to aggregate sample panel data used within analysis of the productive efficiency of container terminal that produced statistics which inferred data are nonstationary (Cullinane and Song, 2010, p.264). In the context of present study, some of the ports under PSC or JVC can be vital to derive production capacities to determine the productive efficiency in Nigeria's oil export flows, this appears useful going by size, production capacities, ownership of some of these export terminals. Findings revealed despite the privatisation of Korean and UK container terminals, there appears no clear-cut and irrefutable link established between degree of private sector participation and

level of production efficiency, in essence, port privatisation in itself does not guarantee production efficiency. Cullinane and Wang (2012, p.169) worked on hierarchical configuration of the container port industry with focused on 18 major ports in East Asia. An approach based on graph theory-Multiple Linkage Analysis (MLA) this allows a focus on analysing the volume and direction of outflow from any one node in a network. It overcomes disadvantages of primary linkage analysis, it does so by emphasizing the existence of mutual relations between locations rather than the priori ranking of locations within a hierarchy. Hierarchical clustering is added to the sample ports on the basis of the reconstructed liner shipping network that now consist solely of significant capacity flows which later help in facilitation of classification of container port sample into three categories-load, regional and international in accordance with geographical level of shipping services offered by each of the ports. The methodology can be applied to the current study whereby 27 crude oil exporting terminals to determine significant outflows of these terminals with one another, possibly this will revealed the scale of shipping capacity and as well as linkages of onshore and offshore terminals. More importantly, MLA effectiveness in determining port hierarchies as method been tested by an empirical application to the East Asia container port industry (Cullinane and Wang, 2012, p.184).

Essentially, this methodology if applied, appears to reveal significant capacity flow in Nigeria's export terminals and by implications guide the terminal operator managers as well as supply chain actors on optimum performance of key export terminals, distribution outflows across the network flow, transhipment from jetty to barges to mother vessel in case of offshore

terminals and extent to which some terminal were able to operate optimally despite security challenges prevalent in the oil-rich Delta region.

On the role of logistic, it is evident that logistics performance has been central for port operator in an attempt to improve efficiency with the role of corporate responsibility (CR). This is due to pressure from stakeholders for port to gain competitive legitimacy on their host communities and more importantly, competitive pressure appears to derive how port is defined and approach to CR. Essentially, Acciaro, (2015, p.291) worked on CR and value creation in the port sector, whereby the institutional theory explored with the assumption that port authorities combined institutional roles with typical firms (Brooks, 2014). Further, Acciaro (2015, p.302) selected 10 global ports which have extensive website. Key amongst the selected ports is Rotterdam, which appears have direct connection with the current study, traditionally been a destination port for West African oil cargoes, particularly Nigeria. Findings showed that the port of Rotterdam is strict on CR in context of sustainability. Key among the CR actions are educational activities, humanitarian and charities, local communities, sustainability report. For example, the port of Rotterdam appeared to be Europe largest sea port due its outstanding accessibility for sea-going vessels. However, the work offered empirical evidence on the applicability of framework in practice despite no sample population on Africa or Nigeria ports, nevertheless, this has helped to unravel key CR actions practice globally. Crucially, an important CR mentioned that it is significant in terminal performance in crude oil flow in Nigeria is local communities and river environment are critical for effective and efficient system. Empirical evidence have shown incessant militant

activities of vandals and other criminal syndicates are becoming increasingly sophisticated due to negligence by terminal operators and supply chain actors, although these operators do have CR, nevertheless, evidence of implementation appears fell short of standard requirement. Acciaro (2015, 292)'s study would be invaluable for terminal operators in energy flows in Nigeria to emulate global best practices. Consequently, this would add value to the supply chains in terms of efficiency in logistics systems as host communities will be incorporated in the supply chains. Further, implication to Nigeria's crude are huge, for instance, less attack on oil asset/infrastructure will jump start investment in all the supply chains and hence, increase confidence for long term investment.

As ports continue to be significant part of supply chains toward a shift away from traditional cargo handling and storage role. Han (2018, p.129) worked on assessing the impact of port supply chains on port performance, their study aimed to find out relationship between port supply chain integration and terminal performance using confirmatory factor analysis (CFA). Furthermore, they used 10 items scale from (Song and Panyides, 2008) with the use of five –point Likert scale. In addition, Han (2018, p.132) tested whether supplier integration (SI) affect terminal performance, findings revealed that customer integration (CI) and SI have no significant impact on cost performance (CP). Second, the author also examined how TCP associated with ship calls, throughput and amount of sales. Although CI *SI has negative impact on cost performance, this suggest that a combination of supplier and customer integration effort highlight the importance of balancing coordination and information sharing with key supplier and accurate understanding of

customers. In fact, (Han, 2018) findings are strategic importance to current study. For instance, empirical evidence showed that some terminal operators such as low-cost producers including NNPC appears struggling with effective information sharing particularly during vessel clearance with main customers (crude oil traders) and other supply chain actors in the logistics flow. Thus, customisation and/or digitalisation of vessel clearance will facilitate seamless logistics operations and add value to Nigeria's crude in the global oil market. More importantly, (Han, 2018)'s findings include CP which had a positive impact on both ship calls and throughput. In practical terms, it lowers price and that increases competitive edge of a terminal operator among its competitors, hence increased ship calls and increased throughput (Han, 2018, p.133). Although the study context is limited to port of Pusan but it's relevant if the present study can explore SCI to key Nigeria's 27 export terminals in order to determine terminal competitiveness in crude oil flows.

2.9 Business Model

Business model are defined as an architecture to add value, profit formula, key process and resources (Osterwalder et al., 2010). Firstly, a key business model designed by (Osterwalder and Pigneur 2010) composed of nine business model building blocks known as business model canvas which includes key partners, key activities, value proposition, customer relationship, customer segment, key resources, channels, cost structure and *revenue streams.* Hence, next is to re-interpret a strategy through the lens of the business model canvas for the current study. Needless to say, current study focused on upstream business model. Nevertheless, it is imperative to consider five key strategies: fiscal regime, political context, operating conditions, geology and the materiality evaluation (Boscheck 2006). Literature on business models in the oil industry are quite limited (Khorshidi 2018, p.485). However, notable study by (Yusuf et al., 2014) which focused on small and medium-sized enterprises that provide technology and services to oil corporations and as well as centred on administrative design in oil industry, particularly with focused on regulatory role and how its separated from commercial and policy for overall performance in the oil industry (Thurber et al., 2011).

2.9.1 Key Business Model in the Oil Industry

Tantau and Khorshidi (2016, p.484) worked on a new business model for national oil companies (NOCs) which focused on Iraq and Iran; as oil is the main economy backbone of COECs. The study focused on value proposition in the oil industry history since the 1850s to 2017. Findings revealed that value proposition features include agility, efficiency, new technologies which appeared most vital for NOCs. For instance, major issues span reduction in production cost of each barrel through use of new technologies. In addition, IOCs used domestic resources and the challenges of localising knowledge to increase efficiency. Moreover, they found that *financial power and critical* value propositions are vital. Most important findings was hypothesis number 2 which stated that NOC have better efficiency if they make contract with integrated E&P companies instead of splitting the contract among different service companies). However, efficiency and value based management are the most important value propositions. Similarly, Tantau and Khorshidi, (2016, p.488) described framework of both Iran and Irag on a need for a new business model. Firstly, Iraq framework referred to as Badra Development and Production Service Contract (DPSC 2009) which is literally divided into three key components: Contract expenditure, contractor revenue and return on investment.

The key issue here is financial obligation with state contractors or IOCs based on DPSC. Iraq as NOC pays operating cost to contractor after first commercial production. Crucially, in terms of petroleum cost, remuneration cost and finally supplementary cost with all related cost handled by contractor within appropriate time period. Further, Iraq oil marketing company approved

final price of product to final destination ports and/or countries. Nevertheless, Iran's framework entailed new Iran Petroleum Contract (IPC) which comprises exploration and the development of green fields and integrated exploration. In essence, IPC allowed contractor/IOCs to participate in all required activities, and as well as Iran is deeply involved in the supply chains particularly play characteristics and operational reference which include: entry, exploration, appraisal, development, production, transport and sales (Boscheck 2006). IPC relies on model of direct capital cost of project up to first production to the plateau and IPC has the responsibility to pay contractor indirect cost such as tax, securities, custom duties and related cost also been paid by NOC after production. Iraq retained all equipment of contractor after project while Iran appears not. However, similarities exist between them. For example, both practiced JVC, nevertheless Iran pays financial obligation that allowed contractor to reclaimed operation reference cost after first production. Iran contract empowered IOCs in terms of shareholding ratio and compensate them in form of incentives.

More importantly, Khorshidi (2018, p.493) assert that after comparative analysis of Iran and Iraq, there is a need for a new Business model for NOCs where value proposition could be generated by a long term contract with key consideration to guaranty payment and cost of money after due date. On the other hand, Stevens (2016, p.1) worked on IOCs death of the old business model which focused on old business model of 20th century appeared not relevant for its purpose in recent years. Although old Business model were built on three pillars: *maximizing bookable reserves and minimizing cost, maximizing shareholder value based on strategy that*

provided benchmarks for financial returns, and minimizing cost based on outsourcing. It is concluded that IOCs workable solution to new world lies in restructuring and realising many of their current assets to provide cash for their shareholders which entails shrinking into other key areas of supply chains such as operations, geographical locations and functions that might require major changes in corporate culture (Stevens, 2016, p.3).Typically, this study shed light on the challenges of IOCs which appears vital in the context of Nigeria, as a vast majority of production output has been led by the IOCs due to their financial capability and technological advancement.

On a positive note, the author believes that the value proposition appears key to business model of NOCs because due to increasing global concerns such as climate change, piracy/maritime insecurity, financial default on cash call by NOCs, geopolitical instability, Energy transition(ET) scenario, peak oil demand to name a few. Furthermore, *Khorshidi (2018, p.520) emphasised the increasing role of developing the value proposition for business model that explained Iran as a NOC, as a positioning statement that explains what benefit a firm could provide for customers and how it does it uniquely. In the context of the current study, the main research question is optimisation strategies to improve and/or facilitate port performance to maintain a competitive advantage for the purpose of meeting customer requirements as a primary value proposition of NOC (NNPC) and low-cost producers in the supply chains.*



Figure 2.6 Map of Nigeria showing oil and gas fields and pipelines

Source: (The Petroleum Economist, 2020)

2.9.2 Why Change the Nigerian Business Model?

Extant literature reviewed revealed that the Nigerian business model is centred upon NNPC JV operations contract). It is significant to know whether this current model is working or not. The author explored (Osterwalder and Pigneur 2010) model for the current study. The author identified three aspects of Business model: consumer, resources and activities. These three variables are significant in the current study. First, Nigeria has lot of customers across the globe (see table 3.1, crude oil movement destination). Second, lots of key partners in energy supply chains concept (see stakeholders map in figure 4.3). Moreover, SCM concept include key resources such as physical, financial, intellectual or human owned which is either owned or acquired by key partners (Osterwalder and Pigneur 2010, p.36). Furthermore, Nigeria has large proven crude oil reserves of 36.890 Bb (OPEC, 2020) which involved a high cost for exploration and production. Third, value proposition, this is interconnected with customer requirement in the oil market. Furthermore, it allows the customer to build confidence in certain product for a firm as a unique compared to other competitors or contenders (Osterwalder et al., 2014). More importantly, Khorshidi (2018, p.509) highlight significant features of value proposition such as customisation, accessibility, performance, newness, cost reduction and price. In light of this study, performance, cost, price and risk reduction are critical due to incessant complaints by the customers on Nigeria's crude oil export

sales in the global oil market. The author will look into those strategies that would improve performance and reduce cost to a great extent.

2.10 Key Relevant Theories of Business

Theory guide and help to shape RQs, and specific predictions as expressed in a hypothesis (Hair et al., 2016, p.53). The author thought of suitable management concept that underpins improvement in performance of firms. In this context, review of key concepts such as Michael Porter (1979), Drucker theory of business (Drucker 1994) and Resource based view (RBV) (Barney, 1991) were explored. First, Michael Porter (1979) explored five competitive forces that shape strategies ranging from threat of new entrants, bargaining power of suppliers, bargaining power of buyers, rivalry among existing competitors, threat of substitute products or services. All these forces are relevant to crude oil sales and logistics efficiency. The present study is concerned in the effective and efficient logistics for the NNPC and low-cost terminal operators in terms of crude oil export logistics system distribution. Importantly, Porter's theory despite its relevance in business management has its own limitations: Crucially, most of the issues in port performance and logistics appear to revolve around operations, adequate infrastructure, safety, and environmental challenges, policy and resources management. Furthermore, it appears to be much relevant in the service industry. What's more, (Wernerfelt 1984, p.173) asserted that it can be combined with RBV in order to form a sound framework. In essence, its limitation is evident in present study due to inability to form a valid framework for firm performance. Second, Drucker (1994) argued that every organisation, whether a business or not, has a theory of the business. Hence, the assumption that shape any

organisation's behaviour, dictate its decisions about what to do and what not to do, define what the organisation considers meaningful results. These assumptions are about markets, identifying customers and competitors, their values and behaviour and as well as about technology and its dynamics, about a company strengths and weaknesses. These assumptions are about what a company gets paid for and more importantly, are what I call a company theory of the business (Drucker, 1994, pp.95-96).

Port performance and crude oil export logistics systems involves operational, legal and financial strategies. Furthermore, including oil block concessions, proven reserves estimates, oil price fluctuations/volality, drillings, investment in supply chains, offshore and onshore facilities, ship building and repairs and human resource capability. Nigeria's crude oil export industry is more than 60 years old, which includes E&P been performed by many stakeholders including NNPC, key western oil majors and IDOCs. In light of this context, despite the presence of multiple firms, there appears to be challenges in Nigeria's crude oil export logistics systems distribution from meeting customers' requirement in terms of cost effectiveness. Consequently, the author questioned whether this theory of business is no longer valid. Assumptions about the environment, missions and competencies that reflect reality most accurately-with clear premise that our historically transmitted assumptions, those with all of us grew up, no longer suffice (Drucker, 1994, p.101). Drucker's major case studies of IBM and Generator Motors (GM) appears the only developed research on theory of business that provides ample incentive to conduct further research into this concept (Daly et al., 2010). Nevertheless, the author is focused on those
strategies that make other competitors superior to Nigeria. In addition, the author believes that this theory appears less suitable for this context. First, reasoning (Drucker 1994, p.102)'s assertion that every three years, an organisation should challenge every product, every service, every policy, every distribution channel. If we were not in it already, would we be going into it now? In this case, Nigeria has been in the business of crude oil export for a long period of time, thus, it appears that Drucker's theory addressed the service industry which appears smaller compared to the capitally intensive oil industry for the current study. Nevertheless, it appears relevant in explaining technology and particular strategies other competitors might possess over Nigeria. The author considered crude oil as a vital resource. Thus, Barney defined firm resources as all assets, capabilities, organisational processes, firm attributes, information etc. Controlled by a firm that enable the firm to conceive of and implement strategies that improves its efficiency and effectiveness (Daft, 1983) and as a firm attributes conceive of and implement value creating strategies (Hilt and Ireland 1986; Thompson and Strickland, 1983) (Barney, 1991, p.101).

2.10.1 Resource Base View

Third, RBV was formed due to growing influence of strategic planning that have left managers struggling with the best possible strategies. Consequently, Collis and Cynthia (1995, p.1)'s famous article in the Harvard Business Review on Competing on Resources: Strategies in the 1990s assert that RBV was formed as a framework that has the potential to cut through much of this confusion in the strategic field, grounded in economics, and it explains how a company's resources drive its performance in a

dynamic and competitive environment. In addition, Collis and Cynthia (1995) enumerated RBV basic strategies: test of inimitability, test of durability, test of approriability, test of substitutability and finally, test of competitive superiority. Furthermore, it shows distinct relationship between internal capabilities (what it does well) and its external industry environment (what the market demand and as well as what competitors offer. In this context, crude oil export is truly a global industry particularly E&P operations, also is increasing competition and technological change that has left COECs to rise up to challenge of capturing market share and evolving sustainable strategies for effective and efficient logistics systems distribution. The RBV appears best suited to see what Nigeria does well and what the market demand from both the environment and competitors, particularly other COECs and as well as increasing growth in shale revolution in the USA. In addition, increasing campaign to curb emission due to climate change etc. Simply put, Barney (2001, p.649) assert RBV application is useful in firm versus industry effect and as well as in studying the specific sources of sustained competitive advantage to guide their work. Finally, the current study aimed to identify organisation resources that can optimise port performance in crude oil export logistical systems distribution through application of RBV as a theoretical framework.

2.10.2 Resource Base View Applications

RBV has been described as a compelling theory widely been employed in different fields to showcase how resources are employed for enhanced outcomes such as explaining relationship between organisation resources and firm performance (Kozlenkova, Samaha and Palmatier, 2014). In this

context, the author considered port performance and crude oil export logistics systems from a RBV perspective. Consequently, considered as an assets that enable firm to conceive and execute strategies to improve efficiency and effectiveness (Wernerfelt, 1984). Key areas of business and management used RBV, particularly marketing research that has increased by more than 500 percent in the past decade (Kozlenkova et al., 2014, p.1). RBV applications in marketing span marketing strategy CEO Transformational Leadership (Auh and Menguc, 2009), Customer management, SCM (Ramaswami et al., 2009), International marketing such as information, relationship and production development; experiential financial (Kaleka, 2001). Nigeria keeps facing increasing competition among Africa's crude oil producing and exporting countries oil such as Angola, Uganda, Mozambique, Guinea, Libya, Somalia to name a few.

2.10.3 Key Indicators Underpinning RBV

1. Test of inimitability

Nigeria has an advantage of causal ambiguity that makes it difficult to re-create (Collins and Cynthia, 1995). In this context, Nigeria has different streams of light sweet crude oil unlike some of its competitors e.g. Angola, Libya. In addition, logistical geographical advantage to the European market is an added advantage. Final source of inimitability economic deterrence, which occur when a company preempts a competitor by making sizeable investment in asset. Key COECs have more investment capabilities than others. For instance, Saudi energy giant, Saudi Aramco, western oil majors appears to have much investment in the value chains such as vessel ownership,

oil license acquisitions, Single buoy mooring (SBM) platforms, information infrastructure and human resources to name a few.

- Test of durability: Useful resource such as crude must be sustainable and the longer a resource can be kept, the better its advantage (Lynch, 2000, p.282).
- 3. Test of approriability: The Business model of E&P companies is embedded in JVC or PSC which involves different stakeholders bringing resources together for investment in the supply chains. Furthermore, these stakeholders could–and often did–depart to set their hedge funds to another firm where they could raise a greater share of the profit generated.
- 4. Test of competitive superiority: In this context, RBV aims to explain Nigeria's crude oil resources export, which normally exported to global oil market in trying to differentiate its performance levels and provide it with a competitive advantage over other COECs (Barney, 1991). In addition, the author asked for successful strategies that underpin this study in order to maintain a competitive advantage. This is a research problem because understanding sources of sustained competitive advantage has become major area of research in strategic resources management (Barney, 1991, p.99). What are these competitive strategies for port performance or efficiency? In a sense, the author does not know them at the moment. Consequently, the RQ2 would be how the author can derive optimisation strategies for port performance and crude oil export logistics system distribution in Nigeria. Further, there appears a consensus within the literature on greater flexibility of

RBV rather than Porter's prescriptive approach to strategy formulation. A typical example is Hooley et al.,'s (2001, p.503) work on market focused resources, competitive positioning and firm performance which proposed a holistic model from RBV of firm integrated with marketing theory. Porter (1985) highlights the importance of the value chain to assist managers in isolating potential resources based advantage, hence the author believes that the application of RBV would examine those attributes that resources isolated by value chain, analyses must possess to be sources of sustained competitive advantage (Porter, 1990).

2.10.4 RBV Linked With Information Sharing In Crude Oil Flows

Key among theoretical frameworks relevant to the present study identified are environmental uncertainty, customer focus and information technology which are all key to SCM development (Cheng and Paulraj, 2014, p.147). First, the author is concerned with the information flow related aspect of these theoretical concepts that relate to RBV in a great extent. Based on the literature above on RBV. It is imperative to look at (Jones et al., 2014)'s study that identified specific resources such as information sharing and connectivity, capabilities as critical to maintain both resilient and robustness in the crude oil export supply chains. Although the current study discovered information sharing as both theoretical and empirical evidence. Research evidence revealed that information technology emerged as key popular innovation being implemented in the supply chains. In the context of the present study, the author believes that capability is key to maintain competitiveness from perspective of the NNPC which appears to improve and/or enhance measure of operational performance (Kros et al., 2011). Typical examples appears in *buyer-supplier relationship*, in this context of crude oil trader-terminals operators (NNPC, IOCs and IDOCs) relationships in SCM. This is because the collaborative effort, relationships and level integration between supply chain actors impact the performance outcomes (Tan et al., 2007).

Furthermore, *communication and information sharing* is one of the eight key dimension of buyer-supplier relationship as reported by (Boeck and Wamba 2008), gaining attention and in toward creating competitive advantage within

the logistics information technology (Hazen and Byrd, 2012, p.17). In addition, research findings revealed buyer-supplier relationship appears not a significant connection of the relationship between logistic information technologies (LIT) adoption. This suggests that other "resources" must be used to complement and help achieve competitiveness. Thus, beside information sharing, the author is curious about other *complimentary resources* that can improve effectiveness and competitiveness of the current study. Two critical resources in the development of supply chain viability: Supply chain connectivity and information sharing, whereby connectivity relate to the technological infrastructure through information convened to supply chain partners (Zhu and Kraemer, 2012) and information sharing relate to the nature, speed and quality of information been conveyed (Cao and Zhang, 2011). The author would explore theoretical implication of these concepts in present study from both IOCs and IDOCs perspective.

Importantly, a competitive advantage created capabilities appears to be more embedded within the organisation, management and process. Thus, more likely to be sustainable than competitive advantage which is created purely by resources (Brush and Artz, 1999). Information capabilities are necessary in order to utilise information technology effectively and that information system capability rely on technology, human and relational resources (Ravichadran and Lertwongsatien 2005).

2.11 Initial Theoretical Framework for Port performance and Crude Oil Export Logistics System Distribution

This framework was generated by the use of Template analysis (TA) with due consideration to the ROs by strict adherence to seven sequence steps of TA (King and Brooks, 2017, p.3). For details on TA technique, steps and procedures, please refer to chapter 4.10.The author will adopt a subjective inductive approach, hence the conceptual framework would evolve during the study as the author gathers new ideas, insights and knowledge (Verpio et al., 2020, p.993). In addition, tentative conceptual framework will be form initially and this is likely to change as data become clearer to the author (Verpio et al., 2020, p.993).

2.11.1 Research Questions

RQ1. What are the fundamental factors/items, which affect port performance and crude oil export logistics systems distribution in Nigeria?

RQ2. How should NNPC and or other low-cost Exploration and Production (E&P) companies prioritise optimisation strategies for port performance and crude oil export logistics system distribution in Nigeria?

Crude oil export	Vessel voyage	Marine	Environme	Geographical	Port services	Market and Customers
/import terminals		operations	ntal policy	location		satisfaction
Overland	Tanker freight	Bunkering	GHG	Hinterland	Port tariff	Crude oil marketers
infrastructure	World scale	Tanker delay	Emission	Inland	Canal fees	Geographical dispersion of
Pipeline capacity	Charter party	Tanker	Exploration	Facility location	Cargo handling	customers
Pipeline nomination	Contract type	manoeuvring	and		Customs services	Customer outage
Tanker size and	Spot chartering	Inspection and	production		Documentation	Refiners
capacities	Demurrage	navigation	Shipping		Cargo damages	Customers: Europe, North
Cargo throughput	Safety and	channels	Refinery		Service quality	and South America, Asia
	maintenance	/condition,	operations		Third party service	and Middle East
		Change in	Surface		provider	
		structure of	processing			
		shipment				
		Port restriction				
		Tidal and				
		weather				
		condition				

Logistics	Port	Information	Logistics	Crude oil tanker	Inventory management	Supply chain
development	infrastructure	flow network	service	routing and		management
			providers	Scheduling		
Lead time		Structured	Drillers	Shipping	Safety stocks	Supply chain information
Logistic cost	Port services	information	Mariners	scheduled and	Crude oil inventory cost	Total quality management
Tanker transit times	Accessibility	management	Port agent	dispatched		Schedulers
Dependable lead time	Asset specificity	system	Cargo			Decoupling point
Environmental safety	Maritime	Volume of	surveyors			Push and pull orientation
and security Land side	uncertainty	delivery				
connection	Labour market	Potential				
Deep water sites		queuing				
		problem				
		Ship position				
Exogenous threat						
Supply chain						
resilience						
Supply chain security						

Table 2.5: Initial Theoretical Framework for Port performance and Crude oil Export Logistics System Distribution

2.12 Summary

This chapter reviewed many performance measurement indicators in port performance in container terminals and a few on oil related maritime transport. However, customer satisfaction is vital for port/terminal efficiency, activity and terminal customer satisfaction. Further, the SLR increased the validity of the detailed literature review, revealed limited study on port performance and crude oil export logistics except in key aspects of the value chains such as optimal throughput level in unloading, information flow network for scheduling and dispatching of crude oil to the customer. Crucially, a theoretical framework to guide the research was derived. Consequently, it is obvious that there was a research gap in this instance which the current study will address within the context of Nigeria. The work aims to find the main themes that explain why Nigeria's crude underperforms in the international market and hence to propose strategies for improvement. In conclusion, an initial theoretical framework which guided the study was derived. The next chapter will explain the relevance of crude oil exports, Nigeria's business model, supply chain key actors, crude oil movements, terminal types, COECs dynamics and the main customers of Nigerian crude.

CHAPTER 3: CRUDE OIL EXPORTS

3.1 Introduction

Essentially, Nigeria's crude oil is exported to all parts of the globe spanning Africa, North America, and Europe to name a few. Although Nigeria's petrol consumption level at projection of 65 million litres per day (NNPC, 2019), as well as consumed some crude oil refined domestically by its moribund refinery with limited production capacity, the majority had is exported to the global oil market. Further, still there is high demand for oil (Clarksons, 2018, 2019). In addition, a detailed overview of Nigeria's oil industry, Nigeria stateowned oil firm with 11 subsidiaries that span marketing, refinery, retail, exploration, exploitation and so on (NNPC, 2019,2020). More importantly, JVCs and PSCs formed major components of the business model. The author explored and discussed COECs dynamics, industry structure, and comparative and growth rate. Moreover, export ports and/or terminals onshore and offshore have been strategical logistics hubs in the crude oil flows. See details in table 3.8 for locations, operators, facility and type of crude streams. The next chapter will discuss the underpinning research philosophy and the methodology.

3.2 Crude Oil

Crude oil is a diverse substance in the earth crust subsurface, commonly found in onshore or offshore. In addition, each grade has its own particular characteristics and may be classified as sweet (low sulphur), sour (high), light, medium or heavy or highly volatile (crude condensate and reconstituted crude (Armitage, 2009, p.7). The commonest crude type are paraffinic and aromatic crude. First, the former contains 6% paraffinic wax by volume and is associated with a higher wax content that deposits a large quantities of paraffinic wax sludge in the slop tank. The latter has a high viscosity at ambient temperature with a high pour point temperature. Crude oil handling and storage requires an adequate knowledge of its properties such as density, vapour pressure, flash point, wax content, cloud point, viscosity, basic sediments and water (BS&W), sulphur content and benzene content. All these properties are vital in the logistics of crude oil flow; however, density and BS&W are critical for effective and efficient crude oil flow. Traditionally, American Petroleum Institute (API) gravity is use as measure of weight per volume of crude oil (Armitage, 2009, p.7). Further, BS&W is a measure of the percentage of free water, sediment and emulsion and is measured as a volume percentage of the production stream. In this case, it is vital in the logistics of any crude oil export as this value is normally applied to the total crude volume loaded to obtain the net volume and weight loaded. Where net weight=Gross weight- Gross weight* BS&W (percentage). More importantly, crude oils with low sulphur content appears easy to refine; Nigerian crude primarily has this vital property.

3.3 Crude Oil Demand/Movement

Crude oil is one of the world's most extensively traded commodities. Its transportation by tanker is an important link between the supplier and refiner. In this study, logistics management activities of crude oil involves inbound and outbound transportation, fleet management, warehousing, material handling, order fulfilment, logistics network design network, inventory management, supply and demand planning and management of third parties service providers (CSCMP, 2019). Furthermore, demand and supply is a key component of logistics management. Crude oil supply and demand planning is vital in this study. The global economic growth is associated with energy demand and supply. Firm growth in the global economy is expected to support steady pace of growth in the global oil demand (Clarksons, 2018, p.17). For instance, economic forecast for 2018 is 3.7% while 2019 forecast was revised down slightly by 0.1% to now stand at 3.5% on the back of slowing dynamic amid rising trade tensions, monetary tightening, particularly in the US, and pressing challenges in emerging markets and developing economies (OPEC, 2018, p.5).

First, global oil demand is currently expected to expand by 1.3% and 1.4% in 2018 and 2019 respectively to reach 100.1 Mbpd (Clarkson, November 2018, p.2). Crude oil price is a key driver in crude oil demand and supply, usually seen when global supply outstrips demand, hence leading to a supply glut. Moreover, OPEC usually meets quarterly to determine production output. For instance, an <u>OPEC and non-OPEC Declaration Of Cooperation (DOC)</u> in 2016 helped to stabilise the crude price committed to removing around 1.8 Mbpd of crude oil from global supplies from the beginning of 2017 (OPEC,

2016, p.1). Furthermore, global oil supply is currently projected to expand by 2% in 2018, with pace of growth expected to accelerate to 2.4 % in 2019 to reach 100.6 Mbpd. Crude tankers transport most crude oil: such as very large crude carriers (VLCC), Suezmax, Aframax, and Panamax. These tankers varied in demand based on spot earnings month in month out (m-o-m) or year in year out. For instance, the crude tankers market improved significantly in October 2018, with average VLCC spot earnings trebling m-o-m to \$33, 491/day while Aframax earnings also rose sharply (Clarkson, 2018, p.3). Moreover, crude tanker demand trend for VLCC for 2018 is 190.5 in comparison to 199.99 for 2019. In addition, Suezmax for 2018 is 62.9 in comparison to 64.3 for 2019.

In conclusion, Panamax is the least with 2.8 for 2018 in comparison to 2.7 for 2019 (Clarkson, 2018, p.3). In this case, global demand will increase; in essence, COECs will need large inventories for crude oil export to the international market in order to provide the world with an efficient sustainable crude oil flows which is cost effective in the long-term.



Figure 3.1: Global Oil Demand Growth

Source: (Adapted from Clarksons Research Oil and Tanker Trade Outlook 2018)

3.4 Crude Oil Exporting Countries Dynamics

Crude oil production is relatively concentrated in a few countries around the world, its consumption linked to wealth of industrialised economies as well as aid in dramatic expansion of emerging and developing economies (Matsumoto et al., 2012, p.820). Over the years, there has been debate on the decline in production capacities of COECs (Hallock et al., 2004, Voudouris et al., 2011). However, Matsumoto et al., (2012, p.828) found out that it is nearly impossible to predict the exact future evolution of country specific crude oil capacity and suggest alternative options such as controlled computational experiment. In contrast, demand for fossil fuel, which is a product of crude is set to increase significantly in developing economies driven largely by increase in prosperity (BP, 2019, p.7). Consequently, COECs are at advantage position to export because of increasing fundamentals in demand. Nevertheless, key COECs and oil majors have more reserves and capabilities than others. Significantly, top oil producing and COECs are USA, Russia, Saudi Arabia, Kuwait, UAE, Venezuela, Kazakhstan, Libya Iraq, Iran and Nigeria. Crude oil including petroleum and liquid gas appears as one of the major commodities handled by seaborne traffic, its fluctuation in demand and supply is associated with traffic volume (Merk and Dang, 2012, p.14). In addition, they enumerated key challenges of input/output oil port sampled from 71 key worldwide ports, which include efficiency of port infrastructure to berth oil tankers and handles liquid oil/gas via pipelines. In this present study, the author's main concern is particularly

on important descriptive statistics of input/output variables of the crude oil which include port sample quay length, maximum vessel capacity, maximum draught, tank storage capacity, pipeline/loading arm capacity. In light of the this study, the author focused on output in terms of crude oil export volume of key selected COECs which would be analysed to determine their comparative share and growth rates in comparison to Nigeria.

Firstly, research shows that Nigeria has limited concern in key acknowledged challenges enumerated by (Merk and Dang, 2012, p.14), in relation to seaborne traffic except for pipeline or loading capacity and inventory management. More importantly, in terms of production capacity, OPEC Member states such as Saudi Arabia obviously appears leading in production capacity with average of 10Mbpd in the whole of year 2017, 2018, 3Q18, 418 and 1Q19 respectively, followed by Iraq and Iran with production capacities of 4446Mbpd and 3,813Mbpd in 2017. That said, others that appears fare better are UAE, Kuwait, see details in table 3.1 showing export production capacities of key COECs. In contrast, Nigeria appears to struggle to produce and export 1.7 to 1.8 Mbpd which appears smaller in comparison to its competitors in the Middle East. Now, USA certainly produced highest volume than any other COECs with average of 13.2 Mbpd in 2020 (EIA, 2019, p.2). This appears possible due to rig efficiency and well-levelled productivity. In my view, these strategies would be continuous work in progress for any COECs like Nigeria to maintain a competitive advantage, and as well as requiring a lot of investment from all stakeholders in the value chains.

COECs	2017	2018	3Q 18	4Q18	1Q19
Algeria	1,047	1,042	1,059	1,055	1026
Angola	1,634	1,505	1,470	1,496	1445
Congo	252	317	320	318	328
Ecuador	530	519	527	517	526
Guinea	133	125	124	114	115
Gabon	200	186	184	185	205
Iran	3,813	3,553	3,603	2,982	2725
Iraq	4,446	4,550	4,6007	4,669	4631
Kuwait	2,708	2,745	2,794	2,774	2715
Libya	811	951	891	1,056	965
Nigeria	1,658	1,719	1,704	1,740	1734
Saudi					
Arabia	9,954	10,311	10,422	10,749	10019
UAE	2,916	2,986	2,982	3,236	3066
Venezuela	1,911	1,354	1,272	1,191	970
Total					
OPEC	32,014	31,863	31,960	32,083	30,471

Table 3.1 Export production capacities of key crude oil exporting countries Source: (OPEC, 2019, p.20)

3.5 Crude Oil Export Growth rate of World Top Exporters

Global oil supply growth appears to be increasing due to demand for crude oil which has seen a surge in global supply growth partly from 2017, 2018e, 2019f and 2020 with equivalent growth rate of 0.5%, 2.6%, 0.3% and 1.7% respectively (Clarksons 2019, p.16). In this context, the author considered Merk and Dang,'s (2012, p.17) study which asserts that increasing oil production volume towards optimal level will improve efficiency. Importantly, findings revealed that port of Texas city, USA, with varying returns to scale (vrs) of 0.768 and return to scale 0.292 appears effective and efficient. In this context, the author assumed crude production capacities of key COECs, see details in table 3.2 seaborne crude oil export of key COECs, which revealed the highest to be Saudi Arabia with over 12 Mbpd followed by Irag and Iran among OPEC. In addition, among non-OPEC, for instance, USA, Russia, Canada and Mexico produced the highest export volume in the world. Essentially, in the case of Saudi Arabia, there is increasing consistency in terms of export volume from 2017 to Q2019, see details in table 3.1. Iraq which is another Middle Eastern oil producer do extremely well and this might be due to effective Business models which appears integrated with IOCs. Other COECs that produced sizeable crude are UAE, Kuwait and Angola. Venezuela appears to be struggling to increase its production capacity share. Nevertheless, this is consistent with estimates of 1.7 Mbpd from 2012 to 2018e. The author understands that it is impossible to estimate actual production capacity of any COECs, as this appears linked to many factors such as geopolitics, reserve depreciation, infrastructure facilities, inventory management, transportation and pricing. Thus, it is imperative to say that the USA, Saudi, Russia and Iran are the top producing countries. In practical terms, theoretical implications is that, these top producing countries export terminals/ports appears to be more efficient than other COECs (Merk and Dang, 2012, p.17), this appear challenging in present study. For instance, Nigeria produced 2.53 Mbpd, which is well below its ambitious oil production capacity of over 3 Mbpd (EIA, 2019). Table 3.1 export volume of key OPEC, show Saudi Arabia been the highest with average of 10 Mbpd and least is Guinea with average 122,000 bpd. Crude oil export sales earnings are critical

to these nations and the more volume share of export, the more the oil receipts for state budget implementation. In this context, Saudi Arabia has nine major oil fields such as *Ghawar, Safaniya, Khurais, Manifa, Shaybah, Qatif, Khursaniya, Zuluf and Abqaiq* (EIA, 2017, p.6). Crucially, Abqaiq alone produced 5 Mbpd and as well as double as the world's largest oil processing facilities and stabilisation plant with a capacity of 7 Mbpd or about 7% of global crude oil production capacity (EIA, 2019, p.1). Saudi's Ghawar oil field is by far the largest conventional oil field in the world with proven reserve of 58.32B barrel of oil equivalent as at 31 December 2018 (Saudi Aramco, 2019, p.2).

Russia was the World's largest producer of crude oil including condensate in 2016 (EIA, 2017, p.1). Nigeria also supply European countries with like any other COECs. Russia has a lot of oil production by region including West Siberia, Khanty-Mansiisk and Yamal-Nenets to name a few. Furthermore, Russia, like Nigeria, has a lot of oil firms alongside with state-owned oil firm Rosneft. More importantly, Main Russia's export goes to European countries such as Netherthand, Germany, Poland, and Belarus. Major export terminals are Novorossiysk, Primorsk, Ust-Luga, and Kozmino which accounted for 84% of Russia's seaborne crude oil exports in 2016 (EIA, 2017, p.15). Nigeria shares similarity from volume of export perspective on this front, combination of Brass, Forcados, Qua Iboe accounting for roughly 722,000 b/d (Lloyd list, 2016). However, a key advantage Russia had over Nigeria is massive investment in pipelines particularly for crude oil export logistics. To buttress this point, Merk and Dang, (2012, p.14) recognised pipeline as one of the key challenges of input/output of oil port performance. In essence, (EIA

2017, p.13) reported that Russia possessed eight major crude oil pipelines with 0.1Mbpd been least capacity pipeline for Baku-Novorossiysk, 0.2Mbpd for TransSakhalin and Omsk-Pavlodar-Atasu pipelines and highest been for Druzhba (2Mbpd), Baltic pipeline system (1.5 Mbpd) and Caspian pipeline consortium (1.3 Mbpd) respectively. Further, destination of the export via pipelines are to Europe, Gulf of Finland, Pavlodar refinery in Kazakhstan and China etc. In comparison with Nigeria, pipelines owned by the Nigerian Government and managed by the NNPC through its subsidiary Petroleum Product Marketing Company (PPMC) (NNPC, 2012, p.30). In contrast, Nigeria has limited pipeline for export, mainly for domestic petroleum product transport which is pumped into pipelines from FPSO at the different export loading terminals. A case study of chevron as terminal operator revealed that been the largest shareholder in West Africa Pipeline Company Limited, with 36.7% interest, which owned and operated the 42-miles (678km) West African Gas Pipelines (WAGP) (Chevron, 2012, p.23), (NNPC group, 2020). Thus, this usually exports as the pipeline is used in transporting Natural Gas to neighbouring countries such as Ghana, Benin and Togo. Nevertheless, considering the capacity of the pipeline, doubts arise concerning its ability to supply the needed products in a few years' time due to the demand rise in the oil industry especially in developing nation and emerging markets, apparently may require an extension to improve capacity of the pipelines and there may be a need for the private sector to take full control/ownership of the pipelines through Private public partnership (PPP) in the future. However, crude oil export is not considered here, this appears a major gap in Nigeria, thus reduces port performance to a greater extent. See

table 3.7 diagram showing various pipelines for crude oil transport in Nigeria. Furthermore, it appears Nigeria's pipeline capacities are highly limited, and hence this formed a huge gap in the supply chains that appears hindered effective and efficient crude export transport via pipelines to the global oil market.

Another significant strategy is inventory management. This refers to crude oil stockpiles which are reserve of unrefined petroleum measured in numbers of barrels, and appears very important in mitigating supply and demand effect on price of oil. In context of the present study, tank storage, alternatively referred to as inventory, are significant for efficiency of sea borne traffic (Merk and Dang, 2012, p.4). To start with, USA has up to 428.5M barrels of crude inventories in January 2020 according to Reuters poll (Reuters, 2020). Meanwhile, Saudi Arabia held nearly 180M barrel of crude oil inventory at the end of July 2019 according to Joint Organisation and Data Initiative (JODI). In contrast, Nigeria's inventory in table 3.8 show clearly storage capacities from highest to the least been *439600M for* Qua Iboe and Obe terminal with 22067M barrel respectively. In essence, Nigeria appears to have less investment in inventory in comparison to some COECs. Large inventory is vital during shock, outages, pandemic period like covid-19.

It is not ultimate for efficiency to be obtain having huge Strategic Petroleum Reserve (SPR) like the USA but having it will substantially increase confidence of customers, hence enhancing Nigeria's reputation as a reliable and dependable supplier. Finally, crude oil price is strategic in determining customer choice, for instance VLCC spot rate for USA and China from West Africa is the same to USA, and as well as China respectively (Clarkson 2019,

p.16). In essence, Nigeria in West Africa region need to prioritise the seaborne trade challenges in order to remain a leading exporter and to be able capture market share of its crude despite immense competitions among OPEC Member states especially in low price environment.

Producing							
countries	Years						
	2012	2013	2014	2015	2016	2017	2018e
Saudi	11.8	11.6	11.7	12.4	12.6	12.1	12.4
United State	8.9	10.1	11.8	12.8	12.3	13.1	15.3
Russia	10.7	10.8	10.9	11.1	11.3	11.3	11.5
Iran	3.5	3.2	3.3	3.4	4.4	4.7	4.5
UAE	3	2.9	3	3.1	3.2	3.2	3.2
Iraq	3	3.1	3.4	4.1	4.5	4.5	4.6
Canada	3.1	3.3	3.6	3.7	3.7	4	4.3
Mexico	2.9	2.9	2.8	2.6	2.5	2.2	2.1
Kuwait	2.5	2.6	2.6	2.8	2.9	2.7	2.8
Venezuela	2.7	2.7	2.7	2.6	2.3	2.1	1.5
Nigeria	2.5	2.4	2.4	2.2	1.8	1.9	2
Angola	1.8	1.8	1.8	1.8	1.8	1.7	1.7

Table 3.2 Crude oil producing countries production per day Souce: (Clarkson Oil and Tanker Trade Outlook, August 2019, p.16) 3. 6 Key Published Measures of Ports logistics efficiency related to oil transport

Feng et al., (2015, p.628) presented work on optimal throughput of crude oil terminals with options for infrastructure improvements. However, this marked a unique departure from most research, which centred on container terminals. The research dwells on optimum throughput level of crude oil terminals due to its critical importance for efficient utilisation of coastal resources and sustainable development. The research methodology utilised data collected from major crude oil terminals in China, whereby two classes of tankers served at the terminals such as 300,000-ton tankers and 100,000-ton tankers respectively. Arena simulation software by Rockwell Automation was used in developing the simulation of crude oil terminal that includes:

- Tanker arrival and value assignment modules (tanker A-100,000 ton) and tanker B (300,000-ton) and their arrival is followed by third order Erlang distribution.
- 2. Secondly, followed by inspection and navigation channels modules
- 3. Berth Module. The module simulates the availability of the berth for unloading operations and is done through an introduction of weekly berth close down with a duration that follows a normal distribution with a mean of 18 hours and standard deviation of 4 hours.
- 4. Destination Module, the Ningbo–Zhoushan port approximately 30% of the crude oil in the tanker goes to the national pipe grid with unlimited storage capacity and the remaining 70% goes to the storage tank with limited capacity

5. Storage tank module, this tank alternately operates in two modes each day, supplying oil to the refinery for 8 hours and receiving oil from tankers for 16 hours. The result of the findings revealed the following results.

Berth utilization rate	62%
Number of tankers served in a year	Class A:22 ,class B :66
Average time spent in a port (including	Class A:63.3 hours, class B 118.1 hours
mooring area by a tanker)	
Crude oil unloaded in a year	22.MMT (15.43 MMT to local refinery, and
	6.61MMT to the national grid)
Average holding time for a crude oil	142.5 hours for oil going to refinery, and
	109.11 hours for oil going to national grid.
Terminal cost in a year	RMB 60.8 Million
Ship holding cost in a year	RMB 71.8 Million
Crude oil inventory cost	RMB 116.8 Million
overall cost per ton of crude oil unloaded	RMB 11.3

Table 3.3: Results of simulation conducted in the Port of Ningbo Zhoushan Source (Feng et al., 2015, p.631).

The result provided a deep understanding of unit logistics cost for an optimal throughput level in unloading oil terminals, but the major gap appears that no specific attention is given to tankers with more than 500,000 tons which is in contrast to most exporting terminals that accommodate Suezmax and VLCCs which are significant in this study. The results of the research specifically deal with improving infrastructural investment such as increase in number of berths, dredging and so on to accommodate the increasing demand for the port oil terminal infrastructure towards a reduction in the logistics cost and better port performances.

Liutho (2003) studied Russian oil exports via the Baltic Sea including extensive debate concerning whether "*Do oil shipments through the European Union (EU's) inner sea bring Russia closer to the EU or bring them apart*? Details spanned Russia's oil reserves, production and consumption, including all the major oil companies operating. More importantly, discussion on the major oil export ports and future of Russia's oil export via the ports in the Baltic Sea. In addition, the study explored several reports ranging from oil majors, Government sectors and banks in discussing the critical issue of oil export from Russia through the Baltic Sea and comparison with EU trade routes. Major findings were that the port of Novorossiysk which is on the Black Sea, was traditionally Russia's largest oil terminal through which roughly one guarter of Russian crude oil was exported in the year 2000, while the Latvian Port of Ventspils was traditionally the major oil terminal on the Baltic sea, owing to the growing competition from the port of Tallinn which delivered oil by rail. The other significant port is Petersburg oil port which handled 7-10Mt of oil products in 2002 and there is also a plan to expand other oil terminals. Traditionally, Russia used both Mediterranean and the Baltic Sea as oil transit. This work presented a deep insight into oil export logistics, particularly through the ports and development of port strategies in Russia for its oil shipment through the Baltic Sea in relation to the political and economic benefit attached to it, and this gives the author an impetus on what are the fundamentals to be considered in an oil export logistics in the aspect of port performances. Most importantly, focused more on port expansion in sea territory with the aim to create a hub for crude oil export transport logistics systems distribution.

Ha et al., (2012) worked on estimation of tanker fleet capacity in Korea's crude oil market. The purpose of the research was to investigate number of tankers available for Korea to utilize in 2009: 822 vessels with 6.74 M gross tonnages (GT) will be enough to meet Korea's transportation demand for

future crude oil import. In Korea, the shipping companies' ship to the various refineries and usually import the crude oil. A demand function for the tanker is set as follows:

VD= (FR, Q, OP)

Where VD represents vessel demand, FR, the freight rate, Q, the volume of oil import, and OP an international oil price. Overall, an econometric model was employed for estimating the oil tanker fleet capacity for Korea, which was as follows:

 $VT = \partial 0 + \partial 1q1 + \partial 2IRt + \partial 3OPt + \in t$

Unit root test of the series, is the first difference and consequently *cointegration* test was conducted among the variables. In addition, an error correction model of the series was introduced, a Vector error correction (VEC) model has cointegration relations built in the specification. Finally, a cointegration equation helped in the validation of the model. Findings revealed that the long-term elasticity of oil tankers with respect to 10% increase in the volume of crude oil tankers with respect to 10% increase in the volume of crude oil tankers with respect to 10% increase of the oil price increase will lead to about 9.5% of the vessel capacity. Furthermore, projected crude oil demand and the required fleet capacity was produced using the cointegration equation. This can be seen below.

Lvt = -6.5223 +1.3843lqt +0.9489lop

The above cointegration shows clearly the long-term elasticity of oil tankers with respect to a 10% increase in the volume of crude oil import. The 2009

fleet capacity of the oil tanker in Korea showed key variables required for transporting Korea's crude oil import demand in 2015, which might lead to creating a serious of overcapacity problems. Additionally, such an overcapacity would continue exerting a serious downward pressure on the freight rate because it was already down from \$2.48 per barrel in 2008 to \$1.45 per barrel in 2009. This has helped in explaining market volatility and the need for a comprehensive econometric model.

Furthermore, Mokia and Dinwoodie (2002, p.39) discussed the spatial aspects of tanker lay-times; the study emphasised prices of oil-based products reflect in part the cost of tankers delayed in ports. However, it emphasized major scope for reducing demurrage claims in the oil industry through extending port lay-time allowances, spatial variation in empirical port lay times was performed through data collected for three years by five shipping companies and trading organisation. Data analysed included tanker dwt, charter party under which tanker was charted in or out, vessels sizes and geographical routes. However, vessel size was kept constant and in addition, variations in lay time were investigated between different charter parties and four particular routes. Finally, during testing for optimal lay-time allowances, for instance, L72, L84, L96 and L108 on a particular geographical route, trade-off between demurrage and dispatch charges for a particular ship size segment were estimated based on the empirical lay time distribution. The lay time is impacted by three important factors, namely charter party, geographical routes and vessel size. See details in figure 3.2 for these factors.





Source: (Adapted from Mokia and Dinwoodie, 2002, p.39). Additionally, demurrage hours by charter party is vital in determining extended global lay time allowances, and invariably depend largely on a particular geographical route (Mokia and Dinwoodie, 2002, p.46). For instance, Middle East Gulf (MEG), far and North Sea–Northern Europe performed best but routes originating from Singapore, and from south to Central America, typically record 6% fewer instances of demurrage with L84, falling a further 5% with L96 policies. Simply put, increasing lay time was shown to have some consequences on the overall voyage cost and World scale (Mokia and Dinwoodie, 2002, p.46). Simply put, spatial optimisation of lay times assists in reducing demurrage claims. Statistically, significant variations in demurrage hours were ascribed to differences in charter parties, ship size and geographical route. In essence, extension of laytime where it is insufficient in order to reduce its effects on ship owners and charterers appears to help in ensuring efficient oil port logistics performance, hence

optimising fuel provision, with implications for mobility, accessibility and economic activity levels.

3.7 Measures of Port logistics efficiency in oil transport using AHP techniques

Pipelines are the most important and safest means of transporting bulk energy, as the economy of a country can be heavily dependent on smooth and uninterrupted operations of pipelines (Dey and Gupta, 200). Thus, its considerable significance in ensuring smooth logistics operation of oil transport cannot be understated; oil pipeline projects are valuable investment decisions. Dey (2004) explored AHP framework techniques to evaluate projects in Indian oil pipeline industry to arrive at consensus decisions on project selection through the involvement of stakeholders. The sample size covered all project stakeholders' requirement and concerns. This project spanned owner, managers, consultants, suppliers, contractors, community, government ministry etc. The comprehensive sample is instructive to the present Doctoral study. Moreover, Dey's study draws all stakeholders in the crude oil export supply chain in Nigeria. The output of the study is largely relevant to the current study. In the present study, Nigeria needs continuous investment to upgrade pipelines either offshore or onshore, as empirical data showed that outdated, ageing pipelines need replacing with a modern and risk averse, and technology driven pipelines to meet international best practices. The utilisation of AHP techniques in this study can prioritise strategies to improve port performance in crude oil export logistics in Nigeria. The impact of efficient pipeline on logistics is immense as it reduces pipeline attacks and thus, make them less susceptible to militant attacks, leaks and sabotage.

Dey, (2004, p.599) concluded that feasibility analyses of pipelines projects are presently conducted within a fragmented framework with many studies

occurring prior to impact assessment. However, there are varied opinions and expectations of stakeholders input in the survey which led to the desired decision of site selection. They found out that prioritising environmental and social factors for site selection problems would not only ensure a sustainable development, but also keep organisational productivity up, as it ensures uninterrupted operations with minimum failure throughout its life. The time and cost are critical physical performance indicators raised by Dey's, (2004, p.603) model, as the project under study was completed successfully without time or cost overruns. In contrast, these have impacts on the logistics chains, for instance, Nigeria's historic poor environmental and social factors revealed by both empirical and archival data appears hindering efficient logistics, as key of the pipelines need upgrading to modern standard. This model can be applied whenever pipelines projects are required in crude oil supply chains.

There is an increasing need for a deep-water seaport in the development of a modern economy, for instance the Baltic Sea is an arterial transport corridor between Eastern and Western Europe. Zavadskas et al., (2015, p.180) used AHP and Fuzzy ratio assessment methods to propose a model that could be implemented in the development of deep–water seaport in Klaipeda. They found that facility location decisions are a critical element in strategic planning for a wide range of private and public firms. This could be replicated in the current study particularly in the development of offshore/ onshore fields to find most appropriate facility location to avoid supply disruption in the chains. One comparison alternative criteria explored, and that appears crucial to this study, is accessibility to the marine terminals for calling vessels. Qualitative data and observation by the author revealed that some

smaller JV oil-producing firms have challenges with dredging and hinders safe and/or easy access to export terminals during loading operations. The proposed model can be used to improve accessibility to marine terminals and this has a huge impact on cost, for instance, maritime insecurity has a huge impact on cost, thus, finding appropriate locations prior to design is critical. Further, empirical data showed the whole logistics systems in Nigeria suffered from a degree of investment such as occasional frequent breakdown of subsea lines, which have to be taken out of the export systems, and that reduces loading rate of vessels which leads to variations in exporting rate and hence disrupts the supply chain distribution network. There are similarities and differences between this study and the present one. Both are case studies and used AHP technique aimed at proposing strategies for a competitive and attractive port strategic management. The major difference is in the use of the fuzzy additive ratio assessment (ARAS) method and secondary data while the current study used mixed methods.

Cargo loading operation is one of the most critical shipboard operations on board oil/chemical tanker due to nature of the work, hence maintaining safety operation for effective logistics system during oil shipment is vital. Akyuz and Celik (2016, p.424) studied a hybrid error probability determination approach that involves case of cargo loading operation in oil/chemical tanker ship. They deployed Human error assessment and reduction technique (HEART) and AHP method to determine human error probability (HEP), due to its importance in the marine industry. Their proposed model is useful in marine operations such as cargo loading and discharge, which is central to the current study. In particular, measurement of cargo quantity such as fixed tank

gauging systems measure ullage locally, and readings are usually displayed remotely on a monitor in the cargo control room. Qualitative data revealed that differences in ship-shore readings tend to be quite significant sometimes, although measures like <u>outturn on delivery</u> is used to mitigate this. Nevertheless, its cost implications to supply chains partners has huge impact on operating cost, revenue, market reliability and could lead to disagreement on quantity loaded. More importantly, human error/ factor in gauging the meters requires terminal operator to increase human capital investment in training and retraining on industry latest Manual of Petroleum Measurement Standard (MPMS) for custody transfer, particularly for manual measurement.

Finally, Akyuz and Celik (2016, p.430)'s proposed strategies in the design of user-friendly software which appears useful to transform operational task scenario in the database into meaningful information for prediction HEP. Thus, technology would play a critical role in reducing the human error element for reliable accurate metering system showing metred quantities for use as Bill lading data (BOL), hence digitizing or standardising metering measurement system will go a long way to definitely re-establish confidence and accuracy of measurement system in Nigeria.

3.8 Review of Strategies to Improve Port Logistics Performance in Crude Oil Export Logistics System Distribution.

International trade heavily relies on ships to move goods. In fact, around 80 percent of internationally traded goods and commodities are transported by ships and these ships passed through various port as shipping by sea is most cost effective, efficient and environmentally friendly (The Baltic Exchange, 2020, p.1). The maritime industry contributes over 80 per cent to global trade by volume, seaborne trade is projected to expand at a compound annual growth of 3.8 per cents between 2018 and 2023 (UNCTAD, 2018, p.15). More importantly, the current study focused on tanker trade volume which appears projected to increase (UNCTAD, 2018, p.16). More than 70 per cent by value being carried on ships, and handle by seaports worldwide, as the most globalised and largest industry sector on the globe (UNCTAD, 2017, p.10). Maritime transportation involves transportation of products between two seaports by sea; however, logistics is an important segment of the supply chain. Logistics involves the management of materials and information flow from supply point to demand points; the supply chain is wider in scope as it involves managing and coordinating the task of the whole supply chain. In addition, some academics and industry professionals define it in different contexts but all towards one goal, which is efficiency in movement of goods and services.

The United States of America Council of Supply Chain Management Professionals (CSMP, 2020) defined logistics management as "that part of supply chain management that plans, implements and control the efficient,
effective forward and reverse flow and storage of goods and services and related information between the point of origin and the point of consumption in order to meet customer's requirements". Similarly, it could be defined as "a set of activities whose objective is to move items between origin and destinations, usually from production to consumption in a timely fashion" (Daganzo, 1999). In addition, logistics refers to the movement of goods and services, and associated flows, from point of origin until point of consumption for the purpose of cost reduction and customer satisfaction (Bichou, 2005). It appears the last definition considered both physical and nonphysical performance indicators "*cost reduction and customer satisfaction*". Thus, the author would explore this as theoretical evidence in gauging the effectiveness and efficiency of crude oil ports/terminals in Nigeria.

First, ports are strategic in transportation of products as they are the last point of call for any crude oil export. They receive cargo at discharge ports. Key research evidence investigated the sustainability ranking of ports, particularly the UK major ports. The UK port system is the largest in the European Union (EU) with a large annual trade and total of tonnage level remained in 2017 compared to 2016 with 48.1 million tonnes passing through all the ports (Department of Transport, UK, 2018). The study carried out an analysis of the five major largest ports instead of considering 800 ports because the five major ports account for most of the trading volume, which is 44% of traffic (Asgari et al., 2015, p.10). A major focus was on sustainability, which considering two dimensions including both economic and environmental factors, as both are critical in sustainable port operations and

management in terms of reduction of cost of fuel, shipping, optimisation of operations and hence creating value added services. Environmental aspect helps to reduce negative impact of port related activities in the environment. Social aspect plays a significant role in sustainability as it aims to maximise level of well-being in society (Denktas–Sakar and Karatas-Cetin, 2012).

Furthermore, Asgari et al., (2015) explored AHP technique to evaluate port performance using multiple criteria, based on score alternatives in corresponding criterion using sensitivity analysis aimed to examine scenarios corresponding to changes in weight of these criteria. The methodology deployed was a survey, conducted with 10 logistics experts and port managers, who were asked to fill out questionnaires based on primary data collected. The main purpose of sensitivity analysis is to reflect the importance of criteria on port performance, forecast future changes that are possible to affect ranking of port and determine criteria that most affect the results (Chang et al., 2007). This is significant in the sense that results showed two aspects, which are environmental, and combination of both aspects. Research evidence showed that London ports have the highest ranking; despite this outcome, the score reduces under the effect of increasing the number of some of these criteria. In addition, a combination of socioeconomic aspects showed that sustainability has not changed that much in comparison to the initial solution. The study provides a framework for sustainable assessment in maritime supply chains by these sets of criteria, which could be applied to measure sustainable performance of other sectors apart from ports. Thus, this sheds more light on whether the AHP methods as a universal procedure, could be used by decision makers to check the

appropriateness of decisions regarding overall improvements in socio– economic aspects of the maritime industry. Moreover, from the perspective of maritime SCM that is quite evolving: this would be of immense significance for proposing optimisation strategies. This study intends to investigate whether the SCM concept is being adopted in Nigeria in relation to crude oil export logistics system. Notable research work on port strategy, development and strategies includes port environmental protection as ports have emerged as part of the logistics chain, particularly as transport networks (Gouleilmos, 2000). Not only that, historically, from the perspective of a first attempt by policy makers to convene Paris European Summit meeting (Kula, 1992), Atlantic Ocean (1984), North Sea 1984, and so on. Importantly, the role of International Maritime Organisation (IMO) through adoption of International Convention for the Prevention of Pollution from Ships (MARPOL) aimed to reduce or curb pollution from shipping.

The MARPOL Convention was adopted on November 2 1973 at IMO. Over the years there has been amendments to this protocol to meet the current environmental challenges, from 1978 as new Annex are included such as annex V1 (prevention of air pollution from ships) that came to force on 19 May 2005. Although the protocol has unique importance in this study, for a seamless crude oil export system, crude oil tankers must adhere to the protocol. However, maritime transport is responsible for only 12% of all pollution (Farthing and Brownrigg, 1997), though in terms of quantity this figure cannot be undervalued. Another point is the role of EU in formulating policy on transport particularly on port activities and environment, as this is critical to overall sustainability. Simply put, to manage resources in such a

way that the average quality of life of our time could potentially be shared by all future generations (Hanley et al., 1997). This study reviewed how European seaports could become more competitive and efficient in order to contribute to the principle of sustainable mobility. Thus, there is increasingly attention of the port sector into maritime transport and other transport modes into the transport chain (Commission of European Communities, 1997). The EU is trying to develop a more balanced transport system by promoting more environmentally transport solutions like intermodalism and short sea shipping (Commission of European Communities, 1995, 1996). This study requires more port infrastructure layout and investment for dredging facilities. The environmental impacts of infrastructure expansion were put into consideration, as environmental requirements are part of investment cost. However, current study explored experts 'viewpoints, the findings from these professionals' subjective opinions showed that there is a need for adequate investment in subsea lines, under maintenance of some critical export facilities, and dredging of the high seas to facilitate movement of tankers into waterways. Additionally, Port performance and crude oil export logistics in Nigeria appears to underuse technology, with increasingly need for technological improvement from information sharing perspective and issues concerning the security of export ports and terminals, vessel scheduling and crews during loading operations and on the high seas. What is more is that Gouleilmos (2000, p.196) asserts that issues around implementation of international instruments such as International Safety Management Code (ISM) for ports and effectiveness of port state control which are relevant to this research.

Furthermore, other studies focused on the Mitigation of greenhouse gas (GHG) associated with an end-to-end maritime transport chain (Gibbs et al., 2014, p.337). To begin with, the study used secondary data and information on actions taken by ports to reduce emission with the latter collected for the main UK ports via published reports and/or via interviews. However, it appears that only a few ports reported carbon emissions in the UK. The analysis method used was Department for Transport Maritime Statistical data taking a case study of port of Felixstowe emission. Gibbs et al.'s (2014) findings demonstrated that emissions from shipping at berth for the year 2007 are 10 times greater than the one from a port's own operations for the 2008 calendar year. However, there appears a need for the UK ports to include carbon footprint in the analysis of emissions from ships, which would help in mitigation of GHG. In contrast, crude oil exports GHG emission mostly associated with gas flaring; which is one of the main components of crude oil products. Gas flaring in Nigeria, historically, has been an issue of concern from both government and industry players alike. There have been several attempts to curb gas flaring, nevertheless, this task appears to be unsuccessful to date. Findings showed that the introduction of technology would significantly help in reduction of GHG emissions, for instance, given the current UK electricity grid mix and reliance on fossil fuel (Gibbs et al., 2014, p.347). The study's major interest was on non-oil export i.e. container terminal with only Aberdeen being an exception, which considered liquid bulk, however, this presents the author with knowledge of critical issues in achieving efficient, sustainable energy and environmental policy in port operation and management.

In addition, Villalba et al., (2011, p.1363) carried out estimates of GHG emissions of marine ports from a case study perspective of the port of Barcelona. The study centred on estimating the emissions from seaports in order to monitor port operators' policy and technology strategy for improvement. This was carried out by calculation of emissions based on cargo handled or per passenger, and also emissions per value of cargo handled. More importantly, Villalba et al., (2011, p.1364) categorised emission type into sea based (hoteling and manoeuvring) and land based (resulting from ocean going vessels). It is significant to emphasise that the current study is mainly focused on improvement strategies for port performance in crude oil export logistics, however, both sea and land-based emissions are apparent in this context. Environmental pollution from oil spills appear common in the oil industry, and recent experience of oil spills from the Forcados export pipelines in Nigeria is a key area of concern. This study aimed to explore in-depth into emerging precautionary guidelines from both terminal operators and NNPC, to consider the overall improvement in efficiency of logistics systems distribution for port/terminal in crude oil export. Similarly, other notable research looked into GHG emissions from maritime transport from the perspectives of import and export taking New Zealand as a case study. Fitzgerald et al., (2011), used a cargo-based methodology to estimate the international maritime transport of New Zealand's imports and exports that showed that the country consumed 2.5 million tonnes of fuel during the year 2017 that generated 7.7 Mt of carbon dioxide (Co2) emissions. Fuel consumption estimated for both main and auxiliary engines were calculated by adapting from methodology used in (Buhaug et al., 2009).

In addition, three relevant core datasets used are quantitative; the first one comprises travelling vessel history details and customs information. Second, statistics HS10 data for import and exported goods, which is derived from Product Declaration Form (PD) and while the last one comprises, total mass of cargo on board on an individual vessel journey, the implication is that, this helps to calculate distance between port of origin and destination respectively. However, Fitzgerald et al., (2011) assert a third core dataset appears quite relevant in present study, since one of the key aims of logistics is timely arrival of goods and services which is a physical performance indicator (Bichou, 2013, p.72). In the context of time arrival, core data set (arrival and departure date) from Nigeria's export terminals needed to link each vessel journey with Notice of readiness (NOR) data, which would allow a distance to be calculated between origin and destination with another port in between, to fully represent the journey distance.

Furthermore, Fitzgerald et al., (2011)'s study demonstrated the importance of a method used in calculating international maritime emissions for individual countries based on what each country imported and exported in terms of goods. However, the key challenge appears in the importance of having a reliable and accurate input data, however, the author believes this data could still be relevant in highlighting emerging basics issues in this field. To start with, HS10 data obtained was used in calculation of GHG emissions and later extrapolated. Thus, the implication here is that this could lead to unstandardized measurement: as emission could be possibly and easily double counted.

Historically, there have been attempts toward implementation of policy through scientific monitoring. For example, environmental management of ports and harbours (Wooldridge et al., 1999, p.413). Ports are unique in terms of location, hydrography, commercial profile and corporate strategy and legislation to accommodate changes in business model or strategy in particular. One of the previous key attempts was British Port Association's (BPA), Environmental Statement and Code of Practice in 1992, later superseded by the European Sea Ports Organisation's (ESPO) environmental code of practice. Woodridge et al., (1999) studied new and evolving legislation of port management from environmental protection perspective; through use of port's policy, its statement of intent and principles regarding the environment. This is similar to Gouleilmos' (1998) study on environmental protection of ports within the marine environment as both tried to propose an effective strategy for port management and environmental impact. Furthermore, there is a need for the introduction of an additional role for ports in the context of environmental protection issues, which is quite relevant to this study. Key traditional/legacy export terminals in Nigeria, for instance Bonny, Forcados, Escravos and Qua Iboe are susceptible to pipeline leakages/vandalism/bombing by militant groups from the oil-rich Niger Delta region (Lloyd's list, 2016, p.2). In addition, there is an increasing growth in proliferation of illegal refineries which comes with significant environmental damage to host communities. Producing, transporting, and refining crude oil into fuels such as gasoline and diesel accounts for approximately 15 to 40 % of the wells to wheels life cycle GHG emissions of transport fuels (IHS, 2012).

Masnadi et al., (2018, p.851) estimated emission in 90 countries including Nigeria in 2015 from 8966 oil streams oil fields. It includes both onshore and offshore fields that are conventional and unconventional-which is a component of crude oil export terminal or port. Importantly, they identified key areas such as emissions from exploration, drilling and development, production and extraction, surface processing and transport to refinery inlet. In addition, the above covered areas are relevant to the current study particularly in production, extraction and transport to refinery. The study explored technical reports, scientific literatures and as well as references from nearly 800 references, which the current study explored in addition to extensive primary data. Nevertheless, there was no comprehensive geographically rich dataset that would allow evaluation and monitoring of life cycle emissions from oil but it presented an estimated emission rate in terms of crude oil export terminals amid intensifying campaign for a green world in recent times.

Masnadi et al., (2018) found that the total petroleum well-to-refinery GHG emissions in 2015 were estimated to be 17 Gt Co2eq, 5% of total 2015 global fuel combustion GHG emissions. Furthermore, crude oil upstream GHG intensities on global weight volume–weight carbon intensities showed estimates for 50 countries including Nigeria (Masnadi et al., 2018, p.852). One key factor that hampers effective crude oil supply chain is gas flaring (burning). It is noteworthy to say that this appears to be a general problem in the oil industry globally due to its influence on carbon intensity (CI). The estimated share of flaring emission is in the global volume: the weighted average upstream CI is 22%. However, there is reluctance to report gas

flaring by government and companies (Masnadi et al., 2018, p.851), and the only alternative is to rely on satellite estimated volumes computed using night-time radiometry. Nigeria appears among countries with above average global CI, which is contribution of routine flaring to the total volume, estimated herein to be approximately 36%. Other conventional COECs include Algeria (41%), Iraq (40%) Iran (21%) and the United States (18%). It is evident that gas flaring remains a critical issue to be resolved from the data above and the author observed this at an export terminal during crude oil loading operations in Nigeria, despite an increasing push for international legislation such as the Paris climate agreement 2015. Nevertheless, research evidence shows an increase in global flared gas from 2010 to 2016 according to Global Gas Flaring Reduction Partnership (GGFRR) 2018 report. Further, there are several strategies aimed at reducing gas flares such as the World Bank GGFR Zero Routine Flaring by 2030. These can be strengthened with international advisory, financial, and technical aid to help countries to implement flaring reduction policies.

In conclusion, GHG emissions from all key areas of transport is still an issue that requires the collaborative effort of all stakeholders; this includes producing nations, companies, crude oil traders, multilateral institutions and research institutions, policy makers etc. It is necessary to implement already agreed regulations in each nation to reduce emissions in their entirety to achieve an effective, efficient crude oil supply chains across the globe.

Recent research has developed a sustainability management system for smaller ports. Kuztnesov et al., (2015, p.59) worked on sustainability needs of smaller ports in Cornwall and Devon (CAD), proposed a systematic

method for identifying and managing them. Research design and sampling is virtually similar as the present study which explored qualitative methods span scoping interview, semi-structured interviews, using a snowball-sampling strategy except for focus groups, archival analysis and observation. This methodology assists in the development of emerging theory, which is an essential element of grounded theory. In this case, theoretical sampling was used to reach saturation which occurred when emerging insights ceased (Charmaz, 2006). Kuztnesov et al., (2015, p.62.) explored thematic and content analysis using inductive approach whereas the current study explored TA and also informal content analysis. However, TA is a form of thematic analysis that does not come with methodological commitment (Miles Huberman, 1994). The Port sustainability management system (PSMS) in CAD derived by Kuztnesov et al., (2015, p.62.), were grounded in the experience of HM in CAD ports. This incorporates a range of experts' opinions, and offers knowledge and examples of what needs to be done in order to achieve improvement. They found that asset management and maintenance received the lowest overall average score; thus, these strategies are very useful in the current study. Some of them were raised in a template of issues gleaned from data collection.

Port sustainability measures present an on-going process towards a sustainable transport network. Most research studies have developed key Environmental Management Systems (EMS), common ones are ECO INFORMATION by Amsterdam Port Authority, Rotterdam Port GREEN AWARD System, Valencia Port's ECOPORT called Valencia, 2000, to name a few. All these initiatives aim for overall improvement for port environmental

policy. It appears that there is limited study of oil logistics performance involving ports and terminals. There is growing interest in the environmental obligations in supply chain and multinational oil corporations by business strategists (e.g. Shah, 2011; Chertow and Miyata, 2011; Sarkis et al., 2010; Ketola, 2007; Miller and Quinn, 1998) but not port authorities which oversee maritime operations including oil loading and discharging. Dinwoodie et al., (2012) worked on a business processes framework to manage potential environmental impact of maritime operations, particularly in smaller ports. This was a case study research strategy with Falmouth Harbour Commissioners, as a context offering inter alia safe anchoring and bunkering facilities for vessels of all sizes. Research context was on sulphur emission area (SECA), environmental management system (EMS) and knowledge transfer partnership (KTP). These three frameworks are significant to this study. For instance, despite the presence of regulation on gas, flaring is still an issue; as substantial amounts of gas are being flared, this has a great impact on the supply chain and logistics of crude oil export. Whilst the study largely related to information sharing within crude oil supply chain partners, the author believe that major oil majors with large cargo throughput have invested a lot into research in contrast to smaller players which are mostly indigenous oil firms. Nevertheless, Dinwoodie et al., (2012, p.123) found out that port authorities have rarely integrated predominantly physical environmental evaluations with business strategy. In the case of Nigeria's export terminals, a landlord port institutional model is adopted whereby public owned land infrastructure and while superstructure and workforce is private is best practice. Furthermore, as a result of this model, major players appear to

have effective and efficient integrated physical evaluations as business strategy due to huge resources available at their disposal, while smaller producers appear struggling despite the presence of oil and gas state regulators (DPR).

In conclusion, Dinwoodie et al.'s (2012, p.124) framework could be explored by smaller oil producing companies, in addition to Eco ports for a better port/ terminals environmental management to enable sustainable maritime operations and development against export terminal closure.

Mora et al., (2005) developed a system of indicators for sustainable port management, which are largely environmental indicators; this is in contrast to the key objective of the present study that is concerned with key logistics improvement strategies for Nigeria's crude oil export terminals. The study is a case study research for the port of Valencia, the methodology explored was that, data were collected from Port Authority, also from private licensed companies within port, which considered port operations and activities that has environmental impacts. Mora et al., (2005, p.1653) used a step diagram to describe processes and activities at a succession stages in their study. They identified key strategies which were later reduced to 17 factors, and in the absence of quantitative information, as this appears appropriate to use indirect measurements through multi-criteria analyses. Subsequently, Delphi methods guided consultation with experts through a questionnaire. Analysis defined 11 variables and evaluation criteria, however, only some of these were used to evaluate potential impacts. For each variable used to evaluate the impact for each aspect/impact groupings; two variables were used in the case of odour or noise. In addition, another nine were used in the case of

odour or noise, and nine were used for water pollution. Overall, a cross matrix (63 aspects times 21 activities) defined a scale of ranking to quantify each of them. Each impact was evaluated using a percentage scale. Overall, the main aim was to assign a percentage or its equivalent to the potential impact. In addition, the category of items used varied. Thus, values close to 100% potentially have greatest impact while those with lower percentages, have minimal impact.

Above all, Mora et al., 2005, (p.1654) used environmental analysis of port activities with a view to designing a system of sustainable management indicators and found 21 corresponding activities identified for large industrial ports out of 63 initial forms of potential environmental impacts. Consequently, there is a high similarity to the present study from MCDM perspective, whereby 14 items gleaned from expert viewpoints in the crude oil export supply chain were later reduced to seven items. In addition, comparisons involved measurements of significance by quantifying the level of impact produced on each environmental aspect.

Where

li- is the value of impact as a percentage,

II - is the product of case variables

II maximum is the product of the maximum value.

However, Peris-Mora et al., (2005, p.1655) used a stage diagram and systemic model (material and energy flow chart) secondary data in the strict sense, which is different from the current study that is largely qualitative in nature. There is a growing shift from traditional quantitative measurement for

port performance in contemporary logistics (Marlow and Paixao, 2003, p.189. In addition, yet only 10-20 percent of recent published research in leading SCM journals employs qualitative research methodology (Fawcett et al., .2014, p.6). They worked on measurement of lean port performance through introduction of agility in ports and transforming them from a logistics hub through, distribution centres into third generation transport solution providers. Thus, satisfying the (UNCTAD, 1999), definition of a port, with present day port requirements for an efficient application of knowledge since these environments in which ports carry out operations are normally associated with knowledge-based economies. First, agility entails an information technology/information system in the port network as a communication centre for control and monitoring purposes. Apparently, agile port strategy is ambitious, as it depends on a human element input and intelligent application of knowledge rather than on technology and capital. This is vital in this study, however, empirical evidence revealed that some of the terminal operators chiefly, the medium size ones, appear to lack or have inadequate expertise in operational issues such as measurement of exports (custody transfer unit), terminal security, training and more importantly, ineffective information sharing within the supply chains. Thus, for a port to be agile, definitely, it needs to become lean. That said, this is mostly applicable in non-oil terminals; particularly container terminals, environmental issues facing the oil industry such as oil spills and pipeline vandalism have been found to have a devastating effect from a port performance and logistics perspective. Skea (1992) studied the impact of environmental policies and regulations in the oil industry. In addition, key examples of oil spills are The Amoco Cadiz accident

off the Brittany coast in 1978, which appears to be one of the largest; others are the Exxon Valdez accident in Prince William Sound, Alaska in 1989, *and* intentional release of large quantities of oil during the Gulf War. More recently, the BP 2010 Deepwater horizon of 4.9 million barrel in the Gulf of Mexico; all these have a negative environmental impact such as photochemical smog, forest damage, acid rain, climate change, contaminated fishing community. Because of an absence of national and international regulatory frameworks for response to oil spills which was evident during the Torrey Canyon, which ran aground near the Scilly isles in 1967 fouling UK and French coastlines, pressure grew for a strong regulation of clean-ups, which spawned International Oil Pollution Compensation Funds (IOPC). This provides financial compensation for oil pollution damage that occurs in member states, resulting from spills of persistent oil from tankers, under the auspices of IMO (IOPC, 2018).

Port operations are a major driver for trade and economy, but appears to face challenges particularly in Nigeria's container terminal operations according to the Lagos Chamber of Commerce and Industry (LCCI, 2016). Key of these issues span infrastructure shortcomings, policy or regulatory inconsistencies, overlapping or duplication of roles among Ministry Department and Agency (MDAs) and high level of infractions. Because of these shortcomings, estimates from research showed that trillions of Nigerian Naira in revenue are lost annually within the ports and business community due to inefficiencies and inherent shortcomings of the nation's maritime ports (LCCI, 2016, p.6). Research evidence showed that Nigeria with 1.1 Million TEUs appears lags behind in port activities behind smaller countries such as

Morocco (3.1 Million TEUs), South Africa (4.8 Million TEUs) and Egypt (8.8 TEUs) (UNCTAD, 2014). The study is significant to the current work as it revealed key relevant issues in container terminal operations, which by implication showed a brief overview of Nigeria's port operation and logistics system to a great extent.





Source: (The Author, Adapted from LCCI, 2016)

Having seeing key of the factors in Nigerian ports, the LCCI survey (2016)

revealed ideals and baseline targets, current reality and gaps for key

selected Nigerian ports and their performance.

Indicators	Ideals/baseline	Current reality	Gaps
	targets		
Number of government	6	14	+8
departments operating			
in the ports			
Cargo clearance	2days(48	5 to 14 days	+3 to 12
timeline	hours)		
Number of	6 agencies	18 Agencies,	+18
papers/paper work and		and 23	
agencies clear cargo		signatures	
Number of	One single	20 Agencies	+20
papers/paper work and	window	and 33	
agencies to interact		signatures	
with for export cargo			
Government's target of	10 million	1.1million	8.9million
TEUs volume per	TEUs	TEUs	TEUs
annum			

Table 3.4: Key selected Port performance Indicators in Nigerian PortsSource: (Adapted from LCCI port users survey 2016).

Essentially, all these selected indicators deal with non-crude oil exports. However, some of them are also applicable to crude oil export such as the number of agencies involved. There are many government agencies involved in crude oil export logistics systems in Nigeria such as Department of Petroleum Resources (DPR), Ministry of Petroleum Resources (MPR), Nigeria Navy (NN), NNPC, Nigerian Custom Services (NCS), Nigerian Ports Authority (NPA), Pollution Control, Nigerian Maritime Administration and Safety Agency (NIMASA), Terminal Operators (TO), IOCs, IDOCs etc. Both oil and non-oil cargo logistics are associated with duplication of government agencies, infractions, lots of paper work and bureaucracy. Thus, investment in electronic communication for vessel clearance by these agencies is key for effective and efficient port or export terminal logistics system operation for cargo transport, hence enhancing trade facilitation to achieve a seamless supply chain management for crude oil flow from Nigeria to the international market. Time and cost of delay at the ports is also an issue. Key of these indicators or measure that are germane to crude oil export can be seen in the table 2.8 below:

Indicators/measure	Time	Delay	Cost(US\$/TEU)	Informal	Extra	Extra
	(Hours)	(Hours)		% of	cost(US\$/TEU	cost
				total		% of
						total
Anchorage and	21	13	148		14	
berthing						
Shipping line	20	24				
released delivery.						
Loading at berth	20	0	0			0
Channel operation	6	6	4		4	0%

Table 3.5: Time and cost of delay at Nigeria's Container Port Source: (Adapted from NEXTT (2015) LAKAJI Corridor Report)

The report highlighted that container scanning is largely based on physical examination, showing 27% on average for physical examination, scanning, 27% and fast track document check is 18% on average. Nigeria has adopted a single window, which connects other government agencies under one platform, as this helps to reduce physical contact with cargo and eliminate illegal payment and unnecessary delay in the ports systems.

Furthermore, Nigeria's export terminals are susceptible to pipeline vandalization, leakages/sabotage and theft, which leads to supply disruption whereby militant action continues to impact export infrastructure (Lloyds List, 2016, p.1). In addition, operators in the Niger delta region are working on cleaning up oil spillage that caused environmental degradation. For instance, Ogoniland was contaminated due to exploration and production activities of oil majors, one of the main pipelines; which is Trans Niger Pipelines (TNP) traverses the Niger delta. In 2006, the Nigerian Government commissioned the United Nations Environment Programme (UNEP) to carry out an environment assessment of Ogoniland as part of a wider reconciliation process. SPDC JV with Nigeria funded this report, and provided data as requested. UNEP presented a report to Nigeria in August 2011 and the implementation appears to be on going even in the year 2020.

3.9 Nigeria Logistics Performance in Crude Oil Export

Lagos seaport is usually associated with traffic due to massive maritime transport that involved about 70% of goods and services in Nigeria. Furthermore, concerns are rising from stakeholders to decongest it and as well as allow for a deep seaport development or upgrade of Calabar seaport in the Niger-Delta. Onifade (2020, p.1) assert that grid traffic occurred by too many vehicles competing for road space whereby a lot of truck parked on the road sides. In fact, this is a logistics challenge in terms of container and associated SCM in relation to refined oil import. In addition, Onifade (2020, p.10) discovered that to develop other ports for efficient logistics system. Thus, a critical review of Calabar port and it causes of ineffectiveness is necessary; key findings revealed factors that contribute to ineffectiveness score in terms of percentage composed of depth of water with score (37%), cost of shipment (30%), accessibility to industries (12%) and closeness to neighbouring countries scored (9%). Overall, depth of seaport appears a major challenge for effective and efficient logistics performance whether input/export related purpose and benefit for economic of scale. Finally, the study recommended that capacity of Apapa seaport appears unable to accommodate traffic, hence the justification for another seaport to ease congestion. Similarly, measures that contributed to Calabar inefficiencies need to be given attention particularly depth of water and cost of shipment. In conclusion, development of Ibom deep seaport is paramount as this will serve as hub for logistics efficiency in maritime transport. In the context of present study, oil export is significant, however, Onifade, (2020)'s findings on

depth of water is a critical measure and significant to logistics performance of crude oil export port/terminal.

Apparently, technical capacities of workforce in Nigeria's oil industry is from the IOCs, and empirical evidence revealed foreign workers had huge impact in crude oil export than their Nigerian counterparts. In addition, Nigeria struggled to develop indigenous capacities over the years through introduction of regulatory framework named Nigerian oil and gas industry content act in 2010. To buttress this point, Atsegbua (2012, p.479) examined this framework in terms of 23 strategies for Nigerian content development short-term directives which span engineering design, procurement, fabrication and integration of all fixed (offshore and onshore), fabrication of piles, decks, anchors, buoy to name a few. Finally, Atsegbua (2012, p.492) asserts that though local content policy appears not new in OPEC member states but key concern is that interest of all stakeholders must be protected in order to guarantee economic drive and growth in local capacity building and high return on investment. The author believes that with effective framework implementation that will employ capable workforce which appears the main challenge from state actors, crude oil export flows will be impacted in terms of effective and efficient port logistics performance in the whole supply chains.

Similarly, the role of effective regulatory framework cannot be underestimated, in the context of commercialisation of NNPC as a terminal operator to make it more efficient. Petroleum Industry Bill (PIB) aimed to privatise NNPC partially in order to improve its commercial viability, avoid conflict of interest and minimize political interference (Perouse de Montclos,

2014, p.411). In addition, to reform the fiscal regime of JV to create commercial viable NOC, increase revenue and as well as support gas production. In the context of this study, NNPC as a terminal operator have multiple functions such as collecting royalties, regulating the oil industry and inspection of operations-these multiple roles appears what made it less efficient in its operations and could not be able to produce large quantity of crude oil except with help of IOCs which are mainly commercial in terms of operation despite been a JV partners. Finally, *host community fund* is a key element of PIB for Niger delta *development* but because of political and conflicting interest from all stakeholders, it is pretty difficult to have a sustainable regulatory framework which will impact all the supply chains from oil block ownership to shipping of oil cargo off the waterways to the international market.

Over the years, Nigeria's oil-rich Niger-Delta has been epicentre of security threat to important oil installations and pipelines. Further, there appears intensification and increasing rate of violent acts from certain period of time to another. Pipeline vandalism or attacks on oil installation will automatically disrupt the supply chains which leads to loss of crude and/or oil theft, and hence impact logistics performance. Omeje (2006, p.477) studied petro business and security threat in Niger-Delta and found out that different IOCs respond differently in terms of approach. Key security threats such as abduction and kidnapping of oil workers, attack on operational areas and concentration facilities. Findings revealed that IOCs applied different approaches which appears non-streamlined. Further, Omeje (2006, p.487) discovered transnational oil corporation adopted several strategies such *as*

security communisation, security privatisation, security corporation. The author believe that these strategies are preliminary in nature and appears inadequate from the perspective of 27 crude oil export terminals that had different storage and export volume. What is critical, appears comprehensive review of security strategies whereby stakeholders will be task to secure all terminals regardless of ownership and interest. Though (Omeje 2006, p.494) acknowledged that security threat is caused by magnitude of ecological devastation caused by IOCs and NNPC which appears occurred prior to radicalisation of anti-oil protest in the 1990s which demanded a comprehensive environmental remediation action plan. Moreover, increasingly return of militancy in late 2015 saw a gradual return of oil theft and pipeline vandalism with a group known as Movement for Emancipation of Niger Delta (MEND) fuelled by inability to implement "2011 UN Environmental Program report" and among other issues of payment of stipends to militants (Oputu, 2015). In addition, (Oputu 2015) is of the view that cracking down on corruption as the key strategies to develop the Delta. On the other hand, Onuoha (2016, p.1) posited danger of militarisation as it would escalates the violence and hence cascading economic and security consequences for the country. In addition, Oyewo (2016, p.57) shed light on challenges of integrating militants such as lacking credible and comprehensive consultation with stakeholders, discrimination in contract awards, amnesty programme did not include victims of militancy etc. Finally, the author believes both national and international efforts in terms of dialogue and infrastructure development support appears critical, except local leaders are able to jettison selfish interest in the interest of all stakeholders.

3.9.1 Nigeria's Port performance in Crude Oil export Logistics System

The oil industry involves a lot of investment between the Crude oil consumer countries (COCCs) and COECs in the whole supply chains. In the context of present study, Verma, (2018, p.372) studied reasons why China outperforms India in the oil industry in Angola and Nigeria. Findings include oil block licensing which normally started with commercial and/or contractual agreement with companies to acquire a stake in JVC or PSC. For example, China acquired a total of 24 oil blocks through its companies such as Sinopec, CNOOC and Nexen to name a few in Nigeria. China performance appears better because of two factors: macro and micro level (Verma, 2018, p.380). First, at the macro level it has better economic, diplomatic and political power than India; for instance, China's GDP in nominal term was \$10.35 trillion which is five times than India. The author believes that the study has shown how COCCs are able to acquire oil block through competitive bidding with the aid of economic, diplomatic relations with COECs in developing economies like Nigeria and Angola.

Another point, key driver to supply chains disruption appears to be Niger Delta crisis that lingers on over a long period of time due to environmental degradation, pollution, gas flaring, and increase call for resource control and so on. In this context, Abang (2012, p.180)'s key findings revealed that 17 records of incidents of kidnap, ransom and demand where applicable worth 5 Million naira to 500M (Abang 2012, p.189). In addition, Nigeria had introduced several measures to solve this intractable problem over the years

but appears struggling. Thus, key intervention agencies span Oil Mineral Producing Areas Development Commission (OMPADEC) established in 1993, Niger-Delta Development Commission NDDC (2000) which provide 15% monthly statutory allocation to the Niger Delta states from the Federation account. Furthermore, the government introduced Ministry of Niger-Delta in 2008 to address all issues regarding developmental challenges. In conclusion, all these intervention agencies appears had failed to address developmental challenges in the Delta, the author believe failure might due to incoherence in the policy as well as lack of accountability in project management and/or seriousness of political leaders to convince key actors.

3.10 Examining Research problem in Nigeria context

Although the author had a thorough literature review as well as thoughtful RQs linked to research problem. Equally important is the RQs are peculiar to Nigeria, hence the author believes this requires extensive and in-depth description of Nigeria port strategies in crude oil flows (Yin, 2014, p.14)

3.10.1 Nigeria's Crude oil Export Terminals Performance and Information flow

Wang et al., (2019, p.1) studied time reliability of maritime transportation network for China crude oil imports. In addition, time reliability as a framework incorporated bi-level programming and a Monte Carlos simulation, hence it's aimed to access the impact of node capacity degradation of transportation time reliability of maritime transportation network for China's imported crude oil (Wang et al., 2019, p.4). In addition, it focused mainly on Saudi, Iraq, Iran, UAE, Kuwait, Oman, Angola, Columbia and Brazil. Findings

revealed key transportation time reliability of network is relatively low due to capacity variations in strait or canal nodes and sometimes relatively high due to capacity variations in port nodes. Further, their model revealed that Strait of Malacca, the strait Hormuz and the Taiwan Strait identified as vulnerable nodes and as well as significant in maritime transportation of crude oil. Though, present study focused on logistics performance in crude oil SCM in Nigeria from contract agreement to end point when cargo is loaded in waterways for crude oil export purposes. However, the current study focused on Nigeria port performance and information flows but it is worth knowing more on maritime shipping lane like the Gulf of Guinea which is traditional shipping route for Nigeria's crude oil export.

On the other hand, there is increasing change to maritime of oil transport in recent years. Recent study by (Gritsenko 2015, p.701) explored changes to quality governance as a case study of the Baltic Sea, whereby key findings were based on emergence and development of rule, norms and strategies that defined and materialised practices associated with quality shipping in the Baltic. First, the Baltic sea seen as laboratory for quality governance in maritime transportation in particular in tanker traffic-it developed initiative like non-special fee in Baltic port, aerial surveillance of illegal oil spill, banning of single hull tankers, <u>tanker safety project aimed at proliferation of enhanced navigation support information</u>(ENSI) (Gritsenko, 2015, p.709). Thus, the last initiative on ENSI appears related to present study research problem "challenges of information flow system" (See section 1.5). Although Gritsenko, (2015, p.709) assert that quality of maritime oil transport is a topic which is much debated and as well as can be re-interpreted depending on

transportation service demanders and suppliers, and their embeddedness in relevant economic, political, spatial, technical and social context (Gritsenko, 2015, p.714). In summary, to expand the research, the author would examine the context in greater depth to unravel main issues peculiar to Nigeria in terms of port performance in crude oil flows.

3.11.1 Nigeria's Crude Oil Export

Nigeria has been a major exporter of crude oil in the last 6 decades and the 15th largest producer in the world in 2016 according to U.S Energy Information Administration (EIA, 2016). Nigeria's main customers are North America, South America, Central America, Europe, Oceania/pacific, East Asia, Far East and Africa respectively.



Figure 3.4: Nigeria's 10 Year Crude Oil Exports

Source: (Adapted from NNPC Statistical Bulletin, 2017)

3.11.2 Overview of Nigeria's Oil industry

Nigeria's state oil corporation, NNPC was established in April 1977. NNPC performed activities ranging from exploration, operational functions such as refining, petrochemical and products transportation as well as marketing. NNPC has 12 distinctive commercial business units covering the basic spectrum of the oil industry such as operation and production, gas development, refining, distribution, petrochemical, engineering and commercial investment. NNPC activities are carried out by its subsidiaries, which include.

Nigerian Petroleum Development Company (NPDC)

Nigerian Gas Company (NGC)

Products and Pipeline Marketing Company (PPMC)

Integrated Data Services (IDSL)

Hydrocarbon Services Nigeria Limited (HYSON)

National Engineering and Technical Company (NETCO)

Warri Refinery and Petrochemical Limited (WRPC)

Kaduna Refinery and Petrochemical Company Limited (KRPC)

Port Harcourt refining Company Limited (PHRC)

Duke Oil

NNPC Retail



Figure 3.5 Nigeria's Crude oil Export Stakeholder's Map

Source: Author, 2019

BUSINESS OPERATIONS	Operational categories
Upstream Ventures	Explorations, Oil production, Gas Production and Joint Ventures with multinational oil companies such as Shell, Chevron etc.
Mid –term Ventures	Greenfield refinery initiative, Refineries and petrochemical, Nigeria gas master plan, Renewable energy, Gas and power, Engineering and Technology.
Downstream Ventures	Retail services, Product distribution showing daily product dispatch domestically and Research and development
Subsidiaries	NNNPC has 13 subsidiaries: NPDC,NGC,IDSL, PHRC etc.
Business Information	Investment opportunities in Nigerian gas, crude oil marketing, upstream opportunities and downstream opportunities, Oil and gas in Nigeria, Health, Safety and Environment, Partner, Performance data showing monthly data performance and Vendor registration.

Table 3.6: NNPC Business Operation Structure

Source: (Adapted from NNPC, 2018)

3.11.3 NNPC Joint Ventures Operation

NNPC is operating in partnership with major IOCs. Majority of operations are carried out in the onshore Niger delta, coastal areas and lately deep-water areas. Further, the strategy used by NNPC in Nigeria is use of concessionary agreements by the NNPC, which is a state-owned Oil Company owned with major IOCs. Further, part of the management operations being carried out are exploration-bidding rounds for oil and gas management and this is done through product of PSC. Joint operating activities (JOA) are the basic major agreement between operator and NNPC. In essence, the agreement entails private oil companies' maintained role of terminal operator and the NNPC reserves the right to become operator, and both parties normally share the cost of production and operation. Each partner can lift oil and as well as dispose of it in the interest of production subject to payment of Petroleum profit tax (PPT) and royalties. Finally, Nigeria operate JVCs with the IOCs.

International Oil companies (IOCs)	Joint Venture Composition and production capacity per day
Shell	The JV is composed of NNPC (55%). Shell (30%) operates on eighty oil fields. Production capacity per day is 889,000 barrels per day (bpd).
Chevron Nigeria Limited (CNL)	The JVC between NNPC (60%), Chevron (40%) operates in Warri region west in the Niger delta. Daily production capacity is 400,000 bpd: it is reported that it might increase to 600,000 bpd.
Mobil Producing Nigeria Unlimited (MPNU)	The JVC between NNPC (60%) and Mobil (40%) operates in shallow water in the south eastern coast of the Niger delta. Production capacity per day averaged 632,000 barrels in 1997.Further, it has 50% interest in a PSC in a deep-water block. Moreover, might increase production to 900,000 bpd.
Nigerian Agip Oil Company Limited (NAOC)	A JVC between NNPC (60%), Agip (20%), and Philip petroleum (20%). Production capacity per day is 150,000 bpd.
Elf Petroleum Nigeria Limited (EPNL)	A JV between NNPC (60%) and Elf (40%).Production capacity per day is 125,000 in 1997.
Texaco Overseas Petroleum Company of Nigeria Unlimited (TOPCON)	A JVC between NNPC (60%), Texaco (20%), Chevron (20%), currently produces 60,000 bpd and mostly operates in offshore oil fields.

Table 3.7: NNPC Joint Venture Operations Contract

Source: (Adapted, NNPC, 2019)

NNPC operates in partnership with IOCs under JOA/JVC or PSC. Nigeria's crude oil reserve is estimated to be about 36.972B barrel, while there is still ongoing exploration (OPEC, 2020 p.1).NNPC uses IDSL, a subsidiary to gather field data for the exploration during upstream activities. Significantly, it is responsible for most of the country's major oil discoveries and continuing an intensive exploration programme to increase the nation's hydrocarbon reserves. Nigeria produces a maximum crude oil production capacity of 2.5 Mbpd (BMI, EIA, 2016). Nigeria ranks as Africa's largest producer of oil and

was fourth largest producer of LNG in 2015 in the world (EIA, 2016, p.1). Nigeria appears to have a higher potential for gas than oil, as its gas production in the year 2000 was approximately 1,681.66 BScf; 1, 3715B Scf was associated gas and the rest 310.16B was non-associated gas. Nigeria produces only high value low sulphur content, light crude oils such as Antan Blend, Bonny Light, Bonny Medium, Brass Blend, Escravos Light, Forcados Blend, IMA, Odudu Blend, Pennington Light, Qua Iboe Light and Ukpokiti respectively. Below is a diagrammatic representation of crude oil production capacity in Nigeria. Daily cumulative crude oil production for Nigeria (1,000b)

Year	Quantity of crude oil
1960	1.74
1970	1,083.1
1980	2,058.3
1990	1,726.7
2000	2,053.6
2010	2,048.3
2017	1,535.6

Table 3.8 Daily Cumulative Crude Oil Production in Nigeria (1000b) Source: (Adapted from OPEC Statistical Bulletin, 2018, p.31) See below the number of producing oil wells in Nigeria from 2010-2018

Year	Number of wells
2010	2,068
2011	2,116
2012	2,168
2013	1,951
2014	2010
2015	1,947
2016	1,668
2017	1,777
2018	109 change
	17/16

Table 3.9: Number of Producing Oil Wells in Nigeria from 2010-2018

Source: (Adapted from OPEC, 2018, p.30).

3.11.4 Nigeria's Crude Oil Export Dynamics

First, key participants in the Nigeria's upstream sector are Shell, ExxonMobil, Chevron, Eni and Total (NNPC, 2018, 2019, and 2020). A vast majority of the companies owned and operate field in agreement with the Federal Government through the following contract agreements such as *concession*, *JV and PSC*. See details in table 3.4 JVC-operation contract and table 3.8, Nigeria crude oil export terminals. However, Government of Nigeria through the MPR has overall regulatory oversight of the Nigerian oil and gas industry (Ajayi, 2013, p.6). Empirical and theoretical evidence revealed high levels of dominance by the Government in the oil industry, which sometimes appears to bring instability with inadequate coherent and structured policy in the administration of this sector on the part of the Government. The entire oil companies are involved in JVCs and NNPC export crude oil to the global oil market. Importantly, oil is transported through either pipelines or vessel/tankers respectively.



Figure 3.6 A Diagrammatic Representation of an Ideal Crude Oil Export Map

(Source: The Author, 2020)
3.11.5 Crude Oil transport in Nigeria

Pipeline transportation is the most reliable and economic mode for transporting large amounts of petroleum product (Hassan, 2008, p.26). The crude oil is transported using pipelines which is one of most economical ways of oil transport. Nigeria has several pipelines managed by many operators, which can be seen from the table below. Nigeria is part of West Africa's crude oil supply which is typically feedstock for refineries in South and East Asia, Europe, and the United States.

Connection from/to	Owner/Operator	Length (Mile)	Diameter (Inches)	
Escravos /Warri/Kaduna	NNPC /PPMC	421	24/16	
Obriafu /oben node	NNPC/PPMC	130	48	
Drill centre 2 /drill centre north	MPNU	100	11	
Ogoda /Brass	NAOC	62	24	
Okoro 2 /IMA terminal	AMNI	60	12	
TEBIDABA /Brass	NAOC	57	24	
Bonny/Port Harcourt refinery	NNPC/PPMC	34	24	
Brass creek/Forcados	SPDC	34	24	
Oso/Qit/tanker berth 2 and Oso SPM	MPN/MPNU	31,37,45	18,36,42	
Rapele manifold /Forcados terminal	SPDC	31	28	
Edop /Qit	MPN	30	24	
Alakiri/Bonny	SPDC	21	24	
Buguma/Alakiri	SPDC	20	29	
ldoho/Qit 2	MPNU	19,48	28* 24	
Forcados CLP	SPDC	19	48	
Ughelli PS/WRMILL	SPDC	19	20	
Bonny terminal offshore (SBM 1 and 2)	SPDC	2*19	2*48	
Bonny CLP	SPDC	18	48	
Forcados terminal/ Offshore SBM	SPDC	18	48	
Brass manifold /offshore terminal	NAOC	16	36	

Table 3.10 Diagram showing various Pipelines for Crude Oil Transports in Nigeria, including the Operators.

Source: (Adapted from OPEC, Annual Statistical Bulletins, 2015, p.75-76)

3. 11.6 Nigeria's Crude Oil loading Export Terminals

Nigeria exports crude oil on a daily basis to the international oil market at up to 2.5 Mbpd (Ajayi, 2013, p.2). All the key IOCs operating in Nigeria do export crude oil to the global oil market. However, there are five major oil export terminals, see details in figure 3.1 below. Additionally, each of the oil companies mainly IOCs have separate terminals in which they load through the Floating production storage and offloading vessels (FPSO) and tank farms designated near the oil port/ terminals, before being transported to their various destinations. Further, these terminals are part of the ports, for instance Qua lboe terminal is managed by ExxonMobil, *Onne port in Port Harcourt port is been managed by SPDC* Escravos terminal part in Warri port is a Chevron operated crude oil export terminal and finally Brass terminal been managed by Eni Petroleum. For process flow diagram of crude oil export terminal, see details in appendix 24.



KEY: Items in blue are offshore and green are onshore terminals.

Figure 3.7: Description of Major Crude Oil Export Terminals Capacity in Nigeria measured in Thousand Barrel Per Day

Source : (The Author, 2020, Adapted from Orlean Invest, 2013, p.11)

ExxonMobil 1 Yoho Offshore FPSO Yoho crude 1,925	city els)	
ExxonMobil Yoho Offshore FPSO Yoho crude 1, 925	els)	
ExxonMobil 1 Yoho Offshore FPSO Yoho crude 1, 925		
	,000	
2 Qua Iboe Onshore Terminal Qua Iboe 4, 396	6,000/	
light 1,925	,000	
Esso 3 Erha Offshore FPSO Erha crude 2,142	,600	
Shell/ Snepco 4 Bonny Onshore Terminal Bonny light 3,563	3,563,000	
5 Forcados Onshore Terminal Forcados 3, 140	0,00	
blend		
	000	
6 Sea Eagle Olishore FPSO EA crude 1,400	000	
Chovron 8 Escravos Onshoro Torminal Escravos 1,833	,000 822	
light	,022	
9 Pennington Offshore FSO Pennington 1,350	,000	
Chevron And 10 Agbami Offshore FPSO Agbami 2,200	,000	
Statoll Crude	000	
Agip (NAOC) 11 Brass Unshore Terminal Brass blend 2,780	,000	
NAE 12 ADO UTISNORE FPSU ADO CIUde 933,1	30	
Allied Energy 13 OYO Olishore FSO Oyo crude 980,0	000	
NPDC 14 Okono Olishore FPSO Okono crude 1,055 Tatal F8D 15 Amanam/O Offabara F8O Amanam 2,448	,000	
dudu blend	,000	
Total 16 Akpo Offshore FPSO Akpo 2,000	,000	
Esso 17 Usan Offshore EPSO Usan crude 1.861	000	
Adday 18 Antan Offshore FPSO Antan 1.628	460	
blende	,400	
19 Okwori Offshore FPSO Okwori 1.500	.000	
crude	,	
20 Okoro Offshore FPSO Okoro crude 2,000	,000	
AMNI 21 Ima 2,000,000 FPSO Ima 2,400	,000	
condensate		
Express/Atlas 22 Ukpokiti Offshore FPSO Ukpokiti 2,000 crude	,000	
Cavendish 23 Obe Offshore FPSO Obe crude 212,0	67	
(Not		
active)		
Sterling Oil 24 Tulja Offshore FSO Okwuibome 2,000	,000	
crude		
Oriental 25 EBOK Offshore FSO Ebok crude 1,200	,000	
Yinka 26 AJE Offshore FPSO Aje crude - Folawiyo - - - - - - -		
Brittania-U 27 Ajapa Offshore FPSO Ajapa crude -		

Table 3.11: Nigeria's Crude oil export terminals showing location, stream and storage capacity

Source: (The Author Adapted from NNPC, 2016, 2018, 2019)

3.12 Global Crude Oil Movement

Crude oil movement is determined by demand, which is a function of trade. Maritime transportation is composed of oil transportation, which is a primary driver of trade growth (Siddiqui and Verma, 2013, p.2041). Further, oil transportation was required for 62% of the world production, a quantity of 2.4Bt in 2005 (Rodrigue et al., 2009). The author used Clarksons research archival document on demand for VLCC to show global crude oil movement from producing to consuming regions, which showed quantities in Mbpd and millions of Dead weight (M.Dwt) (Clarksons, 2018, p.5). Clarksons research is respected worldwide as the most authoritative provider of intelligence for the global shipping industry. It can be seen that West Africa (WAF) crude oil output is much lower than Middle East Gulf (MEG) but relatively the same as Caribbean. Nigeria formed the major share in WAF crude oil market (see Table 3.1).

Oil movement from		Total Quantity
Regions	Years	(M.Bpd/M.Dwt)
MEG to China, Japan	2016, 2017, 2018 and	8.6,8.5 8.2 and
and Korea	2019	8.3
MEG to Other	2016, 2017, 2018 and	3.8, 3.8, 4.2 and
Asia/Pacific	2019	4.4
	2016, 2017, 2018 and	1.7, 1.8, 1.7 and
MEG to North America	2019	1.6
Caribbean to	2016, 2017, 2018 and	1.6, 1.6, 1.6 and
China/India	2019	1.7
West Africa to Far	2016, 2017, 2018 and	1.3, 1.5,1.6 and
East	2019	1.7
	2016,2017, 2018 and	0.5, 0.4, 0.5 and
WAF to India	2019	0.5

Table 3.12: Global Crude oil movement from 2016 to 2019

Source: (Adapted from Clarksons Oil and Tanker Trades Outlook, November 2018, p.1)

3.12.1 Crude Oil Movement in Nigeria

Empirical evidence have shown that IOCs in Nigeria supply a substantial portion of crude oil to Nigeria for domestic purposes through the pipelines from the loading terminals and this product now passes through pipelines to Nigerian has four major refineries (Warri, 2 in Port Harcourt, and Kaduna). However, pipeline transport is being used to ship imported petroleum products from onshore terminals on major jetties in Lagos ports subject to certain amounts being charged by the NPA. However, PPMC is responsible for supplying crude oil to the NNPC local controlled refineries even though not working up to optimum capacity (Udo, 2016). However, it is significant for us to know what are the capacity of these refineries? It is from the refineries where crude oil is processed and later sent through pipelines (about 4000km) to the 21 widely dispersed depots that are located all over the country called bridging to the designated related outlet. Nigeria's existing four refineries produce below their installed capacities owing to decades of corruption and inefficiency and cannot supply the 45m litres the nation consumes per day (Africa Research Bulletin, 2017, p.1). Obviously, Nigeria's refineries are not meeting the local consumption demand; apparently this may be due to poor maintenance culture on the part of the management, irregular Turn round maintenance (TAM), old refineries structure and design to name a few. In the advent of shortfall and inefficiency of the Nigerian refineries, products are normally imported and are received through the port of Lagos jetties such as Atlas cove, Ibafon terminals etc. Although, distributed through the pipelines to

the refineries and shipped through smaller ports due to the low draught conditions of Nigerian ports/terminals.

3.13 Summary

In this chapter, Nigeria's crude oil industry was reviewed, COECs dynamics and their export growth rate in comparison with Nigeria. The main findings are that Nigeria's crude characteristics with a low sulphur content for easy refining offered an advantage over its competitors; Also, Nigeria has many crude oil reserves both onshore and offshore. More importantly, the business model appears to be in line with international best practices but appears need to be revisiting to accommodate funding and legal challenges associated with industry such as force majeure and demurrage claims to name a few. Further, PSC has predominated in recent years because cash has been tied up because of JVs, despite being the fundamental form of contract adopted by stakeholders for many years. Nigeria's crude oil domestic transport is very limited due to ageing and moribund refineries, limited pipelines capacities and susceptibility to vandalism by militant groups in the oil-rich Niger delta. More importantly, pipeline and storage capacity investment appears less in Nigeria in comparisons to major COECs. In the next chapter, the author will consider research methodology, underpinning philosophy, strategy, conceptual model, research ethics and the rationale for adopting multiple mixed methods.

CHAPTER FOUR: RESEARCH METHODOLOGY AND UNDERPINNING PHILOSOPHY

4.1 Introduction

The study adopted a pragmatic philosophy which allows the author to explore subjective meanings from social actors to gain a proper understanding of the study as a social constructionist view of the reality (Saunders et al., 2009, p.111). Furthermore, appropriate for this social research, a case study strategy was adopted because of the research question which entails how to optimise port performance strategies in a crude oil export flows in Nigeria (Yin, 2009, p.2). Further, the detailed flow chart of research methodology, included mixed methods. In addition, it is an evolving conceptual model of the study; as the author gathered data and contextualised the study. In summary, the chapter includes detailed description of analysis that was undertaken including ECA, TA, AHP and THA. Furthermore, the TA application appears to be the first of its kind in port management in crude oil flows particularly from a developing country perspective.

4.2 Research Underpinning Philosophy

Philosophy involves total abstraction and limited relationship with practice and as well as, it is a form of theory (Howell, 2013, p.20). Theory has the same root as theatre which provides reflection on society and the world. In essence, theory can be seen in form of a situation, this can be explain as a situation on how human being view the world, and it is highly possible to see the world differently from reference point of knowledge in reality or truth (Howell, 2013, p.20). Theory relates to distinct paradigm of inquiry, it can be positivistic, commonly refers to law oriented, related to natural science (Howell, 2013, p.24). Additionally, research involves understanding the relationship between theory, philosophy (ontology and epistemology), methodology and methods (Howell, 2013, p.22). Ontology entails form of reality, in essence, what can be known about reality (Howell, 2013, p.22). The author is aware of philosophical commitment through choice of research strategy which has immense impact on the understanding of this study through investigation (Saunders et al., 2016, p.125). Meanwhile, the author recognised the importance of been aware of research philosophy by covering continuum of research different paradigms before establishing own philosophical stance.

First, positivism (Naïve realism) is defined as an epistemological position that advocates the application of the methods of natural sciences to the study of social reality, which is aimed at generating hypothesis for testing a theory (Bryman and Bell, 2015, p.28). In other words, Howell (2013) simply put, a positivist consider an external reality exists and can be understood completely and whereas post-positivists argued that even though reality can

be discovered, it may not be understood completely i.e. it is probable. In addition, positivist tends to mimic principle of natural science within the social science context and hence the name positivism coined (Howell, 2013, p.40).

The author explored positivism as a basic philosophy for this study earlier, however, though literature findings revealed some physical port performance indicators such *as* "cost, time, cargo throughput, handling capacity, port/ terminal capacity, can be measured". For instance, *the overall aim in this research is to estimate overall logistics cost per ton of crude oil unloaded for a given terminal*". In addition, other physical factors such as time, capacity throughput, and custom to mention but a few can also be measure in assessing port logistics performance (Feng et al., 2015, p.629).

However, the difficulty of accessing data appears present huge challenge, particularly with regard to cost data in the present study, hence the author took advantage to explore other paradigms. Consequently, the author assumed that positivism paradigm appears not appropriate in this case and hence, the author rejected it.

Second, critical theory entails re-interpretation of modernist positivism in aftermath of First World War and was perceived as a generalised perspective where through education different types of strands of tradition or school of thought provided, critical theory as a paradigm of inquiry was linked with everyday life in the interest of abolishing social injustice, considering the research topic; *"Crude oil export from Nigeria is everyday affair with about 2.1 to 2.5 Mbpd exported to foreign countries*" according to OPEC (OPEC, 2019, p.2). The author believes that use of critical theory to

challenge the status quo here necessitated the need to critically examine history of crude oil export logistics in a broader perspective, specifically on how Nigeria can optimise its performance in this critical sector of its economy and learn from best practices. In addition, critical theorist is of the view that the above positivistic approach directs the researcher towards procedure rather than more humanistic element of the process (Howell, 2013, p.80). In essence, use of critical theory appears not appropriate because it appears only focused on historical perspectives, shaped by history formed by value that are crystallised over time (Howell, 2013, p.22), which is quite voluminous and beyond the scope of present study. Although, it separates value, fact and pursues objectivism thoroughly and deals with instrumental rationality, with other critical element that made up critical theory such as reflexivity/self-consciousness criticism that could easily provide the author accessing stakeholders' perspectives.

4.2.1 Pragmatism

The adoption of a pragmatist position is traced to the most important determinant of epistemology, ontology and axiology of this research question: How Nigeria's port performance and crude oil export can be improved through development of sustainable strategies? Furthermore, the current research question does not suggest unambiguous meaning that means either a positivist or interpretivist philosophy could be adopted (Saunders et al., 2009, p.109), this conforms to the pragmatist's view that it is perfectly possible to work with variations in epistemology, ontology and axiology. Simply put, author <u>used multiple methods</u> that is working with different type of

knowledge and methods which appears appropriate in present study as there is no method could give entire picture and there may be multiple realities (Saunders et al., 2016, p.144). For details, see figure 4.1 for flowchart of research methodology. Literature reviews findings revealed that some physical port performance indicators exist such as "cost, time, cargo throughput, handling capacity, port/terminal capacity, can be measured. While non-physical performance indicators such as customer service satisfaction (Felicio et al., 2015, p.630), exogenous security threat (Lloyds List, 2011, p.1 and Urciuoli et al., 2014, p.53) and information flows network (Hull, 2002, p.18) cannot be measured. Thus, these performance indicators are both a mixture of quantitative and qualitative perspectives that are highly appropriate within the study (Saunders et al., 2009, p.109). In essence, pragmatism tends to reconcile both objectivism and subjectivism fact, values, accurate and rigorous knowledge and different contextual experience. In practical terms, the author's main thrust is to address research problem and question that is finding optimisation strategies for port performance in crude oil export logistics systems distribution through incorporating pragmatist emphasis of practical outcomes (Saunders et al., 2016, p.143). Ontologically, the author took an objective stance as social entities exist in reality external to social actors concerned with their existence (Saunders et al., 2009, p.110).

4.3 Key Research Methodologies

Firstly, Ethnography can be defined as a methodological approach, which emerged through the interest in the origins of culture and civilisation, describes social groups and was initially related to anthropology, the study analysis of primitive societies (Howell, 2013, p.2). In addition, it involves an ongoing attempt to place a specific encounter, events, and understanding in to a fuller, more meaningful context (Denzin and Lincoln, 2000, p.455). On aspect of ontology, it considered human being as the object and subject of their inquiry exist in a multiple strata of reality, which are organised in different ways (Denzin and Lincoln, 2000, p.471), which actually explained the nature of reality, which is a basic belief that leads to methodologies and methods respectively (Howell, 2013, p.29). Epistemologically, ethnography mostly deals with observation of participants but in recent times, there has been a shift from objectifying methodology into an intersubjective methodology and this entails a representation of transformation.

Traditionally, ethnographers always allow both self and other to appear together within a single narrative that carries multiplicity of dialoguing voices (Denzil and Lincoln, 2000, p.471). More importantly, ethnographic approaches involve observation of actual life experience that might require spending long period of time with participants (Hair et al., 2016, p.198). Port performance and crude oil export logistics systems distributions is basically an event and as well as field related. For instance, offshore and onshore oil fields are typical example of field research study and as well as interpreting the thought of people involved in the overall operations of crude export logistics system distribution appears possible. However, a major challenge is

that it requires the author to build trust prior to commencement of field work for its success (Saunders et al., 2016, p.189). This appears difficult as literature review findings showed limited qualitative studies in port management in crude oil flows logistics system (see details in appendix 1 SLR). In the first instance, especially during scoping study, the author faced numerous challenges from respondents as it appeared difficult for some to take part in the scoping study, *hence the author concluded that it is quite difficult to use this approach due to sensitivity of accessing data and vulnerability to piracy.*

Secondly, Ground theory (GT) is a way of collecting data through comparative analysis and coding; a means of generating or building a substantive theory (Howell, 2013, p.135). In addition, Glaser argued that the purpose of GT is to generate theory, not to verify it. GT are founded upon Glaser's epistemological assumption, methodological terms, inductive, logic and systematic approach (Denzin and Lincoln, 2000, p.512). In essence, the author assumed that epistemological assumption whereby all the experts involved are expected to present their experiences, thoughts and opinions through appropriate methods that is related with ontological construction. Furthermore, they are in involved phenomenological interpretivist position with pragmatic underpinning; where relationship exist between phenomenon and a certain level of forcing as well as subjectivity in relation to interpretation and emerging ideas that is exist (Howell, 2013, p.152). In addition to subjectivity in its interpretation, GT takes into cognisance these difficulties, hence providing flexibility for a methodological approach that may be used in post-positivist, critical theory/constructivist/participatory fashion. Although, it

allows use of structured interview, journal publications, organisation/company reports, archives and the researcher's reflection and reflexivity. Importantly, GT presented the author with multiple methods of data collection (Denzin and Lincoln, 2000, p.514).

More importantly, the rationale for data collection in this methodology is inductively derived from the study of port performance in the crude oil export logistics systems distribution in Nigeria which is considered within the concept of analysis and theory is reciprocal. In addition, the theory is not considered at first stage, which is then tested but within an area of study which is relevant to the area that is derived through data collection; finally, which shows induction is grounded in social phenomenon. One common advantage of GT lies in its flexibility; it would allow the researcher to look at data from different perspective or vintage points position (Charmaz, 1983:111), and involves comparing the analysis and diffuse data which are collected from different places and through separate methods (Howell, 2013, p.136). Essentially, the author would like to explore company reports, archives, observations notes, trade transaction document and oil statistical bulletin of NNPC on crude oil sales export for twenty years to analyse total logistics cost of these years. Consequently, compare it with other crude oil producers that have excellent logistical operation such Oman, Saudi Arabia, USA to name a few. In this context, open coding, which is the first step towards gradually making sense of a data would be explored, through categorisation of data with the aimed of generating an emergent set of categories and their properties which fit, work and are relevant for integrating theory (Howell, 2013, p.137). The author foreseen a few concerns in regard to

this methodology which lies in a non-proper definition concerning induction and deduction. Typically, it shows that where the induction begins and deduction ends, there appears there are elements of ambiguity, which need further clarification (Howell, 2013, p.152). In addition to methods of data collection; the author foresaw a possible delay in accessing data in Nigeria coupled with the fact that low oil price that the industry witnessed also contributed to difficulty in accessing data, a typical example is the PIB that was supposed to be passed since 2008, it is 13 years the proposal has been sent to Nigerian parliament with no response for passage into law. Although NNPC provides Annual Statistical Bulletins information and also IOCs annual reports as well. Nevertheless, this may not be enough to get a coherent and comprehensive findings in the end. More importantly, more in-depth information regarding the operational performance and procedures of crude oil export need to be accessed. The author believes that GT appears to fit in perfectly in the present study owing to its advantage of been objective and building constructionist visions. Hence this allows interpretive study which enable quest to understand the current study (Denzil and Lincoln, 2000, p.528) which involves many experts representing different segment of crude oil export logistics system as a whole; wide range of ideas, experience and thought of these individual/experts would be explored, which is purely phenomenological and while still maintaining objective stance (Howell, 2013, p.29). The author rejected this approach because, it is well established that in qualitative research, data collection are often concurrent with analysis initiating additional data collection which in turn stimulate more analysis (Hair et al., 2016, p.302). Finally, time required to collect data was a problem-

access to interviews was problematic and also insufficient time to analyse them using GT before the next interview.

4.4 Actor Network Theory

The author would briefly explain what is meant by Actor Network Theory (ANT), its historical context, and impact choice of research method in few selected studies. In addition, detail analysis and how it sits within the present study and its appropriateness. Firstly, it was developed by (Bruno Latour et al., 1980). Although it carries theory in its name. Although, it is more of a method of doing research. In other words, it is also referred to the enrolment theory or sociology of translation, termed as a conceptual frame for exploring collective sociotechnical processes, whose spoke person have paid particular attention to science and technological activity. ANT is mostly described as a research method with a focus on the connections between both human and non-human entities that are part of issue a stake (Dankert, 2011, p.1). In addition, seen as heterogeneous amalgamation of texture, conceptual, social and technical actors (Crawford, 2005, p.1). Thus, ANT is described as highly dynamic and inherently unstable. However, it could be stabilised whenever people, technologies, roles, routines, trainings, incentives, and so on are aligned. In this context, alignment is achieved (or at least attempted) through translation which involves four stages of problematisation (defining a problem for which a particular technology is a solution), interessement (getting other to accept this problem-solution), enrolment (defining key roles and practices in the network) and mobilisation (engaging others in fulfilling the roles, under

taking the practices and linking with others in the network (Callon, 1986). The author believes that most important point relevant in the present study appears to be the fourth <u>stage</u> called "<u>mobilisation</u>". To summarise, both theoretical and empirical research evidence have revealed that information shared among the supply chain actors particularly from NNPC and major trading partners appears to be slow, ineffective and inefficient (refer to section 1.4 for detail). In the end, this impacts the efficiency of port performance in crude oil export logistics systems distribution.

4.4.1 Key Studies on Actor Network Theory

Heeks (2013, p.1) explored ANT in developmental studies despite its limited usage and found out that it is highly limited though unfamiliar in the field. However, it is gaining popularity in addressing developmental research questions in recent times. That said, Andrade and Urquhart, (2010, p.352) applied it in affordance of ANT in information and communication technology (ICT) for development research and findings revealed great deal of insight into underlying anatomy of the project which showed that when actor interest are not aligned and network procedure defined by the ICT4D initiative sponsors appears unfamiliar to local people the network cannot be establish. Further, their work showed the importance of computers in information dissemination in rural community which show interaction between people and non-human computer. Thus, it shows its importance interest in the use of computer by passing infocentros to access computer, demonstrated a network is emerging by showcasing role of ANT in telecentres in the context of ICT4D. More importantly, it revealed an important scenario which theory

appears not, is the fragility in creating the network along the translation process. That said, Greenhalgh and Stones, (2010, p.1288) worked on large information technology (IT) focused on theorising big IT programmes in health, due to increasing investment in technology in the UK National Health Service (NHS). ANT was used to study the relationship between that link between people and technology in dynamic network, they found that human agent to be critical in the network. ANT showed how IT as technological advancement when applied to healthcare delivery system could be more seamless, efficient and patient centred. However, its importance in present study through facilitating information sharing via improved IT system from the state-controlled oil company, NNPC and its key customers. On the other hand, Jensen and Sandstrom (2019, p.1) applied ANT in organising rocks in which underground mine, whereby space was theorised in which disparate mining operations are better understood in terms of co-existence and difference, inclusion and exclusion. Another sector where ANT application was explored is project accountability in an exploratory case study (Burga and Rezania 2017, p.1024). Essentially, a case study of enactment of accountability in the renovation which show project of a historical building at public university. Hence, ANT and concept of accountability revealed that artefacts are important actors in translating accountability through disclosure of information which show that it is being enacted spontaneously not by design. Finally, its theoretical contribution include de-naturalisation of the concept of accountability of project.

Furthermore, Aka (2019, p.524) used ANT to track and succeed in a sustainable innovation development process. In essence, ANT was used as

theoretical framework to analyse innovation which described innovation as process a translation in which actors both human and non-human constantly negotiate and adjust the social and technical characteristics of innovation overtime. Findings revealed sustainable innovation development as a matter of time and space and revealed a managerial practice that leads us to consider the development of sustainable innovation as a synchronous process". In a sense, it has been possible to use ANT to complete application of the socio-technical graph method to track managers and the stakeholders' interactions and transformations. Thus, ANT's theoretical framework and methodological were used to understand and track the temporal and relational dimensions of the sustainable innovation process within the small and medium enterprises (SME) context. Furthermore, ANT have been explored in tourism management with focused on creating sustainable tourism ventures in protected areas (Dedeke 2017, p.161). In essence, the use of ANT provides evidence that it is very helpful in understanding how principal actors found sustainable tourism ventures whereby it explored use of theory's translation phases including problematisation.

4.4.2 Why ANT in Port Performance in Crude Oil Export Logistics System Distribution?

In the first instance, the author intended to explore this methodology, simply because of its importance in development informatics which has two cognate disciplines-*information system and development studies* particularly been use in information system (Heeks, 2013, p.10). Therefore, ANT is often described as being dynamic. However, the author sees the importance of ANT in the current study by reflecting logically on verbatim quotes from respondents to

show significant of information flows, which is key for optimisation of port performance in crude oil export logistics system distribution. Essentially, information flow appears the main theoretical framework for this study. Below is a verbatim report that necessitated the use of ANT in the present study. *"Information is slow if you are loading from NNPC as a prime supplier.* Crude

oil trader with one of world's leading commodity trading house, Feb 2017.

Often the communication; my experience around the world, the issue is usually around communication are usually "*misunderstanding*". Especially if you are dealing with non-English people. You know as an English speaker, you are writing email or filling in document in ports; that does not have English as their first language is normally around "misunderstanding between what I am writing or what they are writing to me and me misreading them and hmmm. These are usually types of communication issues have seen, and normally these can addressed by just a telephone call or just a face to face meeting if it is a big issue; normally if talk to the person individually, you can understand what the issue is and where the misunderstanding is and you clarify that field rapidly". Oil executive with OCIMF, London, Dec 2016.

Both verbatim quotes are information flow related and the main thrust /research problem of the present study is also information flow inefficiency which impacts port performance and crude oil export logistics systems distribution. The crude oil export logistics supply chains consist of people, different organisations, machines are other entities are unified behind a single/common mission (Latour, 1996; Law, 1992). Supporting this assertion (see detail in figure 3.3 Nigeria's stakeholder's crude oil export map and figure 3.4–A diagrammatic representation of ideal crude oil export map showing processes and measurement). In this sense, whole SCM of crude oil export deals with human and non-human factors which is quite relevant to accomplish seamless and sustainable information flow. *Specifically, ANT appears appropriate in mobilisation phase, particularly actants become actors by actually carrying out contributions that are aligned with purposes of founder and her network (Dedeke, 2017, p.166).* In essence, this is the stage where all members of the supply chain that have critical role to make

information dissemination to be provided promptly without any unnecessary delay. The main concern is on sustainability of information flow in the chain. Thus, the author assumed sustainability is a process. However, ANT appears embryonic in sustainability research (Williams et al., 2017, p.877). The absence of a rigorous framework, hence it appears this framework appears less appropriate but its application to facilitate information flow network is critical in this study, though this study is exploratory as there are limited extant literature on information sharing/flow in crude oil export logistics system and as well preliminary scoping interviews revealed many templates of issues for improvement in performance.

4.5 Research Strategy

Case studies are one of several ways of doing social research; other ways include but are not limited to, experiments, surveys, histories, economic and epidemiological research. A case study is a history of the past, or current phenomenon drawn from multiple sources of evidence. In reality, this includes data from direct observation and systematic interviewing as well as public and private archives. Any strategy is relevant to the stream of events describing the phenomenon in a potential datum in a case study, since context is important.

4.5.1 Why use Case Study as a Descriptive context Methodology?

A case study deals with a behavioural event; for instance crude oil loading, information flow, communicating to terminal operators by the NNPC etc. In this study, the research question as how or why questions (Yin, 2009, p.2). The aim of current study is to know what, why and how optimisation would be derived in Nigeria's context (Saunders et al., 2009, p.146). In addition, might lead to uncovered important variables for improvement such as critical incidence, ambiguity in contract and demurrage claims challenges. In critical terms, case study research is one of the most powerful research methods in operations and management, particularly in the development of theory (Voss et al., 2002, p.195). Major applications of case study could include individuals, organisations, neighbourhoods, institutions and even events. Yin (2007) asserts that the technical definition of a case study is to be an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context when the boundaries between phenomenon and context are not evident. The case study allows the author to have an overview of the entire situations/strategies in Nigeria's crude oil export logistics system distribution through interaction with among all the variable in a real life settings, also unit analysis which is key feature of case study (Hair, 2016, p.208). Importantly, unit analysis which is key feature of case study. Essentially, it appears to allow comparison of terminal operators' level of operational and logistics performances of key players such as NNPC, IOC or IDOCs to a great extent (Hair, 2016, p.208).

More importantly, to understand terminal operations in crude oil logistics systems particularly, metering systems in onshore and offshore operations, crude oil loading, vessel clearances, cargo surveyor inspectors' role and port agents' involvement in Nigeria's crude oil export terminal operations. A case study is a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon, within its real-life context using multiple sources of evidence (Saunders et al., 2009, p.146). This includes the researcher's preliminary findings from scoping interviews, semi-structured interviews, focus groups and literature reviews. This data might not be rich but a case study presents an opportunity to gain a rich understanding of the context of the research and the processes being enacted.

4.5.2 Research Design Framework



Figure 4.1 Flowchart of Research Methodology.

Source: (Author 2020)

4.6 Why Mixed Methods?

Pragmatism is chosen philosophical assumption. In essence, to establish a robust research, the author believes it is significant to explore mixed method which is a subset of multi-method to overcome weakness associated with using single mono method as well as providing scope for a richer approach to data collection, analysis and interpretation (Saunders et al., 2016, p.166). The author undertook a sequential mixed method research which involved more than one data phase collection and analysis (Saunders et al., 2016, p.171). First, much of the work is mostly gualitative followed by guantitative Likert scale and AHP surveys which is a sequential exploratory research design through collection of both qualitative and quantitative separately. However, the latter was used to support qualitative approach. The author realised the complexity of reaching a conclusion on findings, particularly on issue of generalisability, interpretation, triangulation and confidence as pointed out by (Saunders et al., 2016, p.173), particularly complementarity with detailed qualitative method. In addition, quantitative methods allows meanings to findings to appear elaborated, enhanced clarification, triangulation to ascertain if findings from one method mutually collaborate the findings from the other method. Similarly, both qualitative and quantitative suggested to complement each other quite well.

Furthermore, comparison of both qualitative and quantitative approaches suggest that they complement each other quite well (Heir et al., 2016, p.155), this really helps to a greater extent to increase confidence. Other scholarly publications attest to its significance. Ostlund et al., (2010, p.369) discussed

methodological review of combining qualitative and quantitative research within mixed method research design in health care research, triangulation as a methodological metaphor where analytic approach widely explored with parallel data analysis, while a number of studies used sequential and a few used concurrent in a total number of 168 studies in the UK, Canada and USA.The author suggests the central role of mixed methods that allows it to clarify theoretical proposition and basis of result. In recent times, there is increasing growth in use of this method.

First, Johnson et al., (2012, p.14) described it as research paradigm whose time has come by explaining it key feature - which is methodological pluralism and future success if researchers help to advance its concepts as they regularly practice it. Moreover, more recently (McKim, 2017, p.202) explained the value of mixed methods that revealed students preferred mixed methods passage as more valuable than those who scored quantitative or qualitative as having rigorous methods, multiple perspectives, newer history and providing reader with deep meaning.

In conclusion, there is a consensus on mixed methods as an interesting approach in social and management research. The current research explored a series of semi-structured interview (open ended) and also quantitative survey. The author employed mixed methods to guide exploration in this study as it engages complex phenomenon where both qualitative and quantitative approaches are significant. The choice of this method is justified through decisions to adopt two types of sampling (purposive, theoretical) and two types of conclusion (both qualitative and quantitative).

In addition, rigorous procedures are being adhered to, typically, during literature review, SLR, scoping studies, focus groups, archival research and theoretical approach which were analysed with several technique such as ECA, THA, and TA. In concrete terms, the author mixed the qualitative and quantitative approaches within and across the stages of research process. In addition, during data analysis and data interpretation stages, the qualitative and quantitative phases occurred sequentially and the qualitative phase was given more weight. Furthermore, this data is integrated in the sense that scoping generated into hypothesis, tested by experts' opinion and correlated the result of previous finding ECA, informed the next, focus group and survey. Both qualitative and quantitative have different population that in the same industry but in different roles, so the different stakeholder input enriches the findings. More importantly, the research has benefitted from multiple perspectives through purposive sampling on the social phenomenon of port performance. Initially, the author did exploratory sequential design that involved much more of qualitative data, analysed and findings were used to develop instruments that was adopted to the sample under study. Main advantage of mixed method, it showed how the findings is grounded in participants' experience which produced rich and comprehensive data.

4.7 Conceptual model for Port performance and Crude Oil Export Logistics System

Conceptual model or conceptual framework is a simply put "as the current version of researcher's map of the territory being investigated" (Miles and Huberman 1994). It is explains graphically or in narrative form, the main

things to be studied - the key factors, variables, or constructs and presumed inter relationships among them (Miles and Huberman 1994, p.20). The author understands that a conceptual model plays a significant role as a tool to the present study for continuing improvement; usually emerged from abstract concepts (theory) and empirical data collection drawn from the subjective opinion of experts in crude oil supply chains, and archival documents. Despite a lack of credible theory initially, the author interpreted and understood findings of relevant research after building a conceptual framework to make sense of the data gathered. In concrete terms, the conceptual model included only the important features and this helps to narrow down to focus on one aspect of the research pertaining to: port performance, logistics performance, port security and supply chain management. However, relationships between these features link closely with the main themes gleaned from data collection and analysis. Additionally, the author synthesised the theoretical, seminal, and empirical literature into a cohesive argument for the study.

More importantly, a conceptual model serves as the first analytic display that appears to tell the story of the study in brief as it keeps evolving (Miles and Huberman 1994, p.24). The conceptual model helps in defining the territory of the research, indicates the literature that needs to be consulted and suggests the methods and theories, which may be applicable. The author explored a comprehensive definition that offers an integrated view for the role and function of conceptual framework. The framework appears appropriate as it answers, "what and how questions". "What" questions address issues of purpose and intention strategy, and "how" questions address the means

whereby an activity is performed, via the method to be adopted? Optimisation strategies emerge relating to "how can Nigeria's port performance and crude oil export logistics systems distribution be optimised?"

Additionally, the current study's conceptual model apparently emerged from natural research due to grounding of empirical data obtained, which might likely create a theory. However, inevitably, the choice of system, Venn diagram and conceptual modelling shape how data is interpreted and conceptualised. In addition, the purpose of grounded theory is to generate a theory, not to verify it. Grounded theory is founded on particular researcher's epistemological assumptions, methodological terms, inductive, logic and systematic approach (Denzil and Lincoln, 2000, p.512). Thus, the author used epistemological assumptions whereby all the experts involved presented their experiences, thoughts and opinions through scoping interviews, semi-structured, focus group interviews and observation. Further, these were linked with ontological construction, which involved a phenomenological interpretivist position with pragmatic underpinnings in which relationships exist between phenomenon and a certain level of forcing, as well as subjectivity in relation to interpretation and emerging ideas that exist (Howell, 2013, p.152).

Overall, despite different interpretations by different authors, a conceptual model offers fulfilling integrating functions between theories, which explain the issues under investigation. For this reason, it offers a bridge between paradigms, which explain the research issue, and the practice of investigating that issue. In conclusion, it is significant to note the academic

relevance of a conceptual model. This presents the author with flexibility and a purposeful variety of conceptual framework, which ranges from theory to research strategy, raising the researcher's level of thinking from a content to a Meta – level of conceptualisation. For details see below conceptual model one derived in the first instance.



Figure 4.2: Conceptual Model one

Regulations	Operational issues	Marine operations	Maritime Insecurity	Documentation	Commercial Operations	Supply Chain Management	Port Model	Cost
National regulations : government regulations, Indigenisation policy (PIB Bill)	Crude oil loss	Port state control	 Piracy Pipeline vandalism 	Vessel clearance	 Trade off Marketing 	 Storage tank/inventory Floating production and offloading storage Throughput capacity 	Land lord model	Tangible cost
International regulations: ISPS, ISM, STCW, MARPOL Conventions etc.	Production outages	 Dredging Vessel draft vessel size Environmental pollution 	Kidnapping	Exchange of vital shipping document	Ownership	Integrated logistics /System engineering		Intangible cost
	Measurement of export	Weather	Crude oil theft	Multiple government agencies	Incoterms : Fundamental terms of contract	Labour issues		
	 Custody transfer Metering systems Hose connection 	 Cargo loading operations barging Transhipment 			Demurrage	Monopoly in logistics		
	Technical expertiseTraining	Fishing licensing			Entitlement	Technology		
	Change in lifting programme				Crude oil price	Block chain information sharing		
	 Community agitation Force majeure 				Contractual agreement and negotiation	Corporate social responsibility		
					Port charges and oil terminal dues			

Table 4.1 Conceptual Model Two

Source: Author, 2019

4.8 Population identification and Sample selection

This study employed multiple case studies, hence case selection or sampling is vital in the first instance (Voss et al., 2002, p.202). The need for sampling starts with scoping interviews, essentially that is phase one of this study. The population of knowledgeable people chosen and the sample chosen was judgemental sampling for scoping interviews. In essence, the COMD officials recommended other elements that share common characteristics (Hair et al., 2016, p.172). First and foremost, the author is aware of the significance of the target population, method of sampling and sample frame. In this sense, target population are IOCs, IDOCs, academics in SCM, service providers, Nigeria's state-owned oil firm, business analyst etc. Samples were formed mainly from some of the stakeholders listed earlier, since the study is exploratory, hence the author decided to use nonprobability sampling (Hair et al., 2016, p.192). One major challenge is determining samples in order to reflect sufficient size and quality to yield credible and accurate result with consistency .Therefore, the author ensured minimum sample size 10-20% of the total of individual in total population is adhered to. See details in table 7.2, 7.1 (Likert scale survey) to name a few (Hair et al., 2016, p.185). The author ensured that samples mirrored characteristics of the population because these experts interact extensively in the supply chain, hence this helps author to minimize error associated with sampling (Hair et al., 2016, p.173). First, for scoping interview sample frame, the author considered NNPC officials with sound knowledge of crude oil
export logistics which have daily interactions with all key players in the industry. Further, they composed of elements that do belong to target the population as they are composed of key factors such as exploration and production firms, IDOCs, IOCs, marine services and logistics, engineering and construction to name a few. See table 5.2 for list of exploratory study participants' roles and organisation. Due to difficulty in accessing data, the author undertook purposive sampling as it mostly represent the target population (Hair et al., 2016, p.184). Second, interviews conducted followed the same sampling strategy as scoping interviews. Third, concerning focus group interviews, the author explored snowball sampling via referral, the author decided to narrow target population because it appears difficult to access these experts due to busy schedule and some appear not ready to grant interview due to trust and vulnerability to piracy.

Fourth, the author used purposive sampling for AHP survey at the first stage, (see detail in chapter 4.8.1 sampling frame). In choosing a sample size, respondents were well spread reasonably representative in the supply chain, see detail in table 7.2 (AHP respondents). Moreover, in the second stage of AHP survey to determine group decision makers, the author used stratified sampling which is a probability sampling through selecting categories of professionals that represent different individuals with specific roles for example, cargo surveyor, terminal operators which formed proportion of strata of the target population (Hair et al., 2016, p.184). Further, see details in table 7.10 and 7.11 for group decision makers for traders, cargo analyst etc.



Figure 4.3: Nigeria's Crude oil Export Stakeholders' Map

4.8.1 Sample Frame

The author's target population was sampled from Who's Who of the Global Energy Industry, 2011 & 2015, which appears appropriate to this study. Moreover, to generalise results statistically (Saunders et al., 2016, p.272). Purposive sampling was chosen because this is a case study that requires cases that are particularly informative (Neuman, 2005), and also data collected from multiple sources from key supply chain members, with data needing to converge in a triangulating fashion (Yin, 2018, p.15). Another point is that focus of research inquiry is on improvement strategies (Kervin, 1999). Key attention is given to those engaged in logistics of crude oil that are familiar with Nigeria's oil industry (Saunders et al., 2016, p.275). Moreover, the sample represented full cases ranging from crude oil trader, terminal operators, ship captains etc. in a way that is meaningful, and which can be justified (Becker, 1998). The target population were equally represented, particularly those experts engaged in crude oil flow, hence this reduces possible risk of non-response bias. The author interviewed crude oil traders, as they are key driver in port performance and crude oil logistics systems to get different perceptions of this situation because of their own view of the research project (Saunders et al., 2009, p.111). Further, the participants for the interviews and surveys span various terminal operators including IOCs, crude oil traders, NNPC officials, marine pilots, export tanker masters, port agent, business developers, senior mooring master, shipping departmental officers, logistics officers, supervisor efficiency, supervisor JV operation, accountant, maintenance leader, regulatory officials. The author

choses samples are on the basis that it is a representative sample of the population as a whole.

Criteria	Nationality	Size	Years of establishment	Ownership
			ootabiloninont	
NNPC	Nigerian	large	1977	State
IOC	International oil	large	1937	International
	companies e.g. Shell			
IDOC	Oando	large	1966	International
IOC	ExxonMobil	large	1955	International
Crude oil trading	International	large	1974	International
company				
Maritime company	local	large	2003	Local
Industry regulator	DPR	large	1971	State
Indigenous crude oil	Nigeria	large	1989, 1966,	State
trading company			1993	
(ICOTC)				
International Oil	International	Large		International
company marine forum				
(OCIMF)				
Indigenous crude oil	Nigerian	large	1989	Local
lifters (ICOL)				
Nigerian Navy (NN)	Nigerian	large	1914	State
Lecturer in logistics and	Nigerian	-	-	-
SCM				

Table 4.2: Case Selection Criteria

Source: (Author, 2019)

4.8.2 Criteria Justification

- Nationality: Key players in the Nigeria's oil industry in the upstream sector are the western IOCs such as Shell, ExxonMobil, Chevron, Eni and Agip. They have been operating for over five decades and registered in Nigeria despite being foreign companies.
- Size: For example, ExxonMobil's investment in Nigeria's oil industry is about \$11B as of 2012. Also, terminal operator of Erha, Yoho and Qua–Iboe, which is one of the large oil field. See details of Exploration and production firms in Nigeria's crude oil value chains in appendix 6.
 - Ownership: NNPC upstream operations are in partnerships with the major IOCs. These multi-national E&P companies are operating predominantly in the on-shore Niger Delta, coastal offshore areas and lately in deepwater. As with many other developing countries, the IOCs in Nigeria had been operating under what is called a concession system, with NNPC being the concessionaire, while the companies are the operators. NNPC also is responsible for the management of the exploration bidding rounds for oil and gas. The IOCs operate in partnership with NNPC under PSCs (NNPC, 2017).

3. Management structure: All the companies are either national or international and it is a critical requirement that they have board members, and most of these respondents interact with the board members in daily operations, hence they gathered wide experience in management of oil and gas industry. Another point, respondents cut across the entire oil industry and this presents the author with different opinions and viewpoints on the study with no ambiguity.

S/N	DATE	INTERVIEW TYPE	RESPONDENTS AFFILIATES	LOCATION	TIME DURATION	DESIGNATE	YEARS OF EXPERIENCE
1	30 th March, 2016	Nine (9) Scoping Interview	NNPC	Abuja	Each is approximately 10 mins	Senior supply chain managers state of oil firm (NNPC)	14+
2	02/12/2016	Semi–structured interview/discussion (2)	Oil Companies International Marine Forum (OCIMF)	London	1hr 36min 52s	Oil executives (Technical adviser and captain)	20 +
3	02/12/2016	In-depth Semi–structured interview	Duke Oil Services, London	London	49mins 35s	Crude oil trader	14
4	16/02/2017	In-depth Semi–structured interview	Glencore Energy, London	London	52: 17secs	Crude oil trader	12
5	06/02/2017	Semi –structured interview	Plymouth University, UK.	Plymouth	55mins 15s	Lecturer in logistics and supply chain	-
6	20/03/2017	Semi –structured interview	Plymouth University, UK.	Email reply		Academic	-
7	16/02/2017	Semi –structured interview	Nigerian National Petroleum Corporation(NNPC)	London	52: 20secs	Senior oil executive	14
8	16/02/2017	Semi- structured interview	NNPC	London	49mins	Senior oil executive	13
9	18/2/2017	Focus Group	NNPC	London	1hr 15mins	Senior oil executives	14,14,10,13,17 ,10
10	14/04/2017	Semi- structured interview	Blue Sea Maritime	Skype	1hr 18min 2s	Port agent	13
11	18/05/17	In–depth semi-structured interview	Shell	Telephone conversation	1:18;38secs	Fleet operation managers of FPSO	37
12	20/08/2017	In depth semi–structured interview	DPR	Lagos	1h, 10mins, 2s	Regulatory agency	13
13	16/09/2017	Semi- structured interview	DPR	Lagos	44mins 10s	Regulatory agency	23
14	23/08/2017	In-depth semi-structured interview	DPR	Lagos		Regulatory agency	19
15	26/8/2017	In-depth semi-structured interview	ExxonMobil	Lagos	1h, 37min, 2s	Senior marine supervisor	18
16	20/09/2017	Semi- structured interview	DPR	Lagos	15mins	Senior official	14

17	26/08/2017	In-depth semi structured interview	ExxonMobil	Lagos	30mins	Marine supervisor	18
18	27/08/2017	Focus group (6 Members of Nigerian navy)	Nigerian Navy	Lagos	1hr, 10mins 4s	Lieutenant Colonel in Nigerian Navy	12
19	17/09/2017	In-depth semi structured interview	Exxon Mobil	Lagos	1hr 24mins 2s	Senior marine supervisor	18
20	30/09/2017	Focus group on security (6 members of IDOC)	Terminal Operator Sterling Oil	Delta (Kwale)	39mins 20s	Oil workers	10
21	30/09/2017	Focus group on Investment (7 members of IDOC)	Terminal Operator Sterling Oil	Delta(Kwale)	1hr 01min 44s	Oil workers	8,12, 9,10,9,1012
22	3/10/2017	Structured: written reply	Terminal operator	Lagos	-	Facility manager	15
23	21/08/2017	In depth semi structured interview	DPR	Lagos	45 mins	Senior regulatory official	15

 Table 4.3:
 Data base of Respondent profile from Scoping, Semi-structured and Focus group Interview

The data collected were primarily from scoping interviews with top officials of NNPC, with experience of crude oil export terminals in COMD, to unravel some of the basic issues in port performance and crude oil export logistics systems distribution in Nigeria (Saunders et al., 2009, p.146). This revealed experiences of social actors particularly focused on Nigeria rather than any other COECs (Thomas, 2016, p.3). Furthermore, other sources of data, such as observation, were employed by simply being present. The author visited a crude oil export terminal jetty in the oil-rich Niger Delta region in southern Nigeria and observed crude oil operations that exported crude oil from flow stations, pipelines, barges and metering systems (Least custody unit transfer) commonly referred to as LACT UNIT, navigations, dredging, information sharing and communication among terminal operator's workers in the field. In addition, maritime security issues in onshore and offshore locations, whereby security operatives provided security before, during and after loading day and night.

It is possible that the data is unreliable or invalid due to the observer effect. The implication of observer effect is that an informant may work harder or act more ethically in the presence of an observer. To overcome the effect, the author maintained minimal interaction throughout with informants. Periods of observation were made more reliable by limiting minimal eye contact, maintaining unobtrusive position and, most importantly, were frequently repeated, allowing habituation to reduce any innate responses to achieve reliable and valid data. The author took cognisance of documentary analysis in shipping and news such as Lloyds list, Clarkson's Shipping Information

Networks, reports, local news on Nigeria, archival documents, media publications and Trade Winds news update, and as if to emphasise the dangers of constructing neat boxes in which to categorise approaches, various strategies and technique (Saunders et al., 2009, p.146). This research devised preliminary findings or propositions based on several sets of interviews and offered multiple sources of evidence in which data needed to converge in a triangulating fashion, to guide data collection and analysis (Yin, 2009, p.18).Triangulation refers to the use of different data collection techniques within one study to ensure that the data is telling the author what he or she thinks they are telling him or her (Saunders et al., p.146).

The author sees port performance and crude oil export logistics system distribution in Nigeria as an investigation that appears best described as an exploratory case study. Thus, a case study may comprised of one case or a small number of cases in a large number of features of each cases. *To start with, Nigeria has 27 crude oil export terminals with different operators with the NNPC in production sharing agreement, service contract, sole risk and JV respectively*. The purpose is to understand the details of what is happening, the situations and what is going on in this particular event in Nigeria (Thomas, 2016, p.37). In addition, this presents an opportunity to interview any expert in one of the Nigeria terminal operators and key supply chain partners to gather rich data in this study. The researcher believes that multiple case studies appear to be preferable to a single case study and that, where one chooses to use a single case study they must present a strong justification (Yin, 2003). This evidence is seen in Nigeria's various export

terminal operators, all aimed at exporting crude oil from the same country to the global oil market.

4.9 Research Ethical Issues

Ethics refers to a set of standard behaviours guiding research conduct in relation to the rights of those whom the researcher interviews or who are affected by the work which is guided by various influences (Saunders et al., 2016, p.237). The author gained approval from the University research ethics committee. It is a standard that requires interpretation of the current study in terms of principle and standard contained in the code of ethics such as ethical protocol, confidentiality, openness and honesty, protection from harm etc., despite being written in abstract terms. Nevertheless, the code is designed to prevent misconduct (Bryman and Bell, 2007).

The author is aware of the risk associated with crude oil export logistics as a global commodity such as commercial sensitivity and vulnerability to piracy. Letters were sent to the respective company's management that comprises the sample frame for this study. The information included is private, ensuring confidentiality of data and maintenance of anonymity of respondents in the interview and survey questionnaire. In addition, consent was sought to quote responses anonymously or to reproduce a transcript of some or all replies, for example in an appendix, 3 and 4 (Saunders et al., 2016, p.244). Furthermore, the author considers it imperative to seek respondents' consent to request access without applying pressure and most of them were happy to help (Saunders et al., 2016, p.249).The author made phone calls to remind prospective respondents, which was very helpful as most of them had busy

schedules, despite assurances given that they would take part in the study. One key challenge encountered was when the author was requested by the senior technical adviser to OCIMF to help speak to terminal operators with operations in Nigeria regarding whether they could participate in the study and all of them declined. Additionally, some ship owners declined to grant interviews. However, a shipbroker took part in one of the questionnaires in a later stage of the study.

4.10 Research Validation

A copy of the interview transcripts was sent back to each respondents via email for validation. This presented the author with confidence in the findings of the research and helped to confirm that the findings and impression are congruent with the views of those with whom the research was conducted (Bryman and Bell, 2015, p.401). Nevertheless, some of the difficulties encountered included a slow response from the respondents, which is due to workload, and the busy nature of the oil industry.

4.11 Methods

Basically, this explained in detail the techniques and procedures used in the analysis of statistical and non-statistical data collected to pave way for systematic interpretation of findings with a clear purpose of research aims (Saunders et al., 2016, p.4). Crucially, ECA, TA and AHP are significant in this study which their application appears rare or outstanding in port management in crude oil flows in recent times.

4.11.1 Ethnographic Content Analysis

There is increasing use of ECA in analysis of qualitative data. Dinwoodie et al., (2014, p.64) used ECA to synthesize the perceptions of early careers specialist regarding trends in dry bulk shipping flows to 2050 using Delphi, this helped to developed insight for policy formulations. Olsson et al., (2015, p.575) used ECA to explore experiences of teenagers and young adults with cancer in Sweden. The findings are summarised into four categories: *personal professional interaction, knowledge and participation, age*

appropriate environment, and support. In summary, there was a demand for increased knowledge on the special needs for the study in clinical practice. Its application in the current study will help to unearth basic themes that need attention in the crude oil flows as both of them are empirical qualitative data. In addition, the technique is appropriate to the analysis of archival data. Gottschalk (2001, p.2017) derived content analysis of strategic information systems technology documents for description of responsibility for implementation. Findings revealed 50% of the plans, out of 55 descriptions of responsibility, 32 were concerned with users, 13 managers, and 10 with developers. More importantly, the author chose ECA because it allows systematic and objective identification of specified characteristics of messages (Naccarato and Neuendorf, 1998., Riffe and Freitag, 1997).

4.11.2 Description of Process for Analysis

First, a sampling technique was devised. Using theoretical sampling, the target population included the senior officials of the NNPC in the Crude oil shipping and terminals (CST) department. Furthermore, Saunders et al., (2016, p.277) note that *theoretical sampling* requires that all main stakeholder views are represented purposively to inform the evolving story line. The author considered the above processes in choosing the sample. First, one single sample frame in the CST was not accessible but the author met face to face with 70% of the targeted population in CST, NNPC office in Abuja, Nigeria. The author met seven members of NNPC out of 10, and all agreed to be interviewed and other two interviewees represented a crude oil trader from Vitol and an indigenous oil trading company, Eternal oil Nigeria.

Obviously, the sample is complete, accurate and up to date; and ensures a credible pool of interviewees (Saunders et al., 2016, p.277).

Furthermore, concerning generalisability of findings from this sample, NNPC is a regulator and commercial entity in Nigeria's crude oil export logistics systems distribution. In its special role, NNPC provides the staff of CST department who interact always with IOCs, IDOCs and terminal operators. They are guite aware of what is going on concerning port performance and crude oil export logistics systems distribution in Nigeria and as NNPC operates a JV operational contract with all oil majors. Most of these interviewees have been in the department for several years. Thus, the perceptions of these experts in the industry will contribute phenomenological to the research findings. These people were selected because they have experience in Nigeria's oil and port industry (Merton et al., 1956 p.3) and they are available to be interviewed about their involvement. The author performed face-to face contact with the targeted population to ensure that samples were representative. Rogelberg and Stanton (2007, p.196) compared late respondents' responses with those early respondents, known as "wave analysis". Responses showed a lot of similarity, particularly in the last question: which was "Please describe what agenda the industry needs for improvement? Most of the respondents agreed on the need for of a PIB in Nigeria.

Analytical categories were derived from the data. This is made possible when the author immerses himself in the data collected whilst noting key aspects that related to the purpose of the research. An analytical category fulfils general principles for systematic development (Saunders et al., 2016, p.611).

Scope and purpose of the research were defined by three research objectives and later analyses were carried out based on appropriate scoping interview questions. Manifest content of the scoping interview requires that "what is apparent in the data was used" (Saunders et al., 2016, p.609). This means objectivity was sought whereby factual objects in the data were used not necessarily based on subjective judgement (Saunders et al., 2012, p.676), and that social entities exist in a reality external to, and independent of social actors concerned with their existence. "If we can agree that a physical object exists, we can measure it and this is entirely a positivistic paradigm of inquiry" (Ibid 676). The author used words or phrases that were physically present in the data as the basis of a system of categories to analyse its content. For instance, "improved security" is a category, which is shown in the coding manual using tag J2, and the frequency of response is shown in the descriptive data analysis. This is done consistently in a transparent way, improving reliability. Latent content of the data was analysed to interpret its meaning in order to code units of the data such as sentences or paragraphs (Saunders et al., 2016, p.610). For example, change in "date of lifting programme" is one of the sentences derived from the data; this has interpreted the meaning of the event in the scoping interviews. Thus, both manifest and latent content were used. The unit of analysis depends on both the research question and research purpose, and considers both manifest and latent content. Manifest content reflected the use of words or phrases as the unit of analysis. In addition, latent content was reflected in the use of larger units of analysis and as mentioned earlier, it focused on characteristics of the content that are relevant to record, which

usually varies from individual images to visual sequence (Saunders et al., 2016, p.611).

4.11.3 Coding Ethnographic Data

The author immersed himself in the data collected while noting key aspects that relates to purpose of the research. The author read thoroughly the scoping interviews while keeping in mind key aspects that related to ROs concerning the use of this technique. For instance, questions 4 and 5 of the scoping interviews are related to objective 3, while question 6 is related to objective 5 and finally, question 3 is related to objective 2 of the research. All the analytical categories fulfilled the general principles for systematic development (Saunders et al., 2016, p.611).

4.11.4 Justification of the Process/Technique

Content analysis (CA) is used in analysing descriptive questions, which help in answering a RQs with a wider exploratory, explanatory or evaluative purpose (Saunders et al., 2016, p.610). A critical justification is that one of the ROs is "to evaluate the performance of ports crude oil export logistics systems distribution in Nigeria", which uses CA as a technique, since it has an evaluative purpose and this contributes to other objectives to measure port performance. In addition, to "analyse the characteristics of ports systems in crude oil export logistics systems distribution in Nigeria" is also an objective that is more exploratory in this regard. Thus, CA presents the author with the means to quantify variables in the scoping interviews in order to analyse the relationship between them statistically, based on how frequently they appear in the CA.

Secondly, CA allows the author to analyse qualitative data generated through conducting interviews, which is the case in this research, whereby a transcript was produced for each interviewee and later used CA as a technique (Saunders et al., 2016, p.610). Thirdly, it is applicable in a variety of context, it has been used in analyses of content of newspapers, and other media including radio and television and as well textual materials such as documents, policy statements, briefing papers etc. (Saunders et al., 2016, p.610). This presents the author with an opportunity to use it in further analysis, which is highly possible, given nature of the ROs. CA is relevant to the analysis of company reports involving oil companies, terminal operators and pipeline investors in Nigeria, which can be accessed through company reports, archives and policy statements.

4.11.5 Critique of Content Analysis

Reliability: it is quite difficult to attain 100% reliability, due to the following:

- There may be shortage of available materials, such as company reports, and even they are available, they might not be connected with the exact research topic or research needed at that point in time.
- Devising system categories, during coding, with a friend might make assessing inter-reliability of data samples across all the data difficult.
- Coding requires a lot of concentration to avoid analytical drift, which could affect intra-rater reliability, which concerns reliability of coding by a single researcher over time (Saunders et al., 2016, p.612).

4.12 Template Analysis Analytical Technique and Procedures

Template analysis (TA) is a form of thematic analysis that does not come with methodological commitment e.g. (Miles Huberman, 1994, Braun and Clarke, 2006). TA tends to encourage greater depth of coding than many other thematic approaches where data are rich and highly relevant to the research question (King and Brooks, 2017, p. 7). In addition, the author sees this coding template as a hierarchical list of codes and themes used as the central analytical tool in TA. Therefore, the author selected 9 initial interviews in order to develop a set of initial codes (Saunders et al., 2016, p.588). Further, the chosen transcripts represented a good cross section of data set. Moreover, it allows coding up to four times or levels to elaborate fine distinctions within the main themes. It allows recording of thought during analysis, reflexivity, and audit trail. The author used some "a priori" themes, however it is not compulsory (King and Brooks, 2014, p.333,). The author had key a "priori themes" from the scoping interviews and literature reviews such as Metering system, Documentary process, Maritime insecurity, Vessel clearance, Contract model, Training and retraining, Information flow network, and Regulation (Petroleum Industry Bill) and multiple government agencies.

"A Priori" themes	Meaning	Source
Metering systems	Used for measurement of exported	Qualitative data, Literature
	crude oil to know exact quantity	review
	loaded	
Documentary process	Documentation of relevant materials	Qualitative data
	for transaction evidence	
Maritime insecurity	Lack of security and safety of people	Literature, Qualitative data
	and cargo	
Vessel clearance	Different stages vessels passes	Qualitative data
	through before it is allowed to load	
	cargo	
Contract model	Business model what composes the	Literature, Qualitative data
	terms and condition of E&P, cargo	
	lifting	
Training and retraining	Training required in technical and	Qualitative data
	operation of oil industry for effective	
	and efficient operation	
Information flow networks	Information is key to a flawless	Literature
	supply chain management operation	
Regulation	Rules and directive guiding the	Qualitative data
	crude oil value chain	
Petroleum Industry Bill (PIB)	Nigeria local regulations for	Archival, Qualitative data
	management of oil and gas	
	exploration and production.	
Multiple government agencies	Government departments and	Qualitative
	agencies representing the	
	government in the value chain.	

Table 4.4: "A Priori" themes for Port performance and Crude Oil Export Logistics System Distribution in Nigeria

Source: (The Author, 2019)

The author used them in deriving an initial template for this study. If it transpires that, they are not relevant, they are dropped and the reasoning is justified (King and Brooks, 2017 p.80). However, none were dropped. The author adopted (King and Brooks, 2017)'s TA procedures. Originally, all the interviews are audio and transcribed, and the first stage is familiarization with the data through listening to interviews often and reading them a couple of times. This helps to realise important items in the textual data highlighting points of interest and looking at materials that support "a priori" themes *leading to preliminary coding.* The third and fourth procedure is clustering and producing an initial template. Therefore, based on preliminary analysis, emerging and "a priori" themes are clustered into meaningful groups and ordered hierarchically within broader themes; encompassing one or more levels of more narrowly focused themes. Furthermore, an initial version of the template being produced emerges from cluster of themes and this shows hierarchical organisation of themes within each cluster and sometimes includes links across clusters (King and Brooks, 2017, p.3). As such the initial template was applied to further datasets, such as transcripts, field notes and diary entries to mention but a few. The template amended where weaknesses occurred which helps, in knowing how well it is captured and what is relevant. In addition, significant items in the data were then applied and modified in an iterative fashion. In conclusion, once the template shows that no more changes are needed, it shows that all - important data are covered. A full data set was coded, as the final version of the template, and was used for interpretation of the data.

4.12.1 Justification for Using Template Analysis

The TA method was considered appropriate for this research because detailed review of academic databases revealed that, there has been no application of TA in port performance and management particularly in crude oil export. In addition, it is significant to this research because of its flexibility, which unlike thematic analysis, does not require all data sources to be coded before searching for themes (Brooks et al., 2015). Especially useful is the freedom allowed in the nature of coding structure, with options to use integrative themes and other lateral connections between hierarchical clusters, plus the exhortation to code as many levels as the author needs for the richest parts of the data set (King and Brooks, 2017, p.87). First, Park (2016, p.38) utilised TA to investigate the role of age in the online shopping behaviour of children, to understand consumer socialization processes.

The aim of the research was to develop an understanding of child perceptions of online shopping and to explore the extent of its adoption within the retail sector. This design is relevant in the current context, because of its emphasis on understanding and analysis of the perspectives of different stakeholders, which is required in this study. In addition, it helps in understanding of meaning of the study with application of qualitative methods mentioned earlier (King, 2004, p.16). Sample size for semi–structured interviews (63) compares with the current study (22) plus 4 focus groups. Although, Francis et al., (2010, p.1237) suggest a minimum sample size of 13 for theory based interview studies. Thus, both studies have reached saturation evidenced from sample sizes and have really presented rich, indepth, reliable accounts and result in revelation of knowledge through the

research instruments of semi-structured interviews (Thaichon and Quach, 2016, p.80).

Additionally, Alarcon et al., (2014, p.223) also used TA to get pig farmers' perceptions, attitudes, influences and management of information in the decision-making process for disease control. This design is relevant in the current context as they adopted a qualitative study involving 20 face-face interviews with English farmers. Similarly, the design is similar to the current study as both used face-to-face interviews to collate perceptions of stakeholders. The analytical approaches whereby codes or themes represented as first, second, third order codes to detect key themes emerging in the interviews (Crabtree and Miller, 1999) is classical to the current study. The author used Excel spreadsheets for analysis instead of Nvivo to derive the research coding template (King, 2012) which appears effective through the use of reflective diary and applying reflexivity that showed the author's influence on research process and outcome (Haynes, 2012). TA proved to be useful in capturing high variation of experience and perceptions among participants being interviewed, but also identified common and shared themes successfully.

King et al., (2013) used TA to examine how specialist and generalist nurses work with each other and with other professionals, carers, and patients in providing supportive and palliative care to cancer patients. It showed that TA is invaluable due to its flexibility to manage large textual data as their total sample size numbered 79 with most interviews lasting between 45 minutes and an hour and a quarter. In addition, four research teams developed the template while the current study interviews span 15 minutes to one hour 36

minutes 52 seconds (See full details in table 4.3). Other researchers that used TA include Sameera et al. (2014) who studied work–family attitudes and behaviour among newly immigrant Pakistan expatriates, Rafique, (2010) worked on exploration of the presence and content of metacognitive beliefs depressive rumination in Pakistani women. Also, Wyatt and Silvester, (2015) reflected on the labyrinth. They investigated black and minority ethnic leaders' career experience and they also explored boundary-free career drivers–exploring macro–contextual factors in location decisions. There is increasing use of TA research due to its flexibility with any philosophical approach, data collection, use of "a priori" themes and quality assurance (Kings and Brooks, 2017, p.76).

4.12.2 Case Summary

King and Brooks, (2017, p.31) considered that choice of TA should of course reflect the RQ making sense of the experiences and view of the sample as a whole, rather than a highly idiographic focus on individual accounts. Thus, all the respondents understood in detail the research aims and objectives.

Except for the few that do not understand the terms of logistics maybe due to their roles. However, most respondents understand that the study is about improvement strategies. Furthermore, there is a high rate of uniformity in the respondent's viewpoints except for one of the regulatory officials that has different views in all the qualitative data. In addition, some were reluctant to grant interviews at the very beginning, but accepted after seeing some of their colleagues granted one. Finally, all of them are open and willing to share their experiences with the author.

4.12.3 Research Technique

TA is a research technique that can be used with any kind of textual datathat is data in the form of written words: Interviews appear to be the most commonly used method of data collection in qualitative research as a whole (King and Horrock, 2010). Saunders et al., (2016) assert that an inductive approach involves collecting data, and then exploring the data to see which themes or issues to follow up. Moreover, if the transcripts are coded inductively in the absence of a predetermined or clearly defined theoretical framework, it is significant that theory will emerge from the process of data collection, analysis and interpretation (Saunders et al., 2016, p.570). Further, inductive approach thus enabled interview transcripts to be searched in depth without bias in order to recognise meanings in the data and to allow for an understanding of the social context (namely, port performance and crude oil export logistics systems distribution in Nigeria) and perceptions of research participants from which data were collected.

This present study involves a lengthy period of concurrent data collection from scoping interviews, series of structured and semi-structured and focus group interviews in order to research issues adequately or derive a wellgrounded theory (Saunders et al., 2016, p.571). Another point is that preliminary data collection presents an opportunity to identify relationships between data and questions through inferences that developed into hypothesis to test the data in this study (Saunders et al., 2016, p.57). In this context, the author used a deductive approach in analysing the data as well as preliminary findings where coding was carried out using informal

ethnographic CA as well as in deriving priori themes for TA (see Hayes, 1997; Kiffin-Petersen et al., 2012). It appears that TA does not have single fixed position in the induction-deduction balance, as this will vary according to the methodological approach the author used–implying that it is in between inductive and deductive approaches or mid-range of this continuum (King and Brooks, 2017, p.6).

4.12.4 Critique of Template Analysis

• King and Brooks, (2017, p.34) noted inherent dangers in producing an initial template very early in the analysis process, as this would sometimes make the author become over-sensitized to data that easily fits into a template, thus jettisoning material that cannot be as readily encompassed. However, the author kept an open mind throughout the analysis to allow emergence of new codes/themes as this presents an opportunity to modify the template as necessary: this is evident from the detail analysis explanation on how themes were derived.

4.12.5 Key Research Techniques

4.12.5.1 Scoping studies

Firstly, there appears a very limited number of studies about this present study. Thus, the author carried out a scoping study to extract body of evidence from actors engaged in the SCM of crude oil export that aimed to reveal developmental and intellectually creative viewpoints (Davis et al., 2009). The major aim is to rapidly map out the key concepts underpinning a research area and the main sources and type of evidence available (Arskey and O'Malley 2005). In addition, it gives a comprehensive and panoramic review that not only illuminates extent and context which entails influencing policy and practice development. The author's main concern is a RQ which is port performance optimisation strategies and as well as to draw evidence from this study. First, to generate an intellectual overview of what is known around the current study (Davis et al., 2009, p.1398). The author ensured that scoping study adhered to framework proposed by (Arskey and O'Malley 2005), particularly stage 6 "optional consultation with key stakeholders has potential to add value, additional reference and valuable insight through interaction with some industry experts in the state-owned oil company which helped to enhance this study, a known view confirmed by other researchers (Oliver 2001). Focus group appears a vital methodology that allows for a rapid scan of literature on a specific topic which helped the author to know key concepts and issues in the current study. In the end, this formed the basis for hypothesis generated for research questions. All the focus groups carried out had participants at minimum six in numbers which developed a

clear of consistency and diversity of responses (Hair et al., 2016, p.203). For further details, see table 4.3 for data base of respondents' profile.

4.10.5.2 Focus Group

Focus group method is also a form of group interview in which several participants including the moderator-place emphasis in questioning on port performance and crude oil export logistics system distribution in Nigeria, and the accent is upon interaction within the group and joint construction of meaning (Bryman and Bell, 2015, p.513). Focus group was explored through engagement of oil port terminal operators, NNPC officials in different roles, oil traders, shipbrokers, ship charterers, and logistics service providers with businesses in Nigeria's oil industry both in London and Nigeria. Despite initial scoping interviews and the SLR, the author found limited studies on the present study. However, the author took advantage of focus groups that tend to provide a broader range of responses and elicitation of details that might be otherwise overlooked, despite been aware of its limitation, particularly, side tracking of discussion to irrelevant issues and competition for dominance among participating members (Merton et al., 1994, 1956/1990). The major reason for adopting this technique is in its ability to present any tentatively identified issues to members for confirmation or clarification which in the end increase reliability and validity of this findings (Kidd and Parshall, 2000, p.299). One of the RO is to analyse the characteristics of port performance and crude oil export logistics system distribution in Nigeria. Overall, Hair et al., (2016, p.206) enumerated benefit of focus group to include identifying usage patterns, identifying salient attribute such as product or job characteristics and as well as identifying researchable

propositions, help in forming hypothesis. Furthermore, it allows similar range of concerns, through interviewee experiences regarding port performance and crude oil export logistics system distribution in Nigeria (Merton and Kendall, 1946, p.541).

4.13 Summary

In this chapter, this study was presented as a social research case of Nigeria underpinned by a pragmatic philosophy to generate knowledge methodologically concerning the logistics performance of crude oil flows. This philosophy helped the author to identify a reality which was locally constructed based on the experience of those engaged in supply chains although shared by many. The author justified the application of mixed methods because of complementarity of both qualitative and quantitative approaches to enhanced and rich findings. In addition, a sample frame comprised the main target population and theoretical and purposive sampling were both appropriate due to the sensitivity of crude oil flows data. The author explored ANT which appears sound novel methodology but due to limited data on information flow network and nature of study being exploratory was suspended. In addition, description of analytical techniques for data analysis span ECA, TH, TA explained to revealed themes and issues to derive practicable key improvement strategies, which appears rare in its application for this kind of study. Finally, key research techniques scoping and focus group revealed key preliminary findings which included inadequate investment in the value chains and predominant level of maritime insecurity.

CHAPTER FIVE: QUALITATIVE DATA ANALYSIS PHASES

5.1 Introduction

The study is an exploratory scoping study aimed to reveal the main themes and issues of concern in crude oil flows as a whole, particularly from the perspective of the NNPC as terminal operator. It's is an obvious point, work to date has generated foundation knowledge from which inferences were drawn that generated further qualitative data questions. To summarise, the major agenda identified related to the clarification of different contract models, particularly knowing Nigeria's equity shares, training and retraining, and urgent need for security both (onshore and offshore). It is important to list other themes such inadequate modern technology in the supply chains such as metering system, pipeline ageing and vandalization, manual documentation, multiple government agencies, government interference, and delayed in facilitation of legislation for PIB that frustrates a more businesslike approach in the oil industry. 5.1.1 Phase One: Ethnography Content Analysis of Scoping Study/Interviews Findings

This section showed rare application of ECA in explaining preliminary

findings of the present study. In essence, these findings appears linked to

key ROs such as 2, 3 and 5 respectively. Though preliminary findings

reshaped the author's research through iterative process to access data

collection that is valid, which can be replicated.

5.2 Scoping's study's findings

The author started with scoping studies for initial data collection in the form of exploratory study, aimed at gaining a much better understanding of what are the main issues in port performance and crude oil export logistics from the perspectives of professionals engaged in the supply chains of crude oil export? The significance of scoping is emphasised as a vital concept that helps in understanding of a problem (Saunders et al., 2012). The scoping interviews (Table 5.1) were held on 30th March 2016, with seven members of staff of NNPC in the Crude Oil Shipping and Terminal (CST) department, two crude oil traders and crude lifter and each interview lasted for at least 30 minutes. Not all the participants agreed to taping or recording of the interviews, however, they did agree to note taking which was shown to them to establish the validity of what they said. Finally, a summary of the interview was agreed with all the participants. To summarise, Table 5.1 and 5.2 represents both exploratory study prompt sheet and summary of scoping study participants' roles and organisation respectively.

1.	"Please describe your role in crude oil export logistics systems distribution in Nigeria and in
	your company".
2.	Please briefly describe your recent experience in these systems.
3.	Please describe the different components of the crude oil export logistics systems
	distribution in Nigeria.
4.	Please, what do you think about these issues in your company?
5.	What do you think of the situation nationally in the industry?
6.	Please describe what agenda the industry needs for improvement.
7.	Explicitly, how might you be able to assist my research? Could you give me access to data
	bases, contacts, company systems, and willingness to participate in further
	interviews/survey /focus groups?

Table 5.1: Exploratory study prompt sheet

Serial	Job title	Organisation
number		
1	Supply chains manager/documentation manager	NNPC
2	Joint venture liaison manager /crude oil lifting	NNPC
3	Tanker clearance and information officer	NNPC
4	Supply chain manager in crude oil sales and	NNPC
	valuation	
5	Managing Director in a crude oil trading/lifting firm	Eternal
6	Crude oil programming officer	NNPC
7	General shipping and terminals	NNPC
8	Crude oil trader	Vitol
9	Supply chain/marketing vessel clearance	NNPC
	manager	

Table 5.2: List of Exploratory study Participants' roles and Organisations

QUESTION	Number	RESPONDENTS	Coding schedule	Category	Coding manual- comment	Tag	Frequenc y
Q4. Please, what do you think in your company.	1	A	Crude oil export terminal	Insecurity (A)	Insecurity	A1	7
				Lack of modern technology	Lack of modern technology	A2	1
				Differences in crude oil quantity	There is usually reported differences in quantity of crude oil loaded in Nigeria and the discharging point, leading to differences in American petroleum institute (API) figure.	A3	3
Q.4 and 5.	2	В	Issues of concern	Pipeline vandalization	It is well, except issue of vandalism, which is usually lead to change in lifting programme.	B1	7
				Change in date of lifting programme	Lifting date tempered due to vandalization.	B2	5
				Drop in production volume	Moreover, eventually leads to drop in production capacity.	В3	4
				Dispute over entitlement	You do not have the right to lift oil, this leads to continued case and arbitration.	В4	2
Q4 and 5.	3	с	Measure of port performance	Security threat to operation(C)	In terms of reinforcing security on the high sea, seen as a threat to our operation, ensuring security personnel are able to checkmate the activities of vandals.	C1	1
			Logistics and laycan issue		Arrival of vessel, laycan logistics issue.	C2	1

Q4 and 5.	4	D	Port performance	Operational delay(D)	I think they are doing well except in terms of delay, there is area for improvement, need to be look at.	D1	4
Q4 and 5	5	E	Port performance	It is fine and ok (E)	Nigeria's is the biggest exporter of crude oil in Africa.	E1	
Q4and 5	6	F	Port performance /measurement	Performance is good (F).	Performance is good, lay time is still good enough; we usually get the quantity of crude either higher or lower.	F1	4
				Free on board basis(FOB)	Most of the cargoes are sold on FOB basis, meaning no insurance responsibility for cargo.	F2	2
Q4 and 5.	7	G	Pipeline vandalism	Pipeline vandalization(G)	Issues arises, chief among them is pipeline vandalism, drop in crude oil price and non-passage of petroleum industry bill whether old /new version.	G1	
Q4 and 5	8	н	Crude oil system	Crude oil system is not about port but terminal(H)	However, port performance depends on three things; terminal location, production capacity of field and capacity of the terminal; they are performing in best system.	H1	1
	9		Measure of port performance	Different size of vessels and terminal(I)	Terminal are not the same size, size of the vessels varies in as they go to a different terminals.	11	1
			Pipeline vandalism	Pipeline vandalism	Occasionally, we experience pipeline vandalism, particularly at terminal onshore, for example, Forcados terminal has been broken down.	12	7
			Insecurity	Maritime insecurity	While offshore is more of maritime Insecurity.	13	1
			Terminal operate on JVC	JVC	All terminals are owned in JV Nigeria government does not owned her own terminal, meaning Nigeria have no 100% ownership.	14	6

Table 5.3: Preliminary findings showed Schematic representation of ECA from Scoping Interview Result 1

Source: (The Author, 2016)

QUESTION	Number	RESPONDENTS	Coding schedule	Category	Coding manual- comment.	Tag	F
Q3	1	A	Crude oil export component	Offshore well(R)	Loading from offshore at times no tank is needed.	R1	2
				Onshore well.	Well to tank to onshore.	R2	1
				Analysis Machine metering equipment.	There is need for modern technology, analysis machine, metering equipment to be replaced with modern ones.	R3	3
Q3	2	В	Lifting Programme	Publishing of programme(S)	The different component of lifting programme are:		2
				Vessel clearance	Vessel clearance	S1	4
				Documentary instruction	Documentary instruction	S2	5
				Lifting programme	Lifting programme	S3	5
				Shipping document	Shipping document	S4	2
Q3	3	С	Port performance	Security threat to operation (T).	Security threat to operation.	T1	1
				Logistics issues	Logistics issues.	T2	1
				Laycan challenges.	Laycan challenges.	Т3	2
Q3	4	D	Documentation	Allocation of crude (U).	Allocation of crude.	U1	1
				Opening of letter of credit clearance.	Opening of letter of credit clearance	U2	2
				Loading operation	Loading operation.	U3	2
				Crude valuation.	Crude valuation.	U4	1
				Payment.	Payment.	U5	1
				Bill of lading date/figure	Bill of lading date/figure.	U6	2
				Official selling price (OSP).	Official selling price (OSP).		1
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						U7	
Q3	5	E	Nil	Nil	Nil		
Q3	6	F	Crude oil lifting	Contract signing(V)	Signing a contract is a liberty one should have in order to lift a cargo.	V1	2
				Curtailment meeting.	Curtailment meeting had once a month to review issues, terminal functionality or level of performance and next is meeting of traders and NNPC.		4
Q3	7	G	Lifting programme	Nomination of companies and vessels (W).		W1	6
				Vessel Clearance.		W2	
Q3	8	Н	NIL	NIL	NIL		
Q3	9	1	Production has two arms at terminal	Federal government or NNPC's arm.	For federal government arm, crude oil is exported on free on board basis(FOB), once terminal is cleared and crude oil is loaded, federal government hand is free from loaded crude	X1	1
				IOCs arm	They are free to transfer their product to anywhere around the world.	X2	1

Table 5.4: Preliminary findings showed Schematic representation of ECA from Scoping Interview Result 2

Source: (Author, 2016)

QUESTION	Number	RESPONDENTS	Coding schedule	Category	Coding manual- comment	Tag	Frequency
	1	A	Agenda for improvement	Review of contract(J)	Review of contract terms	J1	3
				Improved security	Improved security	J2	3
Q6				Modern technology	Analysis machine need to be introduce to mitigate the differences of crude oil during loading.	J3	2
	2	В	Agenda for improvement	Passing of PIB (K)	Original version of PIB oil and gas reform implementation committee (OGIC) should be passed	K1	6
				Deregulation of downstream sector	Some supported deregulation of downstream sector	K2	2
Q6	3	С	Agenda for Improvement	Regulatory challenges. None of passage of PIB (L)	PIB is long overdue; NNPC is the driver of putting the Bill, Nigerian parliament has all what it takes to pass it, passage of the bill would lead to key changes in oil and gas industry in Nigeria	L1	6
				Eliminating government interference	Eliminating government interference, bringing in autonomous system, physical regime and production sharing contract.	L2	2
Q6	4	D	Agenda for improvement	We are less serious (M)	We are less serious	M1	1

Q6	5	E	No response	No response	Nil		
Q6	6	F		Total deregulation (N)	He advocated use of public private partnership for oil and gas sector, whereby government will remove her hand completely.	N1	2
				Improved production capacity	Production capacity and OPEC quota should be increased/improved.	N2	1
				Improved local/indigenous participation	Government should encourage local coy to join upstream sector.	N3	1
				Tax holiday incentive/ removal of multiple taxation	Other are improved tax systems, issue of multiple taxation, tax holiday incentives to new entrants in the crude oil export.	N4	1
Q6	7	G	Agenda for improvement	Onshore pipeline protection	Government should do more about onshore pipeline by deploying a new technology for pipeline protection and surveillance.	O1	1
Q6	8	н	Agenda for Improvement	There is a need for improvement (P)	There is a need for improvement	P1	1
Q9	9	1	Agenda for Improvement	Clarification of contract model(Q)	Clarification of different contracts knowing what is Nigeria's equity shares	Q1	1
				Training and retraining	Training and retraining	Q2	1
				Security	Security(onshore/offshore)	Q3	1
				Facilitation of legislation on PIB	Facilitation of legislation on PIB	Q4	6

Table 5.5: Preliminary findings showed Schematic representation from Scoping Interview Result 3

Source: (Author, 2016)

5.3 Summary

The scoping interviews presented the author with prime foundation knowledge of the main themes in the study, thus helped the author to keep focus on research aims and objectives, although not in-depth. Both theoretical and purposive sampling were appropriate due to the sensitivity of crude oil flows data. In addition, various analytical techniques for data analysis including ECA revealed foundation themes that span operational issues: change in date of lifting programme or schedule, slowness in communication in the supply chains due to presence of multiple agencies, pipeline vandalism, manual documentation of shipping document, legal issues including dispute over entitlement, non-clarity in contract, business model review and much need for passage of PIB. Furthermore, security spans maritime insecurity, cargo theft etc. The next chapter will explain the result obtained using these analytical techniques in connection with research objectives and questions.

The next chapter will discuss in detail analyses of all the qualitative data including scoping, semi-structured and focus groups interviews using TA. Although the scoping study findings answered some of these objectives but in a preliminary stage. Further, it explains how themes for the key improvement strategies were generated in relation to ROs and which revealed preliminary findings that led to inferences for in-depth data collection.

5.4 Phase Two: Analysis of Qualitative Data Using Template Analysis5.4.1 Introduction

This section details the application of TA, expands its relevance to theoretical concepts/literature, flexibility compared to other forms of qualitative analysis technique such as use of "*a priori*" themes, lack of commitment to any philosophical method and use of hierarchical coding. Thus, it gives a detailed account of how both initial and final templates were derived using the sequences and procedures for analyses which are familiarisation with the data, preliminary coding, clustering and producing initial template (King and Brooks, 2017, p.3). Furthermore, some of the themes formed lateral relationships. *This technique helped in revealing key issues that showed preliminary findings linked to key ROs.*

In conclusion, these final templates are well grounded in expert's knowledge and systematically derived in relation to research objectives and questions.

5.5 Understanding Template Analysis

TA has been described as a process typically undertaken in a sequence of seven steps span familiarisation with the data, preliminary coding, clustering, producing an initial template, developing a template, applying the final template and writing up (King and Brooks, 2017, p.3). The author read scoping interview transcripts and questions with a keen interest on research objectives (Saunders et al., 2016, p.395). In addition, familiarisation with the data occurred through reading nine chosen semi-structured interviews transcripts and as well as listening to audio-recordings several times, which helps to correct errors in the transcripts (Brooks and Kings, 2017, p.3). See

table 5.1 for exploratory scoping interview prompt sheet and appendix 3, 4 and 7 for semi–structured and focus groups questions. Moreover, these resulted in preliminary coding of themes, which were later applied to the rest of the interviews. ECA was used to analyse scoping interviews as seen above, and this aimed to maintain focus of the study. To start with, the nine (9) "a priori" themes were derived from ECA results, theoretical concepts/literature review, observatory notes, and organisational documents. Although is not essential but it presents the author with an opportunity to accelerate the initial coding phase of analysis (King and Brooks, 2017, p.29). Further, for each of the RO, an initial template was produced which represents hierarchical organisation of themes within each cluster and sometimes includes links across clusters to be used as an analytical tool in TA (King and Brooks, 2017, p.3; Saunders et al., 2016, p.588).

	Role	Interview time	Interview type
1	Supply chain manager in crude oil	52 mins.	Semi-structured
	shipping		
2	Marine supervisor on an offshore	1-hour 37 mins.	Semi-structured
	terminal		
3	Senior regulatory official	44 mins.	
4	Senior officials of E&P company	1hour, 15 mins.	Focus group
5	Port agent manager	1hour, 18Mins.	Semi-structured
6	Crude oil trading manager	52Mins.	In-depth Semi-
			structured
7	Crude oil trading manager	49 Mins.	Semi-structured
8	Fleet operation manager & trader	1hour, 18mins.	Semi-structured
9	Supply chain managers, terminal	l hour.	Scoping interview
	operators, traders, state oil		
	company's officials		

Table 5.6: Profile of Initial Chosen face-to-face semi-structured Interviews

5.6 Producing Initial Coding Templates

First, there are five research objectives and each RO coding template was produced using an Excel spreadsheet (King, 2012) that allows the template to be recognised and revised. In addition, a hierarchical coding structure was used in order to allow various degrees of specificity in the analysis. The first or higher order theme represented broad, general themes while lower level or sub themes represented themes that are more specific. Firstly, the author started with first level themes written in capital letters and showed relationships between them hierarchically and laterally (King, 2012). For the first or higher order theme (1) EXPORT TERMINAL RELIABILITY; second level themes (1.1) are: onshore terminal are less reliable; third level themes include: 1.1.2 pipeline attack and illegal bunkering, 1.1.3 change to date of lifting programme, 1.1.4 environmental damage. Further, 1.2 offshore terminal more reliable, sub- themes under 1.2 are 1.2.1 FPSO and FSO and 1.2.2 Government incentives for offshore field. Second order them (2) is *Terminal capacity* with sub themes such as higher capacity onshore, lesser capacity offshore, principle of common basket, contract model, joint venture and production sharing contract and so on. Consequently, the author later changed the order of themes to reflect appropriate research questions and objectives to allow flow of meaning in the data. See table 5.7 for the first initial template in comparisons to table 5.8. In essence, the new initial template shows Export terminal as a new first level theme, whilst onshore and offshore are second level respectively. For instance, sub themes under onshore terminals include: less reliability, less safety, high capacity, dredged seabed, pipeline attack and illegal bunkering, change in lifting programme.

See figure 5.1 for some themes/codes that showed the relationship between concepts laterally.



Figure 5.1: Key Themes/Codes showing lateral relationships in Nigeria's Crude oil flows

Source: (Author, 2019)

Pipeline vandalism is a common feature of onshore terminals, such as Qua Iboe, Escravos, Brass and Forcados. The author decided to add *pipeline* attack/vandalism because of its frequent occurrence in the qualitative interview data as an *integrative theme* that permeates through thematic clusters, thought to be undercurrent running through participant accounts (Brooks and King 2014, 2017, p.35). Next, the second level theme 1.3 PORT AS STRATEGIC ASSET, embraced a majority of the participants spanning crude oil shipping officials, port agent, crude oil traders, marine supervisors and likewise academics believed that terminals are strategic assets for crude oil logistics system distribution. Further, the higher order theme TERMINAL CAPACITY with higher capacity onshore as a second level theme was moved to 1.1.3 in a new template because it is relevant as a sub-theme of onshore terminal (1.1) under main theme EXPORT TERMINAL (King, 2012; Saunders et al., 2016 p.588). In addition, lesser capacity offshore 2.2 was moved to level three 1.2.3 under second level theme offshore terminal. Others are FPSO and FSO. 2.3 Principle of common basket was moved to 1.4 in the new template, however, it was relocated under TERMINAL CAPACITY main theme because different producers produce into the same facility and each exports its products with priority given based on highest volume of stock.

CONTRACT MODEL is one of the "a priori" themes which retains its position under a second level theme 3.1 Joint venture and 3.2 PSC and a third level theme 3.1.1 Joint venture contribute to the cost of production. Others are: 3.2.1 Dispute over entitlement and 3.2.2 price of crude oil. Higher level theme INADEQUATE DEGREE OF INVESTMENT (4) was added because of a

need for investment to ensure efficient logistics as mentioned in the focus group by experts engaged in crude oil export supply chains (Saunders et al., 2016, p.588). Further, there are five second level themes under the theme above. For instance, 4.1 is frequent breakdown of subsea lines/old trunk lines, 4.2 reduce loading rate of vessels, and 4.3 under maintenance, 4.4 inadequate funding for JV and finally inadequate modern technology. This explains the level of underinvestment in port infrastructure for effective SCM in crude oil flows. See detailed information in the template below. PORT MODEL higher theme 5 has two-second level theme 5.1 and 5.2, which are Landlord model and Port charges and Oil terminal dues.

The second objective initial template was also considered in scoping interviews. To start with, top-level theme 1, VESSEL CLEARANCE with a medium level theme, documentary process, however, codes were altered after thoroughly listening to some of the interviews which showed that lifting programme came first before vessel clearance in the hierarchy, LIFTING PROGRAMME is traditionally published three months ahead and mid-month in the current month. Everything started from lifting programme, thus promoted to higher theme and vessel clearance demoted to a medium theme (King, 2012 and Saunders et al., 2016, p.588). Further, Dispute over entitlement sub-theme 1.1 has a lateral relationship with lifting programme, dispute over entitlement on quantities to be loaded by JV partners leads to delay in lifting programme; when this happens, everything is delayed. It has impact on crude price, charterer, vessel owner, terminal operator, demurrage and loss of reputation as a reliable supplier.

Vessel clearance (1.2) is an important sub-theme under lifting programme. This involved several processes among the supply chains actors where information-sharing and exchange is critical for effective and efficient logistics operational vessel clearance. These themes showed peculiar characteristics to port performance in crude oil flows in Nigeria. NNPC nominated firms to lift cargoes and companies send documentary instruction (DI) that contains important information such as vessel name, destination volume and so on, which is normally transmitted to government involving different agencies for validation before cargo lifting. Moreover, sub-theme (1.2.1) multiple government agencies, occurred during documentation prior to lifting and during lifting of cargo as well. Major agencies are Nigerian Customs and Navy, DPR, NNPC, NIMASA, and NPA. 1.2.2 Curtailment meeting followed by 1.2.3 entitlement meeting and 1.2.4 vessel contractual procedures/ agent clearance. Further, vessel clearance assumed a critical role in the value chains and involves documentary process, thereby creating two-second level themes 1.3 and 1.4, which are Documentary process and Exchange of vital shipping document. Documentary process is a "priori" theme from qualitative data. Empirical evidence showed delay associated with this process, as government agencies have to satisfy the validity of shipping documents manually which span DI certificate of quantity (CQ), certificate of origin (CO), certificate of sample (CS) through clearance by major government representatives such as NNPC, DPR, Customs, Nigerian Navy and NIMASA.

INFORMATION FLOW NETWORK is a first level and "a priori" theme (2) with a second-level theme slow information sharing (2.1), which has direct correlation with vessel clearance. Empirical evidence showed issues that

spans inadequate provision of good internet connection, fewer members of staff in the context of NNPC with huge impact on speedy clearance of vessel. Under this theme, there are two-third level themes 2.1. Inadequate information between anglers and terminal operators, 2.1.2 No direct communication between regulator and ship captain. INCOTERMS as first level theme (3) with a second level theme free on board (FOB) (3.1) which is a significant commercial term of contract and obligation.

TRANSPARENCY AND ACCOUNTABILITY is also a first level theme with two–second level themes 4.1 *presence of government officials during crude oil loading operation* and 4.2 *crude oil theft*. It shows relevance of transparency and accountability in the value chain, however, research evidence revealed too many officials presence appears not adding value. More importantly, under the Nigerian government law... without officials of government present, loading cannot occur. Furthermore, lack of proper strategy to ensure transparent and accountable quantity of cargo loaded appears to aid crude oil theft.

MARITIME INSECURITY is a first level theme with second level themes: 5.1 piracy/kidnapping, 5.2-war risk zone, 5.3 and 5.4 high cost of chartering and demurrage. 5.5 increase in insurance premium and freight, 5.6 force majeure and 5.7 production loss. Finally, five other first level themes emerged which are WEATHER CONDITION (6), INDUSTRIAL ACTION (7), INADEQUATE TECHNICAL EXPERTISE/TRAINING (8), and CORPORATE SOCIAL RESPONSIBILITY (9), and second level theme: community agitation and lastly, first level theme MONOPOLY IN CRUDE OIL LOGISTICS.

The third research objective generated an initial template derived from revision of the scoping qualitative study. Firstly, a first level theme was derived which is MEASUREMENT OF EXPORT and has two- second level themes 1.1 *old metering technology* and 1.2 *ship shore difference*. The latter has one-third level theme 1.2.1 factors affecting ship shore figure, which has four level themes: temperature difference, calibration out of date, Greek ship effect and weather. First level theme 1.3 METHODS OF MEASUREMENT with two third level themes 1.3.1 static measurement and 1.3.2 dynamic measurement. Further, two-second level themes 1.4 Annual calibration and 1.5 repeatability. In conclusion, to achieve research objective five, to recommend sustainable strategy to optimise in crude oil export logistics system, the author developed 14 improvement strategies gleaned from qualitative data and agreed by ninety percent of experts engaged in the crude oil supply chains in Nigeria, which formed an optimisation template. There are 15 first level themes for RO5:

- 1. Presence of government officials during crude oil loading operations.
- 2. A reliable accurate metering system showing metred quantities for use as Bill of lading data (BOL)
- 3. Simplifying cargo scheduling and marketing
- 4. Modern technology for capturing shipping document
- 5. Increase in security boats, platform and capacity
- Information sharing and synergy between terminal operators and Nigerian security forces in oil and gas security
- 7. Introduction of anti-piracy laws in port performance
- 8. A need for Nigerian owned crude oil tankers
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- Effective communication between security officers and registered anglers
- 10. Annual metre proofing maintenance
- 11. Unbundling of the monopoly of using one company for crude oil export logistics
- 12. An oil derivation fund to be managed by an investment corporation for Niger delta development
- Time chartering of vessel to deliver Nigerian crude oil rather on FOB basis
- 14.A need for government owned export terminals
- 15. Regulation/Legislation
- 16. Petroleum Industry Bill
- 17. SOLAS, ISM, ISPS CODE proper implementation

5.7 Applying Initial Empirical Template in the development of Final Template

An initial coding template represented key ideas and relationships in the data (Saunders et al., 2016, p.588). Consequently, this was applied to the "remaining 13 gualitative datasets" to identify segments of text that are relevant to the RQ and ROs. They were marked with relevant code so that they are clearly denoted as relating to one or more of the thematic categories making up the template (King and Brooks, 2017, p.36). To start with, objective one, First level theme EXPORT TERMINAL RELIABILITY AND SAFETY was altered to EXPORT TERMINAL/PORTS while second level theme "Onshore terminal less reliable and safe" was changed to "onshore terminals" sub-level theme and seven third level themes. These themes are less reliability, less safety, high capacity, dredge sea bed, pipeline attack and illegal bunkering, change in lifting programme and environmental damage all third level themes. Further, offshore terminals which was a second level theme 1.2, with 4-third level themes, that relate to research objectives. All these were merged and EXPORT TERMINALS/PORTS was retained as a first level theme with two second level themes: onshore terminals and offshore terminals. A new sub-theme Government incentive for offshore field development was added to offshore terminal while floating production and offloading vessel (FPSO) retained its position as a sub-theme under offshore terminals. Now, both Terminal capacity and Terminal reliability were promoted to first level themes with two second level themes, which are offshore terminal more reliable and onshore terminals less reliable. Terminal safety also has two second level themes Onshore has less safety and offshore has high safety. In addition, Terminal capacity also has two second

level themes: offshore has less capacity and onshore have high capacity. There is no change to Port as strategic asset, however; principle of common basket is moved under this theme. Its position shows an important node for seamless logistics and a transhipment centre in general.

The Contract model originally has two second-level themes: Joint venture and production sharing contract with a sub theme cost of production. Similarly, production-sharing contract maintained its position as a second level theme with two third level themes: *dispute over entitlement and price of* crude. For INADEQUATE DEGREE OF INVESTMENT, which is a first level theme, four new second level themes were added as seen from the final template. Port model higher order theme has two second-level themes retained as in the initial template. There is consensus that port model from experts' spans port agent, regulator, trader and marine supervisor. In conclusion, a focus group with six senior Nigerian naval security officers with experience in crude oil export terminals generated views in the security sector. A new higher theme SECURITY PLATFORMS AND CAPABILITY has three second level themes which are: 6.1 *inadequate security training for* Nigerian navy officer on oil and gas security, 6.2 inadequate information sharing/synergy between navy and oil companies and 6.3 inadequate *modern technology for pipeline security*. These sub-themes show the depth of key issues that need urgent attention in the SCM in Nigeria's crude oil flow, which are security, information sharing and synergy, infrastructure and training (King and Brooks, 2017, p.35).

Furthermore, the third research objective's final template emerged from the modification of the initial template through revisiting the remaining qualitative

data (Miller and Crabtree, 1999, p.167) and hence a new third level theme human error/factor emerged under the second level theme: Factors affecting ship shore figure added. A new first level theme NON STANDIZED MEASURING TECHNOLOGY had a second level theme *different standard units of measurement.* Finally, objective five considered optimisation strategies for port performance and crude oil, export logistics system distribution in Nigeria. Additional templates of strategies included: contractual agreement and commercial negotiation, maintenance model, Cost insurance and freight (CIF) model for reliable terminals, integrated logistics system engineering and SCM model in port performance and crude oil export logistics system in Nigeria.

Objective one	Objective two	Objective three	
1.EXPORT TERMINAL	1. LIFTING	MEASUREMENT OF	Objective five
RELIABILITY	PROGRAMME	EXPORT	1.PRESENCE OF
1.1 Onshore terminals	1.1 Vessel clearance	1.1 Old metering	GOVERNMENT OFFICIALS
are less reliable	1.1.1 Curtailment	technology	DURING CRUDE OIL
1.1.2 Pipeline attack and	meeting	1.2 Ship shore	LOADING
illegal bunkering	1.1.2 Entitlement	difference	2.A RELIABLE ACCURATE
1.1.3 Change to date of	meeting	1.2.1 Factors affecting	METERING SYSTEM
lifting programme	1.2 Documentary	ship shore figure	SHOWING METRED
1.1.4. Environmental	process	1.2.1 Temperature	QUANTITIES FOR USE AS
damage	1.2.1 Exchange of vital	difference	BILL OF LADING DATA
1.2 Offshore terminal	shipping document	1.2.2 Calibration out of	3.SIMPLIFYING CARGO
more reliable	2. SLOW IN	date	SCHEDULING FOR
1.2.1 FPSO and FSO	INFORMATION	1.2.3 Greek ship effect	CAPTURING SHIPPING
1.2.2 Government	SHARING	1.2.4 Weather	DOCUMENT
incentive for offshore	2.1.1 No direct	1.3 Methods of	4. MODERN TECHNOLOGY
field	communication between	measurement	5. INCREASE IN SECURITY,
1.3 Strategic asset	regulator and captain	1.3.1 static measurement	BOATS, PLATFORM AND
	3. INCOTERMS		CAPACITY

2. TERMINAL	3.1 Free on board	1.3.2 Dynamic	6. INFORMATION SHARING
CAPACITY	4 TRANSPARENCY	measurement.	AND SYNERGY BETWEEN
2.1 Higher capacity	AND ACCOUNTABILITY	1.4 Annual calibration	TERMINAL OPERATORS
offshore	4.1 Presence of	1.5 Meter repeatability	AND NIGERIAN SECURITY
2.2 Lesser capacity	government officials		FORCES IN OIL AND GAS
offshore	5 MARITIME		SECURITY
2.3 Principle of common	INSECURITY		7. INTRODUCTION OF ANTI-
basket	5.1 War risk zone		PIRACY LAWS IN PORT
3. CONTRACT MODEL	5.2 High cost of		PERFORMANCE
3.1 Joint venture	chartering		8. A NEED FOR NIGERIAN
3.2 Production sharing	5.3 Demurrage cost		OWNED CRUDE OIL
contract	5.4 Increase in insurance		TANKERS
3.1.1 Contribute to cost	premium		9.EFFECTIVE
of production	5.5 Force majeure		COMMUNICATION
3.2.1 Dispute over	6. WEATHER		BETWEEN SECURITY
entitlement	7. INDUSTRIAL ACTION		OFFICERS AND
3.2.2 Price of crude oil			REGISTERED ANGLERS
4.3 Under maintenance			10. ANNUAL METRE
4.4 Inadequate funding			PROOFING MAINTENANCE
for JV			11. UNBUNDLING OF THE
			MONOPOLY OF USING

4.5 Inadequate modern		12. AN OIL DERIVATION
technology		FUND TO BE MANAGED BY
4.6 Inadequate		AN INVESTMENT
investment in digital		CORPORATION FOR NIGER
system for maritime		DELTA DEVELOPMENT
security		13. TIME CHARTERING OF
5. PORT MODEL		VESSEL TO DELIVER
5.1 Landlord model		NIGERIAN CRUDE OIL
5.2 Port charges and oil		RATHER ON FOB BASIS
terminal dues.		14. A NEED FOR
		GOVERNMENT EXPORT
		TERMINALS
		15.
		REGULATION/LEGISLATION
		PIB
		SOLAS, ISM, ISPS CODE
		IMPLEMENTATION.

Table 5.7 Initial Empirical Templates for Port Performance and Crude Oil Export Logistics System Distribution in Nigeria

Objective One	Objective Two	Objective Three	Objective Five
1.EXPORT	1. LIFTING PROGRAMME	1. MEASUREMENT OF	
TERMINALS/PORTS	1.1 Vessel clearance	EXPORT	1.PRESENCE OF
1.1 Onshore terminal	1.1.1 Multiple government	1.1 Old metering	GOVERNMENT OFFICIALS
1.1.1 Dredged seabed	agencies	system/ technology	DURING CRUDE OIL
1.1.2 Pipeline attack	1.1.2 Curtailment meeting	1.2 Difference in ship	LOADING
and illegal bunkering	1.1.3 Entitlement meeting	shore difference	2.A RELIABLE ACCURATE
1.1.2 Change in lifting	1.1.4 Vessel contractual	1.2.1 Outurn	METERING SYSTEM
programme	procedures/agent	1.2.1 Factors affecting	SHOWING METRED
1.2 Offshore terminals	clearance	ship shore figure	QUANTITIES FOR USE AS
1.2.1. Floating	1.2 Documentary process	1.2.2 Factors affecting	BILL OF LADING DATA
production and	1.2.1 Exchange of vital	ship shore figure	3.SIMPLIFYING CARGO
offloading vessel	shipping document	1. temperature	SCHEDULING FOR
1.2.2 Government	1.3 Dispute over	difference	CAPTURING SHIPPING
incentives for offshore	entitlement	2. calibration out of date	DOCUMENT
fields.	2. INFORMATION FLOW	3. Greek ship effect	4. MODERN TECHNOLOGY
2. TERMINAL	NETWORK	4. Weather	5. INCREASE IN
CAPACITY	2.1 Slow information	5. Human error/factor	SECURITY, BOATS,
2.1 Offshore terminal	sharing	1.3 Methods of	PLATFORM AND
have less capacity		measurement	CAPACITY

2.2. Onshore terminals	2.1.1 No direct	1.3.1 static	6. INFORMATION SHARING
have high capacity.	communication between	measurement	AND SYNERGY BETWEEN
3. TERMINAL	regulator and ship captain	1.3.2 Dynamic	TERMINAL OPERATORS
RELIABILITY	3. INCOTERMS AND	measurement.	AND NIGERIAN SECURITY
3.1 Offshore terminals	CONTRACTUAL	1.4 Annual calibration	FORCES IN OIL AND GAS
more reliable	OBLIGATION	1.5 Meter	SECURITY
3.2 Onshore terminals	3.1 Free on board	2. NON STANDADIZED	7. INTRODUCTION OF
less reliable.	4. TRANSPARENCY AND	MEASURING	ANTI- PIRACY LAWS IN
4. TERMINAL SAFETY	ACCOUNTABILITY	TECHNOLOGY	PORT PERFORMANCE
Onshore has less	4.1 Presence of	2.1 Different standard	8. A NEED FOR NIGERIAN
safety	government officials	units of measurement	OWNED CRUDE OIL
4.2 Offshore has high	during loading		TANKERS
safety	4.2 Crude oil theft		9.EFFECTIVE
5. STRATEGIC ASSET	5. MARITIME		COMMUNICATION
5.1 Principle of	INSECURITY		BETWEEN SECURITY
common basket	5.1 Piracy/kidnapping		OFFICERS AND
6. CONTRACT MODEL	5.2 War risk zone		REGISTERED ANGLERS
6.1 Joint venture	5.3 High cost of chartering		10. ANNUAL METRE
contract	5.4 Demurrage cost		PROOFING MAINTENANCE
6.1.1 Cost of	5.5 Increase in insurance		11. UNBUNDLING OF THE
production	premium and freight		MONOPOLY OF USING

6.2 Production sharing	5.6 Force majeure	12. AN OIL DERIVATION
contract	5.7 Production loss	FUND TO BE MANAGED
6.2.1 Dispute over	6. WEATHER	BY AN INVESTMENT
entitlement	7. INDUSTRIAL ACTION	CORPORATION FOR
6.2.2 Price of crude oil	8. INADEQUATE	NIGER DELTA
7. INADEQUATE	TECHNICAL	DEVELOPMENT
DEGREE OF	EXPERTISE/TRAINING	13. TIME CHARTERING OF
INVESTMENT	9. CORPORATE SOCIAL	VESSEL TO DELIVER
7.1Frequent	RESPONSIBILITY	NIGERIAN CRUDE
breakdown of subsea	9.1 Community agitation	RATHER ON FOB BASIS
lines/old trunk lines	10. MONOPOLY OF	14. A NEED FOR
7.2 Reduce loading	CRUDE OIL LOGISTICS	GOVERNMENT EXPORT
rate of vessel		TERMINALS
7.3 Under maintenance		15.
7.4 Inadequate funding		16.REGULATION/LEGISLAT
for JV		ION
7.5 Inadequate modern		PETROLEUM INDUSTRY
technology		BILL
7.6. Inadequate basic		SOLAS, ISM, ISPS CODE
infrastructure to export		
terminals		

7.7. Inadequate		17.INCOTERMS AND
dredging on high sea		CONTRACTUAL
7.8 Inadequate		AGREEMENT
investment in digital		18.MAINTENANCE MODEL
system for maritime		19.CIF MODEL FOR
security		RELIABLE TERMINALS
7.9 Inadequate supply,		20.INTEGRATED
crew vessels, tankers		LOGISTICS/SYSTEM
etc.		ENGINEERING
8. PORT MODEL		21. SUPPLY CHAIN
8.1. Landlord model		MANAGEMENT MODEL
8.2. Port charges and		
oil terminal dues		
9. INADEQUATE		
SECURITY		
PLATFORM AND		
CAPABILITY		
9.1 Inadequate security		
training for naval		
security officers on oil		
and gas security		

9.2 Ineffective		
information		
sharing/synergy		
between Navy and		
terminal operators		
9.3 Inadequate modern		
technology for pipeline		
security/automation		

Table 5.8 Final Empirical Templates for Port Performance and Crude Oil Export Logistics System Distribution in Nigeria

5.8 Final Interpretation of Empirical Templates Analysis for Research Questions

King and Brooks' (2017), Saunders et al., (2016, p.589) views on producing a template and its application to code data does not represent the end of study when using TA in a piece of gualitative research; as this allows author different stages of analysis such as exploring relationship. Now, the main crux of the matter is to develop a final interpretation of coded data based on aims, objectives and philosophical position of the study (King and Brooks, 2017, p.37). The author deems it necessary to examine patterns of themes, since listing of thematic headings is likely to result in a dreary but not especially insightful piece. Moreover, frequency and pattern of theme distribution do not on their own reveal anything meaningful but give highlights of areas that needs closer examination (King and Brooks, 2017, p.37). In this case, the author recognised that some of the themes/clusters are likely to give more insight into the study than others. Thus, the author would prioritise some themes for examination in greater depth as they are considered essential (King and Brooks, 2017, p.37). In considering themes to concentrate, the author used King and Brooks' (2017, p.38) vital suggestions:

- The relevance of theme, and/or links between themes, to the research question
- Themes that contradict common assumptions and/or conclusions in the existing literature; including those that spring surprises by lack of prominence

Themes that distinguish between groups of participants in meaningful ways.

In addition, finding relevant themes and developing connections, patterns of themes and relative importance is key as this allows research questions to be answered. However, this study has identified lateral themes with connections with the data as seen above. In addition, hierarchical relationships exist within thematic clusters. Consequently, a model for improvement strategies in port performance and crude oil export logistics system will be developed given the absence of any existing theory (King and Brooks, 2017, p.38).

5.9 Quality Criteria in the Data Analysis

Johnson et al., (2016) argued about selection of criteria that are coherent with philosophical approach. In addition, Mason (1996) asserts that reliability, validity and generalizability are different kinds of measures of quality, rigour and wider potential of research. This study's data collection spans nine scoping, 23 semi-structured in-depth interviews and four focus groups interviews respectively. This has revealed rich information corroborated by archival data to represent the current epistemological assumptions of respondents. Both qualitative and quantitative research use criteria such as reliability and validity. In essence, validity refers to whether you are observing, identifying or "measuring" what you say you are (Mason, 1996: p.24). However, the author used (Bryman and Bell 2015)'s assertion that refers to measurement validity, internal validity, external validity and ecological validity. Thus, in qualitative research, validity is most commonly use in a way that corresponds to the notion of ecological validity, the extent

to which the research context is congruent with the real world context of the phenomenon under investigation (Braun and Clarke, 2017).

The debates around quality criteria continue in business and management research, and quality research more widely. Further, King and Brooks, (2017, p.40) agreed with (Symon and Chassell, 2012:p.221) who assert that researchers should identify criteria relevant to the chosen approach and justify them explicitly; this involves research aim and consideration of the most important element in the study. The author used quality check procedures in TA, see (King and Brooks 2017, p.41). For instance, the author used independent coding during analysis; the Director of Studies looked at the initial template and having been familiar with interview transcripts initially, checked whether themes emerging seem plausible and the clarity of the template to reflect research objectives and questions. Moreover, how well is the template organised to encompass data to help to make changes where needed? Furthermore, the author kept an audit trail of events throughout the analysis process which was also an important quality check criterion, seen in the analysis processes above, where two initial template 1 & 2 were *developed*. Moreover, in some cases, this revealed reasons why some themes are modified to reflect research aims (King and Brooks, 2017, p.41). Others are thick description and use of participant quotes, introduced into ethnographic research. Research findings are itemised into the main themes clearly and thoroughly to provide sufficient details about the context of the study to enable readers to judge how any conclusions that have been drawn may apply more widely (King and Brooks, 2017, p.41).

5.10 Summary

This chapter considered the application of TA as a rarely used technique to analyse themes in the logistics performance of crude oil flows. More importantly, theoretical and methodological considerations during the analysis resulted in an initial and final template of findings for objective 1, 2, 3 and 5 of the study. The main finding is that the security model must reflect international best practices. Second, investment in infrastructure is required across the supply chains particularly pipelines, information systems, and modern technology for capturing shipping documents. The next chapter will consider the interpretation of TA findings concerning RQ1 to revealed indepth key factors/drivers that affect port performance and crude oil logistics systems in Nigeria.

CHAPTER 6: FINAL INTERPRETATION OF EMPIRICAL TEMPLATES ANALYSIS FINDINGS

6.1 Introduction

This section gives a detailed account of the implications of TA findings in the whole study. First, the author brings in cases that relate to the templates and, more importantly, the final interpretation through triangulation that gives validity to the TA findings together with different data sources (observations, archival, survey). This in the form of investigator triangulation which helps in interpretation of collected data so as to expand and/or correct or check the subjective views of interpreters (Flick et al., 2004, p.179). The author showed other selected empirical key improvement strategies in this chapter with the rest in the appendix 24. More importantly, these are subjective opinions of experts engaged in the whole supply chain who revealed their own best practices. Findings include a lack of maritime security that was found to be the highest theme, which appears militating against effective and efficient logistics flow of crude oil in Nigeria. Finally, the author recommended significant changes/review in strategies including a critical need for introduction and legislation of PMSC operation and anti-piracy laws.

6.2 Researcher's Final Interpretation of Empirical Templates Analysis Findings

This shows a coherent account of the interpretation of the data. In this case, the author used a combination of two approaches in presenting the main research findings. First, data was presented as a series of individual case studies, followed by discussion of similarities and differences between cases. In addition, structuring of the account was taken around the main themes identified using verbatim quotes and insight which is a thematic presentation of findings with a small number of cases to illustrate key themes. The author is aware of the challenges of using a "combination approach" as cases chosen in a way that represented themes in the overall data set (King and Brooks, 2017, p.42). The author will discuss the main findings of the research; organised into main and sub-themes, also including selected verbatim accounts in each theme to demonstrate answers to the RQ. In addition, the case study research strategy presented the author with rich data spanning observation, theoretical perspectives, multiple source of data and methodologies (Bryman and Bell, 2015, p.401), which are invaluable in the use of unobtrusive methods in relation to the strategy of triangulation. The triangulation involves a combination of methods which provides the author with the most valid and reliable way to develop understanding of such a complex social reality of performance in crude oil export logistics system distribution. The richness of qualitative data with qualities such as local groundedness, holism, access to causation and emphasis on meaning will

provide the opportunity to produce a final conceptual framework of the research findings (Miles and Huberman, 2014, p.324).

6.2.1 Contract/Business Model

Business models are an integral part of E&P companies and NOC engaged in crude oil export supply chain and logistics systems distribution. Traditionally, COECs enter into two basic arrangements with IOCs on exploration and exploitation of crude oil, namely, concession in form of contract. In both arrangements, the risk for the exploration in case of failure is borne by the IOCs, which finance, manage projects and hope to get returns for their investment in either direct monetary payment or crude oil and gas swap during a specified period. To summarise, there are three types of contracts: PSC, risk service contract and pure service contract. In contrast, key interviews data revealed key issues around percentage of oil lifting, revenue sharing formula, and cash call payment and funding related issues with both JVC and PSC. Furthermore, this implied a unanimous agreement with non-uniformity in contract terms and conditions between NNPC and IOCs. The latter gives a greater share in terms of cash call for E&P cost. To this end, the strength of production output is in the hands of the IOCs. This can be seen from Nigeria's ex- oil minister verbatim quote.

[&]quot;Emmanuel Kachikwu, former minister of state for petroleum resources and Mr Buhari's deputy on the oil portfolio, says shrinking the government is funding obligations in E&P were vital to "reduce the strain on government". Until the country's regulations become clearer, IOCs may be reluctant to sign contracts in Nigeria. "These resources are big, but the PIB is hanging over IOCs. If the government's share of revenues is going to increase substantially, it may reduce their attractiveness," says Dolapo Oni, head of energy research at Ecobank. "Companies could be exposing themselves to even more risk in Nigeria." say people familiar with the thinking of state oil company (NNPC)" - (Financial Times, 27 November 2016).



Figure 6.1: Key Improvement Strategy Model in Port performance and Crude Oil Export Logistics System Distribution in Nigeria

Source: (Based on Interviews/Focus group, 2019)

All the cases in this theme exemplifies clarity in contract models as the paramount strategy for effective funding to mitigate E&P cost; particularly on the part of state-controlled oil company, NNPC and key independent smaller JV terminal operators/low-cost producers. The author proposed model above appears to be a conceptual sustainable optimisation strategy for crude oil flows in Nigeria. In addition, it has profound impact on investment in the crude oil export supply chain, which include investment in pipelines, digital systems, supply vessels/boats, labour training to name a few. It is important to note that JVC and PSC appears to be most commonly used business model.

First, Stevens (2016, p.2) assert that IOCs' business model is faltering and recently began to show poor financial performance. This is evident in the NNPC's case and low-cost producers, particularly the IDOCs. This appears to be deeply rooted in growing shareholder disillusion with a business model premised on assumptions of ever-growing oil demand, oil scarcity and the

need to increase bookable reserves, all of which increasingly lack validity. In my own opinion, acquisition, merger, diversification/divestment is critical, which appears to be evident in Nigeria, as seen from the ownership of oil blocks/fields by different companies to produce a certain grade of crude oil stream. For instance, the most recent Egina offshore field (OML 130) commissioned in the third quarter of 2018 has Petrobras (16%), South Atlantic Petroleum (SAPETRO) 5%, NNPC, 10%, Total (24%), China National Offshore Oil Cooperation (CNOOC) (45%) according to Business Monitor International Limited (BMI Research, 2018, p.3). In terms of low oil price, it is important for the NNPC and low-cost producers to find a sustainable financing model to squeeze cost to avoid the influence of low profit margins and revenue for the shareholders of Nigeria in general. The author proposed model above appears to be a sustainable optimisation strategy for crude oil flows in Nigeria in this regard for identified operators. However, it appears that major IOCs have strong financial strength with many years of operations in Nigeria and overseas. They appears to be operating to optimum standards as they form the bulk of capital expenditure (CAPEX) in the value chain. In addition, the model has a profound impact on investment in the crude oil export value chain, which includes investment in pipelines, digital systems, supply vessels, labour, training and retraining etc. Consequently, clarity in contract model for ownership of block and/or crude oil lifting is critical to draw investment in E&P. Although this could lead to increased marginal levels of production output, which is currently hovering around 1.8 to 2.1Mbpd, reduced production cost and curb disagreement associated with entitlement meetings, which has a huge impact on

curtailment meeting, cargo loading operations and vessel clearance at export terminals/ports. In the end, ensure effective and efficient SCM in crude oil flows, which impact port performance that would enable competitive advantage for Nigerian crude oil in the international market to be realised.

6.2.2 Inadequate Funding for Joint Venture Operations

Evidence from archival documents revealed a former oil executive operating in Nigeria said "Global oil companies are concerned that the NNPC will continue to fail to fund its share of JVs..... a problem that has stymied Nigeria's ambition to double its production to 4Mbpd. Further, key oil executives argued that the target would be achievable if NNPC is freed from direct government control, and run as a commercial enterprise. In addition, \$15B of investment is needed to maintain current production levels and compensate for a natural decline in production of about 250,000 bpd each year as some oilfields mature. Funding issues appear more important to Nigeria's future oil production than other issues such as militancy, sabotage and theft "said Aurelian Mali, a senior Africa Adviser at the rating agency Moody's. (Thisday Newspaper, Nigeria, 26th April 2016). From the empirical cases, it is evident that there was consensus on inadequate funding. However, there appears to be improvement in recent times towards finding sustainable financing mechanisms to improve production growth of JV fields. For corroboration, see verbatim quote from a supply chain manager in NNPC.

Despite increasing progress in financing models, it appears that clarity in terms and conditions is key for a sustainable model to emerged that would stand the test of time, which would help in curbing disputes associated with arrears to the IOCs by the NNPC.

[&]quot;They are part of JV, because of cash call issue. Therefore, we have to devise an alternative way of funding where they contribute minimum of 16%, you see the JV now is virtually 50+ and so, surely if there is issue with JV, there would be cut in production. However, while we could not notice it drastically, because of those mechanisms of alternative way to meet up with budget demand of the JV" (Focus group with senior supply chain official in NNPC, 18 February 2017)
6.2.3 Pipeline Attack and Illegal Bunkering

Constant attacks by the militant group called "Niger delta avengers" include a twin bombing on key Escravos-Warri pipeline and Chevron's abate flow stations (Lloyd's list, 2016). Although delay to load Nigerian cargoes were seen in 2016 when crude export grade Forcados resumed for the first time in eight months, apparently loading delays up to two weeks (Lloyds list, 2016). All the empirical cases confirmed to huge impact of pipeline vandalism on export infrastructure. Key amongst them is delay in loading of cargoes, suspension of loading, sometimes lead to distressed cargo. For instance, this increases the cost of chartering and as well as demurrage. In the end, this sends negative signals to the whole supply chain actors and devalue Nigerian crude in the global oil market. Though this is reflected in the words of Nigeria's former oil minister of state, Dr. Emmanuel Kachikwu, who opined that about \$80 billion loss annually to oil facilities vandalism in the oil-rich Niger Delta faced by the Nigeria government" (The Nation, Feb 10, 2017). Furthermore, this evidence corroborated by former Group Managing Director of the NNPC, Maikanti Baru, who says Nigeria lost 2.1 Trillion Nigerian Naira to militancy, which means over 7000kpd of crude oil has been lost due to vandalism and bulk of the loss is from JV assets. At estimated price of \$45 per barrel, the total 2016 revenue loss to the federation account translates to about \$7B. Thus, it is evident that port security is critical in this regard. The author questioned the role of port security in the value chain and what are the port security strategies to improve seamless logistics flows of crude oil in the

supply chain? Overall, its implications are enormous, as this shows that the business models of both JVC and PSC are linked with pipeline vandalism as stated earlier. Thus, a new business model needs to accommodate investment in pipeline security towards implementation of IMO conventions such as ISPS code: including legal framework associated with practice, procedures and recess. More importantly, the qualitative data revealed non-streamlined operation of IOCs and government security agencies and less training opportunities for vessel security officer courses from both government and major E&P companies including IOCs.

Typically, qualitative interview showed huge impact of pipeline vandalism that appears transcending into terrorist activities. In addition, empirical cases evidence revealed a historic record of pipeline vandalism, which requires a sustainable strategy by all the supply chain actors. The author believe that sustainable strategies should entail regional cooperation among the Niger delta sub-national government and more importantly, the need to embrace proposed model stated above by all and sundry. Still "the effect of pipeline vandalization on production output was profound when production dropped by about 180,000 bpd due to shutdown of the Trans Forcados Pipeline (TFP) on 27th December, 2015 as a result of leaks around Tibigbene-Batan axis. In addition, Trans Export Pipeline (TEP) was shut down and resulted in production dropped by about 80,000bbls as at 11th January while production was restored on TFP and TEP and lifting volumes restored after loading of 20th January 2016" (NNPC, 2016). The financial implication is huge, for instance from the above total loss of crude summed to 260,000 barrels. Further, as of January 2016, the price of crude oil was 54.07 US Dollar.

Thus, 54.07 *260,000 = 14,058,200 US Dollar: this is a huge loss in the supply chains, which confirmed high cost of crude oil flow in Nigeria. Obviously, this reduced competitive advantage of Nigerian crude despite its quality for low refining and geographical logistics closeness to Europe and Mediterranean shipping route.

A key message here is that E&P companies need to reinvigorate their corporate social responsibility to include Partnership, Ownership, Win-win, Empowerment, Respect and Sustainable Development (POWER) in order to improve host community relations. However, PIB regulatory framework is yet to be signed by the executive into law, which appears contained host community strategies for sustainable peace for host community in the oil-rich Niger delta. With the proposed sustainable strategy, attacks on oil installations would be greatly reduced to the barest minimum. However, more investment is much needed in pipelines from all producing companies, as research evidence show that more pipelines are needed to transport crude oil for export purposes.

Furthermore, Ekwo (2011, p.3) worked on conceptual exploration of the challenges in the management of petroleum pipeline Right of way (ROW). ROW for petroleum pipeline in Nigeria refers to the 50-metre distance spanning the pipeline within which other land uses are not permitted (Brume, 2007., National Assembly, 1990d). Ekwo, (2011, p. 22)'s framework emphasised adoption of local knowledge and experiences of the host

communities concerning the environment will be of great importance in

[&]quot;The need for investment is stressed by a call for more private investment to build and double numbers of Nigeria's pipelines over the next ten years through Public private partnership (PPP) has envisaged by then head of state oil company, NNPC recently" Dr. Maikanti Baru (Reuter's news, 2018).

curbing pipeline vandalism, which appears to be similar to one of the partnership variables of the POWER framework. Apparently, the local community inhabitants in the Niger delta particularly the anglers maintained close links with the export terminals. However, qualitative data gathered revealed that it appears that there were no appropriate register yet. Thus, significant legislation would encouraged registration of anglers to aid knowledge sharing to curb widespread pipeline vandalism. To summarise, it appears that using both frameworks would be of immense significance in improving the logistics of oil flow in Nigeria for a secure, sustainable, increased production output and affordable, towards a seamless SCM for port performance. Pipeline vandalism has always been associated with land ownership or resource ownership by the people of Nigeria's oil-rich south of Niger delta. "According to BBC News on 29 September, 2016 says,

"A rebel group of Nigeria's oil rich south says it has bombed an oil pipelines to show the military and oil firms that we own our lands". It is clear that both proposed models above are critical and timely, since it allows the host community to be subsumed in logistical operation of crude oil flows such as providing basic social amenities and employment opportunity to host community, and as well reduce tension associated with pipeline vandalism. Finally, the yet to be passed PIB regulatory framework will address the role of the host community. Overall, monitoring of its implementation appears significant for seamless logistics for crude oil flows in Nigeria.

6.2.4 Lifting Programme

This is a very important component of loading operations, which is being affected by operational failure as revealed in all the empirical cases. It mainly involves information flow, inadequate planning and bureaucracy associated with vessel clearance. Thus, leads to disruption in SCM of crude oil flows. Due its significance, because everything operational task appears start with it, such as determining crude quantity, loading schedule, destination and entitlement. Overall, this will be analysed in detail in the next theme: change to date of lifting programme.

6.2.5 Change to Date of Lifting Programme



Figure 6.2: Common Themes with Lateral Relationship Showing Effect of Demurrage

Source: (The Author, 2019)

The model above shows the inter-relationships between lifting programme, onshore terminal, pipeline attack, delay and demurrage i.e. payment of additional freight cost. Any of these variables reflects an increase in cost for logistics. Chartering is important in shipping because foreign tankers play a vital role in the shipping of most Nigerian cargoes, and hence the reason for the high cost of Nigerian cargoes. For instance, due to the 30-year low output of Nigerian crude in 2016/2017 arising from renewed militancy which resulted in dragging Suezmax earnings down 27% on the Baltic Exchange on continued weakening of the West Africa Market (Lloyd list, 2017, p.1). Notable causes of changes to lifting schedule are due to non-prompt maintenance of key pipelines, trunk lines, infrastructure failure, and as well as repairs etc. Moreover, archival evidence revealed that crude carriers

demand exorbitant fees to lift Nigerian crude when the government demanded letters of comfort from vessels lifting crude oil from Nigeria in an attempt to curb crude oil theft when 113 oil tankers were banned from entering Nigerian waters in 2015. Ship owners were reluctant to bring vessels to Nigeria because of demands for letters of comfort by the Nigerian government (This Day, 29 September 2015).

To summarise, it is clear that the high cost of shipping is evident from both archival and empirical data, and there is increasing demand for a need to create a sustainable framework that ensures low-cost for logistics to provide maximum customer service satisfaction at the lowest cost possible for competitive advantage. For instance, NNPC's General Terms and Conditions (GT&C) for sales and purchase of Nigerian crude oil stated in article six: Loading conditions and demurrage, which appears clear in principle. However, in sub article 6.5.2 on exclusion from laytime and demurrage, which is explicit on why NNPC will pay a buyer's demurrage claim unless it is submitted to the seller in writing within 45 days of the Bill of lading (BOL) date. The condition states that the buyer can still provide any supporting documentation that is not at that time available to the buyer to be submitted to the seller within 90 days of the BOL date. This framework appears unable to consider delay associated with leaks, possible maintenance that appears prevalent in Nigeria because the shipping market is as dynamic with unpredictable freight rate and as well as volatility of oil prices. The NNPC GT&C had provision for "Force majeure" in which both parties shall not be held liable for failure or delay in the performance of its obligation under the contract. Thus, this was corroborated by crude oil trader, which says,

"NNPC does not pay you demurrage for VLCC, and government department does not really access it. Demurrage is a big exposure for anybody trading with Nigeria because if you have demurrage, it is very unlikely you will recover it from NNPC and that is just taking as standard" (Crude trader 1, 16 February 2017).

It is important to stress the absence of standard and sustainable strategy for demurrage, is huge challenge, which is an important variable for efficient and effective SCM in crude oil flows. For this reason, this variable is a big issue that needs revisiting to make Nigerian crude attractive, hence adding value to it in the international market. Not only that... but also reviewing the GT&C to accommodate this provision would facilitate the attractiveness of Nigerian crude in the global oil market in the end.

6.2.6 Vessel Clearance

This is a crucial theme described as Vessel clearance (VC). VC is associated with lots of exchange of shipping documents. Having associated with vital shipping and organisational document; transmitted manually and takes time to happened due to bureaucracy from different government agencies involved. However, Nigeria is not exceptional in this scenario but some COECs fair better than others. Sometimes, communication gap exists in reality, hence the author believes that technology appears to be an optimum strategies in facilitating performance. However, it comes with legal and regulatory framework for the Business model. Furthermore, in other empirical cases, key issues span information infrastructure, absence of national fleets, with more foreign dominated fleets for crude oil transport. Consequently, with complexities in the shipping market, many factors could work against early arrival of vessels for loading operations in Nigeria..... such as <u>unavailability of vessels</u>, high insurance premium, high chartering cost to name a few.

lay can as a driver in VC which affects Nigeria's export due to absence of national fleets for crude oil export logistics unlike the LNG that have special fleet. Although this was corroborated by shipping news that Nigeria attempt to build a national tanker fleet of up to 30 ships to support crude oil trade (Lloyd's list, 17 April 2018). In essence, absence of indigenous national fleet impact the cost of logistics owing to high taxes associated with VC, apart from additional cost that usually arises due to insecurity in the oil-rich Niger delta region.

The author believes that sustainable strategies appears in application of Block chain technology (BT), which is an electronic information system that provides underpinning of cryptocurrencies by recording deals and related information in digital blocks. This is usually encrypted information, stored in linear, chronological order that can be shared and corroborated by those with permission or access; it means that only stakeholders in crude oil value chain have permission to access it. However, there is a growing concern to digitalise global commodity trading industry across the globe; key issues include contracts, letter of credit, invoices and other paper work which are normally sent by email, fax or post. For this reason, platforms like BT allows a faster, cheaper and secured way of transaction and eliminate too many human interfaces/bureaucracy that is associated with VC in Nigeria from the perspective of state-owned oil firm and regulator (Adugbo, 2015). BT establishes, verifies and chronicles events since VC occurs between NNPC and other supply chain actors such as terminal operators, traders, ship owners, shipbrokers, government agencies etc. Thus, application of BT offers information to be distributed in a ledger that can record transaction between

two parties efficiently. For instance, there is a growing automation of transactions; one typical example is KAT and Komgo platforms to hasten information exchange. KAT and Komgo are digital ecosystems for physical post trade processing that are used in leveraging BTs. It eliminates reconciliation and paper based processes such as the current scenario in Nigeria, although, there is increasing effort to digitalise operations in NNPC within the shortest possible timeframe, however, it appears that the electronic system project faced hitches due to mismanagement of resources according the GMD NNPC (Udo, 2018).

The oil industry supply chain actors span energy majors such as British Petroleum (BP), Equinox, Shell, as well as Independent traders such as Equinox, Guvnor, Mercuria and banks such as AND-AMRO, Societe Generale, ING are on the verge of implementing the use of BT platform before the end of 2018 (Reuters, November 6 2017). Another firm that has embraced BT is AP Moller- Maersk, explored it in marine insurance contracts. Further, it has been used in oil and cargo dealing involving Mercuria and is be used in the agricultural sector, where it was applied in soybean transactions by Louis Dreyfus with a Chinese buyer and bank ING, SocGen and ABN Amro (The Financial Times, September 19, 2018). Moreover, Oil blockchain platform is used by most of North Sea traders to digitalise process of commodity trading (Financial Times, February 25, 2019). Consequently, adoption of BT will reduce or even eliminate exchange of physical documents to facilitate VC before, during and after loading operations, because all the actors have access to the electronic platform. However, BT adoption requires gaining institutional agreement on standards

and processes that will require a major change in the business model of the NNPC and other oil majors in Nigeria, which requires social legal and political change (Iansiti and Lakhani, 2017, p.9). More importantly, adoption of electronic (paperless) trading by International group of Protection and Indemnity (P&I) club, the group of WAVE as stated in circular by Gard insurer, which appears largest whereby it advocated use of electronic transaction (Gard, 2019). In essence, WAVE is described as distributed ledger network which uses BT to enable carriers, consignees endorses banks, freight forwarder and other parties to issue and sign a variety of supply chain encrypted documents with no need for central server or registry. In conclusion, from all these empirical and secondary cases. It is extremely important to consider the model below as an improvement strategy. Furthermore, BT appears will do a lot of impact especially in facilitating VC in terms of technology but what is more, it will streamline taxes which could delay VC since different actors are involved. Finally, review of curtailment meetings to involve terminal operators' medium members of staff, as most of the VC pass through them during crude oil loading operation, as qualitative data revealed that non-involvement sometimes causes delay.



Fig 6.3: Key Vessel Clearance Improvement Strategy Model

Source: (The Author, 2019)

6.2.7 Multiple Government Agencies

Multiple government agencies appear to be a common phenomenon in Nigeria in both container and oil related maritime transport according to LCCI's (2016) report *"reforming the maritime ports in Nigeria"*. In this report, key findings revealed that were 14 government agencies in container terminals logistics and operation instead of six as ideal target. Thus, meaning that were additional eight agencies representing government of Nigeria, with has huge implications for inefficiency in the smooth flow of cargoes and information. Although oil cargo appears less complex, nevertheless, duplication of roles need revisiting as empirical data revealed. Although government presence appears to be a global practice with National Oil Companies (NOCs) checkmating effectiveness of regulations from contract, E&P, marine operations, shipping etc. However, in Nigeria, there appears to

be a duplication of roles before and during crude oil loading operations and other related operations. A key oil regulatory official commented on irrelevance of NNPC involvement in VC, as this creates bureaucracy and unnecessary bottlenecks in the supply chain.

Finally, the author believes that reduction in the number of agencies is in line with global best practices and this appears to be a major concern for those who trade oil with Nigeria from global perspective. However, empirical evidence revealed that introduction of technology to facilitate accurate and reliable metering system reading i.e. Manual of Petroleum Measurement System (MPMS) in recent times. The technology will enhance monitoring critical operations in the crude oil export value chain, which will go a long way in crude cargo export facilitation across the supply chains, hence improving seamless logistics flow of oil to the international market.

6.2.8 Documentary Process

Evidence from the literature, final template findings (Table 5.7 and 5.8) and interview questions, a summary on how research objectives emerged, see details in appendix 2, 3, 7 and 8. The author deduced from empirical cases that delay is common, because of exchange of these documents that appears vital in shipping market. Furthermore, common issues appears span bureaucracy, possibility of paper loss, mistakes, which are sensitive and vulnerability to piracy. For details, see empirical case below, which stressed the need for e-documentation as being long overdue.

[&]quot;The issue of documentation and stuff like that if there can be a way of trapping"; a modern way, there is no way we can completely leave this paper stuff. Sometimes, you can hear some paper missing; if there is a way that a particular lifting can be trapped. May be; there is a system we can enter some information anywhere it goes, whether this paper got missing, we should not get worry of as nothing is going to happen, it will go a long way as things are changing" (Terminal operator representative and supply chain manager NNPC, 23rd August 2017).

However, electronic shipping documentation is fraught with challenges in less developed countries since oil shipment triggers frequent transfer of shipping documents. Mei and Dinwoodie (2005, p.200) assert that ecommerce/documentation assists information to travel quickly and efficiently reducing paper work, saving money and fostering strategic partnerships (Barnes and Hunt, 2001). However, a key challenge is trust and security in electronic transactions as they are inescapable (Goh and Ang, 2000). Further, there is ongoing debate on electronic BOLs in international supply chains, because of the interface with financial institutions such as banks. Besides, it must satisfy criteria demanded by successful internet banking system, also, investing in information technology (Galbreath, 2002, p.116). However, there is increasing development in the application of electronic platforms particularly in container shipment. For instance, a typical example of a web-based platform enables shipper and forwarders to do business electronically with a global standard, is INTTRA. INTTRA is a standard webbased portal that streamlines and modernised operation for all documents involved in shipment for efficient SCM. World's leading shipping companies such a CMA, Maersk line, Hamburg sud, Hapag Lloyds, Mediterranean shipping co, P&O Nedlloyd have embraced it since its creation in the year 2000. In the word of CEO of INTTRA, Bloom, he said,

"What has made INTTRA a success is the way it streamlines the process for shippers and carriers of all sizes, ease document creation and format everything into one simple to follow standardised format".
Thus, its application in shipping documentation in the present study will be

significant in improving the logistics of oil flows in Nigeria. As earlier stated,

determining compliance criteria is critical to avoid fraud in ensuring cybersecurity, although appropriate legislation is required for the total

implementation of internet driven documentation among the supply chain actors in crude oil flows. However, big energy majors appear to be fully integrated in using automation systems in all their operation because of the sensitivity of shipping documents such DI, BOL and CQ. In the end, this requires legal change in the core business model/strategy of mostly NNPC and low-cost E&P companies in Nigeria (Iansiti and Lakhani, 2017, p.9)



Figure 6.4: Nigeria's Current Crude Oil Flow Documentary Processes

Source: (Author, 2019)

6.2.9 Information Flow Network/Slow Information Sharing

All empirical cases revealed direct relationship with ineffective communication system. However, the importance of effective and efficient communication is key in SCM. Hull, (2002, p.8) asserts that an effective supply chain requires a smoothly operating information system which includes accurate information flow among the links in a timely, coordinated fashion that minimizes distortion. Furthermore, the DFD for push/pull supply

chain developed for ANS could be applied to a variety of logistics activities such as warehouse and carrier operations. Other notable research evidence includes LaLonde (1985) on information friction associated with last minute orders. Moreover, Chandra and Kumar (2000) assert various ways of reinforcing distortions; whereby supply inventory can lead to price reduction. Majority of these studies appears do not address the current study scenario. Nevertheless, Mason-Jones and Townhill (1997mason) enumerated key factors that reduced information friction to include bar coding, the Internet, EDI and point sale system, which really address the current study slow information concept. This includes application of the concept of "enriched supply chain". Further, they advocate that point of sales data are communicated directly to all members of supply chains. In this study, this involves VC, multiple government agencies, information exchange, terminal security communication between mariners and naval security, vessel rescue operation, terminal operators and information exchange between regulators and supply chain stakeholders to name a few.

Furthermore, Hull's (2002, p.10) logistics framework covers operation of the whole shipping activity from point of production to receiving end, and show an effective information flow that incorporates scheduling and dispatching of shipping activity. The framework shows that inventory and transportation availability are determined simultaneously, and shipping schedule defined, however, this framework appears relevant in the production field in export terminals. More importantly, most of the information friction spans inadequate information infrastructure capability (IIC). The author believes this is associated with a lack of streamlining of government agencies within SCM,

hence showing lack of effective SCM concepts in the whole crude oil flows in Nigeria. Nevertheless, respondent consensus empirically, all are concerned with information infrastructure for effective communication, mostly from the side of NNPC, regulators, and low-cost producers. Furthermore, other cases show similar concepts of IIC. Thus, investing in information communication is significant particularly in electronic communication as revealed in interview data (internet bottleneck appears in slow pace and a fewer work force in the NNPC, as well as DPR.

More importantly, research evidence corroborated logistical issues relating to the spate of electronic communication (Udo, 2018) and the effect of internet on the academic performance of tertiary institutions students in Niger state, Nigeria. Findings revealed issues such as slow internet connections and inadequate power supply. In contrast, Nigeria's population penetration of 170.2M people and its internet penetration ratio was put at 26.5% (Okwaraji et al., 2015, p.115). Despite being among the 20 top countries that use internet in the world, challenges are apparent in formal knowledge network; in the context of crude oil flow for actors engaged in supply chains that need to share knowledge and information to deliver solutions for particular decision problems (Alkhuraiji et al., 2014). The SECI model (Nonaka & Takeuchi, 1995) identified four types of knowledge network: knowledge networks of interaction, knowledge network of interpretation and translation, knowledge networks of influence and institutional knowledge networks (Gourlay, 2003). These are modes of exchange of ideas between tacit and explicit knowledge and it appears that knowledge networks interaction is a key element in this scenario, engaging research evidence from NNPC, low-cost producers and

more importantly information sharing with major IOCs. Most of the issues are around inadequate knowledge sharing and transfer, which is partly because of ineffective information infrastructure. The big question is that: Is there any structured knowledge that can improve the effectiveness of knowledge sharing and transfer in crude oil flows? Hence delivering a more efficient solution for a knowledge exchange process) is critical.

Firstly, Alkhuraiji et al., (2016, p.1537) knowledge network model with organisations and knowledge channels addresses key challenges such as poor IT infrastructure in government sector, interaction among private and public institution. This model could be applied in the present study as an improvement strategy. In addition, Ling et al., (2015) worked on IIC and organisational competitiveness advantage (CA) appears appropriate as an improvement strategy for information infrastructure; because it integrates IIC while Nonaka & Takeuchi's (1995) framework concentrated solely on the dynamic capability of organisational knowledge creation. Thus, this encourages effective knowledge management; and swiftly expands new business process, technique and decision in order to establish long-term CA for NNPC and low- cost producers (Ling et al., 2015, p.1033). Finally, Ling et al., (2015) proposed a framework to overcome knowledge economy management (KM) activity, information technology (IT) and application of IIC independently.



Figure 6.5: Information Flow Network/Information Sharing Improvement Model

Source: (Ling et al.'s, (2015, p.1047) Proposed framework for information sharing)

The above model could be applied in the present study. Ling et al., (2015, p.1047) proposed the model for eight case studies involving international, large and local companies in different disciplines, such as software development, consulting, deployment of wireless mobility over Wi-Fi and WiMAX. The current study links to case study 3: a core business organisation that is a provider of IT management and technology services, such as system integration, application development, Managed services and IT Resources management across a broad range of professions and industries including oil and gas, banking, education, insurance and retail. These industries are major stakeholders in crude oil flows supply chains (see Figure 3.4 for diagrammatic representation of stakeholders map). Thus, key activities span sharing of files through server, hardcopy documentation, online file repository, online discussion board, and source control. The current study major activities appears similar to case study 3 of (Ling et al., 2015, p.1047)'s work, particularly file sharing, hard copy documentation, interactions with many stakeholders in different industries as in case 3. The practical application of Lings et al., (2015)'s model will help the current study to have proper planning on IT management and technology resources. Further, it helps to provide adequate training, education to new and existing

employees to enhance their customer services and support to attain a CA among key COECs across the globe.

6.2.10 Crude Oil theft

Over the years, there have been countless reports, articles and seminars on oil theft, particularly involving hijacking of vessels, robbery of tankers at anchor, oil swaps, opaque trading, smuggling (small or large scale). However, the present study includes oil flows from export terminals to the high seas. Nevertheless, in recent years a key publication focussed on hydrocarbons as illicit trade including case studies such as Ghana, Nigeria, Uganda, Mozambique, Thailand, Morocco, Caucasus, Azerbaijan, Turkey and the EU. However, it appears that there is no comprehensive study until date on oil theft particularly with respect to refining oil (Atlantic Council, 2017, p.2). Oil theft in the form of hijacking for ransom of cargo is found across the globe spanning the region of Somalia, Northwest Indian Ocean, South and Southeast Asia and recently Yemeni piracy (Ralby and Sould, 2018, p.6; Adamopoulos, 2018a). All the same from empirical cases, this is a global challenge particularly in the 21st century; where technological advancement is central to operations of criminal gangs that are unconstrained by law, bureaucracy or normative restrictions that limit legitimate actors. Archival evidence revealed that oil-rich Niger Delta militancy has a symbiotic relationship that evolved between local politicians, militants and power gangs known as cults which has lowered production output in this regard. For example, in July 2016, there is a growing sophistication in tactics by militants used diving gear to sabotage a key pipeline at a major crude oil terminal that is 100 meters under water that appears intimidating (Page, 2016, p.4).

The impact of oil theft and sabotage are enormous from the perspective of risk and resilience in Nigeria's oil industry (Yeels and Akporiaye, 2016,

p.187). Key findings revealed that pipeline interdiction is politically and economically motivated. Nevertheless, sabotage and theft are not a systematic supply risk to the crude oil export value chain. They argued for a relationship between production, vandalisation, sabotage, theft and price. Findings show that changes in the price of Nigerian Bonny light crude follow increases in pipeline interdiction. However, the effect is weak and not consistently price depressing. Specific export terminals such as Bonny, Forcados and Qua-Iboe that experienced theft via pipeline interdiction appear to be associated with price reduction in premium terms. Nigeria losses up to 400,000 bpd, which includes both stolen and production outages according to a senior government official Ngozi Okonjo-Iweala (Financial Times, 2013, p.2). In addition, the UK think tank, Chatham House in its published report said that 100,000 bpd is the best estimate. However, this excludes oil that may go missing at export points. Having explained earlier the various forms of theft, there is another one called "white collar" that is being practiced, which involves a situation whereby crude oil that is illegally obtained is pumped on to tankers already loading at export terminals, or siphoning crude from storage tanks on to trucks, taken out for export to foreign countries. The financial cost of oil theft is estimated to be between \$3b and \$8b a year according to Chatham House 2013 report, this revealed that Nigeria's oil industry appears associated with shady deals, which included secrecy in its oil trading activities and intentional unavailability of information relating to crude oil sales quantity, amount produce by each oil majors, crude oil loss through pipelines sabotage and leakages respectively. Furthermore, Ralby and Sould, (2018, p.3) explained modalities used in oil theft that corroborated

empirical interview in which Nigerian naval officer narrated that no one knows exact quantity of crude being loaded in a ship despite presence of security personnel. In addition, chiefly fraud and corruption include fraudulent allocation of offshore rights, subsidies and collusion by officials is hallmark of systematic theft (Akpomera, 2015, p.156).

Furthermore, piracy and armed robbery at sea include hijacking for theft of cargo, supply vessel and robbery of tankers at sea. Over the last few decades, oil-laden tankers in Nigeria are easy to attack at anchor with ineffective laws for private armed guards. Finally, Ralby and Sould (2018, p.3)'s recommendations include effective metering through the supply chain, and tracking of vessels, prioritising hydrocarbon crime among maritime law enforcement agencies. Furthermore, a striking recommendation that appears paramount to Nigeria's case study appears lies in coordination among law enforcement agencies to understand and exploit the links between hydrocarbons crime and other criminal enterprises in the maritime space. In essence, Figure 6.6 below, show numerous securities actors are involved in Nigeria. Thus, development of synergy among these agencies is critical for improved security for effective and efficient crude oil flows logistics system.

6.2.11 Maritime insecurity/Lack of maritime security

Lack of maritime security appears the main logistical challenge in Nigeria's crude oil export logistics system distribution, according to empirical focus group data, thus leading to supply chains disruption in the last couple of years. Thus, increasing the cost of E&P, maritime transport etc. Further, other concerns are kidnapping, ransom, sabotage. These are common and usually cause delay in logistics operation and increase cost due to involvement of extra security measures undertaken by supply chain members. Archival data revealed Nigeria as a growing hotspot for violent piracy and armed robbery as it accounts for 20% of all captures, according to the International Maritime Bureau (IMB) in 2019. For instance, off Nigeria's waterways, 13 persons were taken hostage on board while 29 were kidnapped for ransom, despite the rise in incidents in Nigeria, piracy across the globe recorded 141 incidents in the first nine months of 2016 which have fallen to their lowest level in 20 years, IMB said (Lloyds list, 2016, p.2). However, a growing threat from global maritime piracy is not limited to Nigeria; from the ship owners' perspective. Increasing growth in kidnapping with crew adoption across the globe jumped 44% in 2016, largely because of increases in the Gulf of Guinea according to global risk consultancy, Control risk (Adamopoulos, 2018b). Nigeria was among the top five locations where incidents take place at ports and anchorage Apapa-Lagos (Nigeria), Pointe Noire (Congo), Callo (Peru), Samarinda and Dumai (Indonesia), and Kandla (India) (Lloyd list, March, 2017). Corroborating the spate of kidnapping is EOS Risk Group half-yearly report that revealed the kidnapped of 35 seafarers in the first half of 2018, equivalent to the same witnessed during

the 2017 period, this involved a combination of hijack for ransom, hijack for oil theft, and kidnap for ransom and armed robbery (Walia, 2018). This frequency of attack is largely consistent, and this shows that measures aimed at tackling this appear to need revisiting. From a cost perspective, it is estimated that overall cost of piracy in West Africa appears \$80.6m, compared to East Africa (Somali water) which was \$1.4bn according to Lloyd list, 2018. The impact of piracy is enormous to whole logistics chains in crude oil export; it affects the ship-owner and charters in terms of high cost of chartering, demurrage and discourages the main customers that are crude traders/refinery operators, as noted in figure above, thus reducing revenues for E&P, producing countries etc. Further, as Mr Gregory noted the rates for piracy are hardening in some areas especially for voyages around Nigeria and the Gulf of Guinea. Moreover, the rates are going in an upwards direction (Lloyd list, 2016, p.3). Qualitative data findings span lack of investment in information security systems, a need for law for independent Private Maritime Security Companies (PMSC), near absence of synergy between government security and IOCs security apparatus, inadequate expansive training in terminal security for naval security officers.

Nevertheless, this raises concerns about effectiveness of implementation of IMO instruments such as International Convention on Safety of Life at Sea, 1974 (SOLAS), International Ship and Port Facility Security (ISPS) Code which helps in the facilitation of safety and security of shipping operations. On the other hand, gualitative data revealed absence of anti-piracy law,

In addition, "You know oil and gas security, when we talk about offshore, those in oil industry, the understanding of issues such as health and safety, professional oil and gas security. They study that in detail but when you talk to security services, there is no specific kind of training (specialised) in oil and gas security for military officers". (Focus group 3, 25 August 2017).

however, there appears to be presence of a few PMSC but it appears there is huge challenge in terms of full integration in the logistics chains. Although, PMSC is a new industry that is still undergoing accreditation globally with International Organisations such as standardisation's ISO 28007 (Lloyd list, 2014, p.2). Despite its huge challenge it faces such as beyond putting guns on ships but cannot operate unless with local security workforce in the shipping world. Qualitative findings from focus group with naval security officers that confirmed absence of policy on PMSC as of August 2017. However, presence of memorandum of understanding among key actors in the value chains and likelihood of focusing of PMSC legislation by policy makers will be help to a great extent.

6.2.12 Use of Private Maritime Security Companies (PMSC)

Increasingly growing maritime insecurity has necessitated some countries to explore key strategies such as promulgating legislation, essentially use of PMSC to help in curbing maritime insecurity/piracy. Key among scholarly publications on PMSC are for instance, Petrig (2013, p.667) studied the use of force and firearms by PMSC against suspected pirates which is very useful in this study. Furthermore, Burgin and Schneider, (2015, p.123) in a comparative study of PMSC regulation in Germany and Spain, revealed that most of the issues span licencing scheme, legislative framework, and increasing awareness by ship owners in the use of PMSC. They found that security at sea is of utmost importance to both countries, which appears a key challenge in Nigeria's crude oil flow based on all the empirical cases and documents examined to date. Nigeria has employed PMSC concepts in recent times but it appears that licence-handling procedures and legislation are not yet in place. In practice, the daunting task is to identify in entirety the rules applicable to merchant ships with armed PMSC personnel on board as it passes through water subject to the sovereignty of third states and to fully comply with Nigeria's domestic legal requirement (Petrig 2013, p.700). In this case, the need to pass anti-piracy laws in Nigeria is vital, which entails copying from international best practices. Thus, the author believes that antipiracy law would be effective and efficient for port performance in crude oil flows-its impact would be great in swift facilitation of crude oil flows. For details see Figure 6.6 below. The author believes the conceptual derived key improvement model appears to curb maritime insecurity/piracy is critical.



Figure 6.6. Key Improvement Model for Maritime Security in Nigeria

Source: (The Author, 2019) 6.2.13 Port Security

Port security has received important attention in recent years due to the significance of seaports as critical components of the global transportation infrastructure. The September 11, 2001 terrorist attack in World Trade Centre in the USA marked a turning point. In the short term, much work is focused on finding sustainable maritime security solutions for ports and terminals (Christopher, 2015, p.3).

6.2.13.1 ISPS CODE

In the wake of the tragic event of 11 September 2001 in the USA, a Diplomatic Conference on maritime security was held at the London Headquarters of the International Maritime Organisation (IMO) from 9 to 13th December 2002. The conference adopted a number of amendments to the International Convention on Safety of Life at Sea (SOLAS, 1974) which appears the most far-reaching of which enriched the new ISPS Code. In addition, the conference adopted key resolutions designed to add weight to the amendments, and to encourage the application of measures to secure ships and port facilities not covered by the ISPS code and to the pave way for future work. This originated because of the 22nd session of the Assembly of the IMO, which was held between 19th and 29th November 2001 where member Governments unanimously adopted Resolution A.24 22 entitled "Review of measures and procedures to prevent acts of terrorism which threaten the security of passengers and crews and the safety of ships". This code came into effect on 1 July 2004, 18 months after its adoption.

There are several attempts by IMO to help member-contracting Governments in implementation of the ISPS code through developing training materials and further guidance of model of training in some less developed countries. In addition, in 2009, IMO's focus was shifting to other pressing security issues such as piracy and armed robbery and implementation of long-range identification and tracking system. The IMO guide to Maritime security and the ISPS code present terminal operators, contracting government, and all key supply chain members in crude oil export with notable knowledge of instruments toward an effective maritime security. An overview of the

Maritime Security Measures is shown below. First, SOLAS CONVENTION: 1974 SOLAS Convention is one of 32 international Conventions and agreement adopted by IMO, SOLAS: In December 2002, IMO adopted security measures related amendment to SOLAS Convention aimed at enhancing the security of ships and port facilities. They explored ISPS code which composes of 2 parts, namely, Mandatory CHAPTER X1-2 and recommendatory section (Part B). Floating platforms are not covered by X1 two of the 1974 SOLAS Conventions.



Figure: 6.7 Maritime Security Measures for Port/Terminal Security

Source: (Author 2019, Adapted from ISPS Code and SOLAS Amendment,

2002)

The high cost of implementing security measures at port facilities was estimated in a 2007 study by the UNCTAD to average US\$287,000 in investment and US\$105,000 in annual running cost per port facility. Nigeria maritime security zones are divided into four geo-functional maritime security zones (MSZs), Lagos, Delta, Rivers, and Calabar MSZ for its ISPS Code implementation (Okoroji and Ukpere, 2011, p.1428). It is evident that this comes with technical requirements that includes security infrastructure and equipment (Emah, 1998). Further, Nigeria has embarked on improving telemetric and surveillance infrastructure for ship to shore, shore to ship, shore-to-shore, intra/inter agency communications through the following maritime communication installation (Sekibo, 2004) such as Automatic identification system (AIS), GMDSS, Vessel identification system (VTMS), ship security alert System (SSAS), Tracking/identification of non-convention crafts, command communication/coordination centres. Empirical evidence revealed that information security infrastructure is still an issue that has not been addressed holistically from the perspective of national maritime authority, supply chain actors collaboration in general. In addition, there is increasingly clamour for infrastructure upgrade and security in the maritime sector (Babalola, Leadership News, 2018), particularly in the port of Lagos such as need for scanners at seaports, entry borders. Furthermore, it has a ripple effect on the logistics of crude oil flows as Lagos is centre for bunkering operations for crude tankers and as well as ship building repairs and storage facility for key terminal and FPSO operators.

Research has shown that most work on port security relates to container terminal efficiency including a benchmarking study of the impact of security

regulations on container terminal port efficiency (Bichou, 2008, p.10), which discussed the container security initiative (CSI), the 24-hour rule and more importantly, container terminal decision-making units (DMUs). Findings revealed that handling, configurations, and operating procedures have a direct effect on container productive efficiency including security regulation and terminal group but there is evidence of generalised productivity gains from technological progress prompted by investment in new security technology (Bichou, 2008, p.5). The implications of these findings in the current study are vital for Nigeria's crude oil export stakeholders to adopt a new security strategy; whereby terminal operators would fund a certain percentage of technological port security technology. For instance, a coastal surveillance system, coastal sensors, would enable a maritime picture to be integrated into a landlord model of crude oil export terminals, which involves contractual agreement and negotiations for sustainable crude oil flows. Moreover, an important study "efficient relationship between residual security risk and security for maritime ports facilitation" was conducted by Talas, (2010, p.9) and proposed adapting Markowitz (1952) theory to the port security environment; and modelling and measurement of the impact of the introduction of new port security technology, changes in background port security threat levels and for planning of port security in Greenfield sites. Finally, both studies are vital for port performance and crude oil export logistics system.

Recent research evidence by (Trelawney, 2017, p.7) revealed a need for a revised code of conduct concerning the repression of piracy, armed robbery against ships and other illicit maritime activity in the western Indian Ocean

and the Gulf of Aden area (Amendment to the Djibouti Code of Conduct 2017). This showed the adoption of the UN Security Council resolution 2018 (2011) and 2039 (2012), this requires cooperation between IMO, Economic Community of West African States (ECOWAS), Gulf of Guinea and Economic Community, Central African States (ECCAS) and Gulf of Guinea Commission to aid in achieving African Union integrated Maritime Strategy (AIMS) 2050. In addition, the Yaoundé code of conduct maritime strategy for 2013. The key questions apparently relate to the implementation of these national, regional and international frameworks for curbing maritime related issues in ports. The author believes effective implementation of these frameworks by all stakeholders will enhance effective port security, which will facilitate cargo flows whether bulk or dry in Nigeria and beyond.

6.2.14 Inadequate Training and Technical Expertise

Qualitative interview/focus groups' empirical evidence revealed that the NNPC and low-cost producers face challenges regarding training and expertise in the whole value chain. However, training is being provided and this appears inadequate due to cost cutting measures of some of the E&P companies. In this case, the EPP concept that appears critical for overall efficient logistics can be jeopardised without an efficient workforce to derive the process. Importantly, it is apparent that NNPC, IDOCs and government regulator (DPR) need to invest more in training and retraining in all aspects of the value chain, particularly in areas of offshore operations, measurement of export/metering technology, innovative technological change, human resource management and devising new finance model for E&P cost. Hence, investing in this strategy appears will breach the gap between major IOCs and low-cost producers for overall efficient, effective and reverse flow of oil and related information from export terminals to the ocean going vessels. 6.2.15 Petroleum Industry Bill (PIB)

Nigeria's Petroleum Industry has been in existence for sixty years, since 1958, when the first oil discovery was made in Olobiri in present day Bayelsa state, Nigeria. Regulation is key in oil and gas E&P. Further, Nigeria's major laws span Petroleum Act of 1968, Petroleum Profit Tax 1959, NNPC Act 1977 and DPR Act 1985. However, the Petroleum Act is the origin of all other regulatory acts but it appears outdated and totally inadequate to meet current challenges and opportunities in the oil industry according to the oil and gas

sector reform implementation committee (OGIC, 2008). The process commenced in the year 2000, the OGIC appeared brainchild of PIB. Over the years, there have been several attempts to pass this Bill by the Nigerian Parliament but to no avail. In this study, the reverence of PIB is immense in the present study. First, the author found that focus groups revealed a need for investment and security apparatus in line with international standards, which appears critical for Nigeria to increase oil production output within the framework of OPEC and to increase production for domestic and export market. Further, Nigeria seeks to maintain its role as a reliable supplier in the domestic crude oil export supply chain. Although, PIB main objective is to create a legal and regulatory environment that is transparent and wellgoverned.

Second, empirical cases revealed a complete absence of SCM concepts in the value chain as virtually everything is centralised whereby NNPC has many roles which appear inefficient and ineffective, which leads to bureaucracy and slow operational procedures with huge impact on seamless logistics as stated earlier in some of the template of issues gleaned from qualitative data. This study has raised issues such as infrastructure challenges in operations security, IIC, absence of SCM, multiple government agencies, contracts ambiguity or non-clarity, community agitation and civil unrest in the Niger delta etc. If the PIB is passed and implemented, it appears that this would solve issues around JVCs and PSCs, which appears crucial to all the crude oil value chains actors in terms of investment in CAPEX and OPEX for sustainable finance mechanism. Furthermore, empirical cases showed that contract model is still a serious issue in crude oil
export value chains in Nigeria. It revealed a complete absence of SCM concept in the value chains as virtually everything is centralised whereby NNPC has many roles, which appears inefficient and ineffective, which leads to bureaucracy and slow operational procedures as highlighted in some of the template of strategies gleaned from qualitative data. Furthermore, this has huge impact as described by the author in previous strategic themes. Passage of PIB will usher in more investment particularly in upstream sector, clarification of contract model, ownership of acreages, commercialisation of NNPC, effective and efficient corporate social responsibility framework to host community that has huge impact on pipeline vandalism. However, there appears controversy in relation to PIB among stakeholders despite being acknowledged as key and most comprehensive petroleum legislation in Nigeria in recent times. Apparently there are huge challenges surrounding its passage into law with each party having different interest ranging from government, IOCs, host communities (oil-rich Niger delta) and national parliament. In essence, the author believes with passage of PIB, there will be a complete change in the business model of major IOCs, IDOCs, NNPC and other supply chain actors in Nigeria. In conclusion, all these changes obviously will improve port performance in crude oil export logistics system distribution in Nigeria.

6.2.16 Metering System

The empirical data from cases clearly showed that technology is still a huge challenge in terms of measurement of exports, as this usually resulted in ship- shore differences sometimes, that affect the logistics performance. However, this has been critical in most of COECs in the past. However, some of the newer terminals in Nigeria are relatively in line with international best practices. More importantly, the idea of numerous inspections is great but digitizing measurement of export appears to be imperative now; either manual or mass flow meter is crucial for effective and efficient logistics flows of crude. In this context, investment in modern metering technology systems such as mass flow metres to accommodate the current API Manual of Petroleum Measurement System (MPMS). In addition, other critical factors that affect ship-shore configurations such as weather and human factors appears common globally but more importantly, training and retraining schemes for government officials and E&P dedicated team for export measurement dependent on technological change and policy are of critical importance for effective SCM of crude oil flows.

6.2.17 Weather

All empirical cases in the interview appeared explicit about Nigeria's waterways coolness and calmness in terms of weather, which facilitates easy marine transportation. However, other world shipping routes such as Canadian Artic, Asia–Europe, Asia–US East Coast marine transportation network where climate change brings increasingly ice-free routes will need fundamental reconfiguration (Parsons et al., 2010, p.549). Nevertheless, globally arctic regions host one-fourth of undiscovered petroleum resources (Cunningham and Smith, 1995, p.419, Ahlbrandt and McCable, 2002, p.14) including a similar proportion of Canada's remaining recoverable light crude oil. First, case one revealed that Nigeria has two to three months of harmattan, which appears to cause minimal delay with the highest waves around 4 feet, or one-third of the North Sea. Furthermore, case 2 evidence correlated case 3 on poor weather condition in the North Sea. For details, see verbatim guotes case 1, 2 3 and 5 below.

Case 1: Yes, weather delay do affect port performance during the November/December period because bad weather for helicopter mostly for logistics purposes to take offshore personnel to the field and because of high tides sometimes for vessel berthing" (senior regulatory official, 20 September 2017).

Case 2: "Therefore, for a crude oil facility in the North Sea, you might have 50% weather to be able to offload, or it could be lower, whereas in a country with nice weather, from a weather perspective you might have 100% operational. These are some of the logistical issues regarding the economics of how you will factor in, you need to understand who is buying the cargo, how frequently you need to offload and because the "frequency offloading" will depend on how much storage capacity you" (OCIMF Discussion interview, 2nd December 2016).

Case 3: "The highest weather in Nigeria, I see offshore is less than 4 feet of waves definitely, unlike on the North Sea you could have seven, I have heard of 12 feet" (senior regulatory official, 27 August 2017)

Case 5: "I had one experience at the Escravos, an accident whereby an export tanker, whereby the rope that is holding an export tanker with towing boat had some issues was cut off due to bad weather and then tanker collided with tug boat leading to the death of one of the staff member. Apart from that, Nigerian waterways are somehow stable unlike the North Sea and some other places in the world, other than that I think Nigerian export ports for crude oil are relatively ok and safe to use". (Supply chain manager in NNPC, 16 February 2017

Nigeria's weather and quality of crude is a plus in the global oil market

logistically, because it is closer to Europe and access to transit routes

because of presence of oceans in the Mediterranean to other West African

countries. In terms of weather, Nigeria appears more stable. Furthermore, logistically compared to others such as North Sea, Canada, USA, Europe, however, the major challenge appears to be finding and managing effective health and safety regulation (HSE) regulations for onshore, shallow water and offshore fields, this is evident in case 5. Furthermore, training and retraining is key for a secure, efficient and effective crude oil flow logistics system. More importantly, this study succeeded in using one or more cases to create theoretical constructs, propositions and or midrange theory from case based, empirical evidence (Eisenhardt, 1989b). Overall, these constructs below illuminate how Nigeria's port performance and crude oil export logistics system can improve and remain sustainable for global competitiveness.



Key strategies to model Port performance and crude oil export logistics system distribution in Nigeria

Figure 6.8: Key strategies to Model Port performance and Crude oil Export

Logistics System Distribution in Nigeria

Source: (Author, 2019)

6.3 Summary

Key strategies to model port performance and crude oil export logistics system distribution in Nigeria were found. These strategies were developed based on well-defined theoretical, empirical, observatory and methodological approaches in the context of crude oil flows logistics efficiency in Nigeria. This model of key empirical strategies would serve as an important contribution toward a sustainable crude oil flow in Nigeria, particularly concerning issues that needs reviewing for a sustainable SCM of crude oil flows. Adopting these strategies to model decision making is of utmost importance for Nigeria to maintain a competitive advantage in the international oil market, as some of the competitors are already in tune with international standards concerning many of the main themes raised in this study. Major distinctions between initial framework and final empirical strategies to model port performance are in areas; metering systems reliability and accuracy, piracy laws, streamline government agencies, adoption of block chain technology, good weather condition and security infrastructure capability, contract model or business model review. The next chapter will discuss the prioritisation of key improvement strategies that were agreed by 90% of experts in the supply chain.

Chapter 7: ANALYTIC HIERRACHY PROCESS (AHP) TECHNIQUE

7.1 Introduction

This section seeks to explain the importance of ranking identified key improvement strategies in table 7.2 which were later trimmed down to seven as final key improvement strategies for port performance and crude oil export logistics system distribution in Nigeria (see table 7.3). First, preference order of group decision making (DM) revealed information sharing and synergy between terminal operators and Nigeria security forces in oil and gas security courses and training to be highest above all other strategies. Second, preference order of Terminal operators group DM revealed increase in security boats, platform and capacity as the main strategy of concern, it showed major issues in the crude oil export value chains in Nigeria which include lack of adequate infrastructure, legal and investment capability in terms of security which is apparent on the land base terminals and on high sea for ocean going vessels. Finally, the next chapter will outline an overview of the oil industry business model, port performance and contribution to knowledge.

7.1.1 Selection of Multi-Criteria Decision Making (MCDM) Technique

First, the most technique used in measuring port performance is Data envelopment analysis (DEA). DEA method is a mathematical programing that converts multiple input and output measures into a single. In addition, DEA can be defined as non-parametric method of measuring efficiency of a decision making unit (DMU) according to (Cullinane et al., 2006, p.356). Though DEA have been applied in seaport productive efficiency due to sheer importance of improving their productivity but (Cullinane et al., 2006, p.354) found it's drawback to be in the technical efficiency indexed ranking obtained using DEA and stochastic frontier analysis (SFA) which appears have similar functionality. Nevertheless, DEA key strength lies in its flexibility to accommodate multiple input and multiple output within single measurement of efficiency and it does not impose a specified functional form to modelling and calculating the efficiency of DMU. In contrast, this study practically involve decision making because the author main concern is about key strategies for improvement in a complex situation where many output and input factors are involved. Hence, a critical look at MCDM technique. Second, the author thought of a technique that solve MCDM complex problem approach that would help in preference evaluation of these improvement strategies. Firstly, Analytical network process (ANP) is a generic form of AHP that allows for more complex, interdependent, relationships, and feedback among element in the hierarchy (Saaty 2001). Initially, the author considered ANP due to its unique features such as modelling systems (non-linear network of interdependence), measuring on ratio scale (mainly derived from

pairwise comparison matrices) and finally, synthesis overall priorities from super matrix calculations (Ocampo and Seva, 2015, p.235).

The current study improvement key strategies derived appears independent of one another. Further, Promentilla et al., (2008, p.480) emphasised ANP ineffectiveness in dealing with inherent fuzziness or uncertainty in judgement during pairwise comparison process. Although ANP is widely use as MCDM but due to objective of this study, the author rejected the technique due to the following reasons because there appears to be relatively less dependencies among the strategies. For instance, criteria C and D appears have direct link because they are technology advancement. However, metering system reliability, presence of officials are independent. In essence, the author borrowed the assumption by (Santoja et al., 2012, p.88) in their work on application of ANP to the assessment of best available techniques to find a scientific method for implementation of the integrated pollution prevention and control approach. Further, key reasons enumerated of using ANP included dependencies among group of criteria and between these and alternative techniques under evaluation. Second, the detailed analysis of the inter-relationships between clusters forces the decision makers to carefully reflect on project priority approach and on decision-making problem itself and this helps decision makers to gain better understanding of the problem and to make a more reliable final decision. Although ANP advances other subjective approaches in identifying preferences through its capability of handling subjective criteria in complex relationship using a methodological with strong mathematical basics (Ocampo and Seva, 2015, p.240).

7.2 Analytic Hierarchy Process (AHP) Technique

Analytic hierarchy process (AHP) is a structured technique for organising and analysing complex decision based on mathematics and psychology. Thomas L. Saaty developed it in the 70s at the Wharton School of Business. Afterwards, it has been extensively studied and reviewed since then. As one of MCDM method, it has been widely applied in different fields such as planning, resolving conflict, numerical extension and optimization strategies (Vaidya and Kumar, 2004, p.2). In addition, extensive applications globally include wide varieties of decision-making situations in disciplines such as government, business, shipbuilding and education (Munasinghe et al., 2016, p.232). The author requires a technique, which allows prioritisation of decisions to be possible in an uncertain environment, in which AHP appears to be useful. The principle behind it appears to give decision makers leeway to find the underlying cause of underlying complex problems by finding the best solution in the understanding of the problem (Madurika and Hemakumara, 2015, p.97). The reason behind choosing AHP. First, it is a technique that could handle a large number of criteria and sub-criteria competently (Law et al., 2006). Second, it combines both objective and subjective opinions (empirical semi-structured interviews), thus, determines priority among them (Saad, 2001). Further, structuring of problems into criteria and sub-criteria levels leads to systematic solutions of problems (Singh et al., 2007). In practice, AHP is a method that derives ratio scales from paired comparison and this input could be obtained from actual measurement. In other words, AHP allows the author to determine weights (significances) of hierarchically non-structured or particular hierarchical level

criteria in respect of those belonging to a higher level. AHP principles can be classified into four stages: First, decomposition of the decision-making problem into a hierarchical structure showing relationship of the objectives, categories, sub categories and alternatives (Sarathy, 2013). Second, pairwise comparisons and establishment of priorities among elements in the hierarchy. Third, synthesis judgement in order to obtain a set of overall weights for achieving the goal (Sarathy, 2013; Saaty, 1994) and Fourth, evaluation and checking of the consistency of judgements.

7.2.1 Why AHP technique?

The author needed a technique, which allowed prioritising of decisions that are being made in an uncertain environment. AHP serves as an effective tool for dealing with complex decision making, thereby helping decision makers to set priorities and make the best decision (Thomas Saaty, 1980). In addition, it is a well-known and robust tool for MCDM in recent work by (Prakas and Barua, 2016, p.351), which applied AHP to find airport service quality enablers for ranking Indian airports for an effective and efficient customer satisfactions due to competitions in the aviation industry.

 As a widely used MCDM tool, AHP helps to incorporate a group consensus, particularly questionnaires for comparison of each element and the geometric mean to arrive at a final solution (Thomas Saaty, 1980). The Likert scale results showed that 90 percent of respondents agreed with the seven items improvement strategies, so the challenge here is to know which one is more favoured with respect to others. Thus, AHP appears to answer this question. For instance,

Singpurwalla et al., (1999) used AHP as a tool to facilitate decision making of two specific health care populations; this helped patients to evaluate and understand their healthcare options rather than relying completely on doctors' decision. Typically, the implication here is that it would help policy makers and supply chain actors to recognise significant strategies for improvement in port management and crude oil flows.

- The model used criteria which are not easy to quantify, and mostly the subjective opinion of experts. In addition, this provides a framework to cope with multiple criteria situations involving intuitive, rational, qualitative, and quantitative aspects (Alberto, 2000; Briggs and Tolliver, 2012).
- The AHP model application is relevant to determine investment decisions to activity based costing which could include both monetary and the non-monetary benefit in analysis (Angel and Lee., 1996, p.1331). The proposed strategies can be evaluated based on cost and performance. Despite being a stand–alone methodology, AHP could be combined with other methods. However, there are different MCDM techniques and approaches. The most common include AHP, TOPSIS, ELECTRE, hybrid MCDM, ANP, PROMETHEE, Dematel DM aggregation methods and Vikor. More importantly, MCDM has grown in popularity in recent years, particularly AHP methods and hybrid MCDM (Mardani et al., 2015, p.516). On the other hand, there is an increasing interest in AHP applications in SCM. For instance, Barker and Zabinsky (2011) employed AHP for assessment of reverse

logistics for an utilised research study. In addition, (Chwolka and Raith, 2001, p.176) used extended different preference aggregation approaches, applying AHP for solving problem DM issues and AHP for selection of 3PL provider. The author's preference is for AHP as a well-known and robust tool for a MCDM model (Lee et al, 1995, p.343), significant in determining the relative importance of a set attribute/instruments as improvement strategies. Although, AHP has been used in port management and logistics in various decisionmaking problems, such as Woodridge et al., (1999) applied it in ports and harbours, Gouleilmos (2000) worked on port environment, other such as Marlow and Casaca (2003) worked on port performance aiming to build up a framework to transform lean port performance to a dynamic network. It was observed from the existent literature that no study appears to have applied AHP technique to identify and prioritise port performance strategies in crude oil flows, specifically in the oil industry. The author believes this has not received much attention in port performance and management particularly in crude oil export logistics in recent times. In order to propose strategies for improvement, the author utilized AHP technique to determine the relative importance of these strategies. For this purpose, the following objectives have being designed.

- To investigate and categorizes the strategies in port performance in crude oil flow
- 2. To prioritise the relative importance of these strategies which could serve as invaluable lessons to supply chain members in crude oil flow

for ensuring access to sustainable, affordable and reliable sources of energy for billions of people in emerging economies and developed countries. Significantly, decision making about strategic questions is not easy for managers but using AHP, it is likely for stakeholders to know some of the mistakes that can occur during decision making by processes, considering applications in strategic management.

7.2.1.1 Basic steps of AHP techniques

AHP is a popular MCDM tool for formulating and analysing decisions and its application to a decision problem involves four basic steps (Zahedi, 1986). First, structuring of the decision problem into a hierarchical model. Second, making pair-wise comparisons and obtaining the judgemental matrix, calculating local weights and consistency of comparisons and finally, aggregation of weights across various levels to obtain the final weight. *The author stated the problem, which is the overall research question: RQ 2. How can Nigeria optimise its port performance and crude oil export logistics system distribution from NNPC and low-cost operators' perspective?* In essence, that is to evaluate and select the most appropriate improvement strategies. Hence, proposing some improvement strategies is the objective of the problem, which considered all actors, objectives and its outcome. To summarise, a typical hierarchical structure is developed consisting of two levels: objective and a category, however, there are seven key improvement strategies gleaned from empirical qualitative data.

Step One: Construct a hierarchy framework for analysis.

Structuring of the decision problem into a hierarchy. Furthermore, the criteria and sub-criteria were structured into hierarchy descending from overall objective or goal to sub criteria level. Firstly, the top level of the hierarchy represents the defined objective. Secondly, showed seven key port performance improvement strategies, which is the criteria in essence. Next, AHP structure for the two-hierarchy structure, include the Goal and Criteria, for details see figure 7.1 below.

Step Two: Collect empirical information and data

After building the AHP hierarchy, the next phase is the measurement and data collection. Qualtrix software was used for the survey. See table 7.5 for a graphic distribution summary of response rates. Some of the respondents were contacted via email invite. Due to sensitivity of the research, some of the respondents were not willing to respond immediately, this could be related to busy schedules, vulnerability to piracy, company policy and or lack of interest. However, the completion time for the survey is approximately 13 minutes. In addition, some of them complained about the questionnaire link expiration and the author found out during follow up calls or reminders. Therefore, a new link was sent again in order to a get a sizeable number of respondents. Moreover, an email invite to six shipping companies (mostly the shipping arm of oil majors) received no response. Afterwards, the author downloaded each respondent's results and entered it into an Excel spreadsheet for further calculation. This was done twice in order to avoid mistakes and likewise another two researchers with expertise in AHP helped with validation of this process.

Step three: Pairwise comparisons for each criteria and obtaining the judgement matrix

The author conducted pairwise comparisons for each level of criteria. On a broader note, it is only one level of criteria, which are the seven items gleaned from empirical qualitative data. First, an information sheet explained the instruction procedures and guiding principles on how to perform the comparison in the questionnaire to guide the respondents in making informed decisions based on their experience. The views of decision makers (DM) were obtained for comparing the criteria. Elements are compared pair-wise and judgements on the comparative attractiveness of elements are captured using a rating scale. Usually, an element that obtained a higher rating is considered as more important to one that receives a lower rating. Matrix entry for each judgement are usually governed by three rules where ai is greater than 0; aij= 1/aji; and as well as aii= 1 for all i. This was used to know whether transitivity holds or not, if it happens to hold that means all the entries of the matrix, then the matrix is said to be consistent. If the transitivity property holds for all the entries of the matrix, then the matrix was considered consistent. If the property does not hold for all the entries, the level of inconsistency can be captured by a measure called Consistency Ratio (CR), (Saaty, 1980). As earlier stated, pairwise comparison, judgement matrices were obtained from 79 respondents; only 33 responded and only 17 completed their response. Moreover, these judgements were combined in the end, using the geometric mean (GM) approach at each hierarchy level to obtain the corresponding consensus. Saaty's (2008) ratio scale of real

numbers from one to nine was used in ranking as discussed in the

questionnaire below.

Scale	Judgement
1	Equally important
3	Slightly important
5	Strongly more important
7	Demonstrably more important
9	Absolutely more important
2,4,6,8	Intermediate values between the two adjacent judgement

Table 7.1 AHP Rating Scale

Source: (Adapted from Saaty scale, 1970)

Step four: Calculating local weight and aggregation to obtain global weights each criteria

The author calculated both local and global weights. In essence, local weight means preceding hierarchical level while global weight refers to highest hierarchical level (Talib et al., 2015). The Eigenvector method (EVM) was used to calculate local weight on an Excel sheet. Further, this normalised eigenvectors corresponding to the principal eigenvalue of the judgemental matrix, then provide the weight of corresponding criteria.

Step Five: Perform the consistency test

It is important to check the level of consistency of paired criteria to know whether it is consistent (Talib et al., 2015). Therefore, CR is usually use to check whether a certain criterion can be used for decision-making and this is usually 10 percent (Saaty, 1980). In addition, a value of CR less than 0.1 is considered acceptable i.e. human judgement is considered not perfect; this is because of the nature of the scale introduced. However, there is wide debate on the standard of consistency test (Murphy, 1993; Karapetrovic and Rosenbloom, 1999 and recently Kulakowski, (2015, p.333). Simply put, pairwise judgements are often inconsistent particularly in decision involving a large number of objects, show that even for sufficiently consistent pairwise comparisons matrices, this condition cannot be met. However, recent investigations indicate that human beings make mental representations of numbers as numeric to resemble a mental number line (Dehaene et al., 1990, p483, Zorzi et al., 2002, p.139). Furthermore, pairwise comparison has a good mathematical basis, as researchers have shown more interest in the approach (Podvezko, 2009).Thus, quality control is important to measure consistency of the multiplicative reciprocal comparison matrix (MRCM). In this case, the consistency index (CI) formula is as follows:

$CI = CI = (\lambda max - n)/(n - 1),$

Where 'n' is the number of criteria or sub-criteria of each level and λ max is the largest eigenvector in the matrix. Thus, a perfectly consistent decision maker is always obtained when CI= zero. However, a small value of inconsistency, is usually tolerated especially if CI/RI is less than one.



Figure 7.1: AHP Model for Port performance and Crude Oil Export Logistics System Distribution in Nigeria

Source: (Author, 2019)

7.3. Sampling Frame

The author's target population was sampled from "Who's Who of the Global Energy Industry", 2011 & 2015, which is appropriate to this study and to generalise results statistically (Saunders et al., 2016, p.272). Purposive sampling was chosen, because a case study requires cases that are particularly informative. In addition, data was collected from multiple sources from key supply chain members, with data needing to converge in a triangulating fashion (Yin, 2018, p.15). Another point is that the focus of research inquiry is on key improvement strategies. The sample represented full cases that span crude oil trader, terminal operators, ship captains etc., in a way that is meaningful, and which can be justified. The target population

were equally represented, particularly those experts engaged in crude oil flows in Nigeria (Saunders et al., 2016, p.275), hence this reduces possible risk of non-response bias.

S/N	Respondent/role	Years of	Number of
1.	Academic	5.10	2
2.	Marine/tanker handling coordinator	11	1
3.	Manager fleet operation & technical support, Shipping and Maritime	33	1
4.	Regulator	15,23, 16	3
5.	Crude oil trading manager	11,15	2
6.	Terminal operator	above 10	
7.	Assistant operations superintendent terminal	12	1
8.	Regulator	13	
9.	Crude oil cargo analyst	above 10	2
10.	Terminal operator	16, 17	2
11.	Marketing/sale/logistics	16, 14	2
12.	Crude oil shipping	16	1
13.	Business development/operations	9	2
14.	Port agent	11	1
15.	Terminal marine pilot	5	1
16.	Marine pilot	11	1
17.	Ship broker	10	1
	Total		23

Table 7.2: Background of respondents for AHP Survey

Source: (Author, 2019)

S/N	Answer	%	Count
1	1-5 years	18.6%	2
2	6-10 Years	13.00%	3
3	Above 10 years	78.2%	18
	Total	100%	23

Table 7.3: Working Experience of Respondents

Source: (Author 2019)

Respondents were asked to tick one option from the pairwise questionnaire below to indicate relative importance of the following possible improvement strategies in this study. *As an example when comparing the "presence of government officials during crude oil loading operations" to "* a reliable accurate metering system showing metred quantities for use as Bill of lading data" *as improvement strategies if you think that*:

"Presence of government officials" is strongly more important than a "reliable accurate metering system showing metred quantities for use as Bill of lading data"; please tick "5" on the left hand side

←					ual	► More	importa	nt		
	9	7	5	3	1	3	5	7	9	
Presence of government officials during crude oil loading operations			~							A reliable accurate metering system showing metred quantities for use as Bill of Lading data.

Table 7.4: Sample of AHP Survey/Questionnaire

"A reliable accurate metering system showing metred quantities for use as Bill of lading data" is absolutely more important than "Presence of government officials during loading operations"; please tick "9" on the right hand side. If you think that the two options are equally important, please tick 1. Please do not respond to any option that you do not understand or do not have any opinion about. Key: 1 = Equally important, 3 = Slightly more important, 5= Strongly more important, 7= Demonstrably more important, 9= Absolutely more important

Distribution	Audience	Survey started	Response	Uncompleted	Completed	No	Completion
channel			rate			response	rate
Invite over	79	18	14	5	17	11	67%
email							
Anonymous			1	6			
link							
Number of			18				
response rate							
Total			33	11	17	11	67%

	Table 7.5:	Distribution	summary	of AHP	Survey
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7.4 AHP ANALYSIS

7.4.1 Prioritising Key Strategies and AHP Analysis

In March 2016, a qualitative study involving scoping interviews with nine experts in crude oil export supply chains was undertaken to understand the issues of concern. The results were analysed using informal ethnographic content analysis ECA as this allows categories to emerge (Bryman and Bell, 2015, p.300). Key categories that emerged are "training and retraining, improve security architecture, lack of modern technology, security threat to operation, difference in quantity of crude oil lifted, inadequate funding model, clarification of contract models, changes in date of lifting programme". In addition, "crude oil theft/loss, deployment of new technology for pipeline protection, documentation, crude oil loss, multiple taxation, ineffective information sharing among stakeholders, maritime insecurity, and dispute over entitlement, and operational delay were identified". This resulted in inferences and subsequently hypotheses that guided semi-structured interview questions and two phases of interviews. Next, 23 semi-structured depth interviews were conducted followed by four focus groups and documentary analysis of shipping and news sources.14 items/strategies for improvement strategies were formed from a template of issues gleaned from the empirical data. The author used Likert scales to measure respondent's attitude after which seven items emerged; these were then used as an instrument for experts to rank using the AHP technique.

7.5 Data collection method

Over the years, different methods have been used to measure character and personality traits (Likert, 1932). It appears that there are difficulties in measuring these characteristics, attitude, and personality traits, which lies in the procedure for transferring these qualities into quantitative measures for data analysis purposes. The 14 items for improvement strategies in this case were formed from a template of issues gleaned from a series of scoping, structured and focus group interviews undertaken with key members of the crude oil supply chain in the oil industry in Nigeria and the UK. The author sent an email to each respondents to measure their attitude towards possible improvement strategies. Since Likert scale type data is ordinal scale data, which implies that we can only infer that one score is higher than another without knowing the precise distance between the points.

S/N	Respondent/role	Experience	Organisation
1	Marine coordinator	17	Shell
2	Regulator	10	DPR
3	Supervisor shipping	13	Duke oil
			company
4	Second officer	8	Transocean
			shipping
5	Supervisor joint venture	13	NNPC
6	Crude oil trading manager	7	Duke oil
			company
7	Marine officer/pilot	11	Shell
8	Assistant operations	12	Chevron
	superintendent		
9	Accountant	11	NNPC
10	Team leader maintenance	11	Shell
11	Supervisor efficiency	16	Shell
12	Marketing/sale/logistics	16	NNPC
13	Crude oil shipping	16	NNPC
14	Business development	7	Agip
15	Business	9	Agip
	development/operations		
16	Business development	4	Oando
17	Administration	12	NNPC
18	Port agent	11	Blue sea
	-		maritime
19	Terminal marine pilot	5	Shell
20	Marine pilot	11	ExxonMobil

Table 7.6 List of participants for Likert scale survey

	Item	Score
1	A need for Nigerian owned crude oil tankers.	84
2	Presence of government officials during crude oil loading operations	93
3	A reliable accurate metering system showing metred quantities for use as Bill of Lading data.	96
4	Simplifying cargo scheduling and marketing.	86
5	Annual metre proofing maintenance.	82
6	Modern technology for capturing shipping documents.	96
7	An oil derivation fund to be managed by an investment corporation for Niger Delta development.	70
8	A need for government owned export terminals.	56
9	Unbundling of the monopoly of using one company for crude oil logistics.	73
10	Time chartering of vessel to deliver Nigerian crude oil rather than on an FOB basis	63
11	Increase in security boats, platform and capacity	86
12	Effective communication between security officers and registered anglers.	84
13	Information sharing and synergy between terminal operators and Nigerian security forces in oil and gas security, pipeline security courses and training	87
14	Introduction of anti-piracy laws in port performance and crude oil export logistics systems distribution in Nigeria	92

Table 7.7: Result of Fourteen Strategies for Likert scale survey

7.5.1 Data analysis method

7.5.1.1 *Method* 1

The raw score of each respondent was summed for each item (maximum possible score 100 with 20 responses, minimum possible score 20). Item 3 ("a reliable accurate metering system showing metred quantities for use as Bill of lading data") and 6 ("modern technology for capturing shipping document") respectively top the scores on 96. Because Likert scales are ordinal data, interval between each gradation is variable and unknown, denying their use for addition and hence we use the mean, as a measure of central tendency is arbitrary. If one item is rated "agree" it scores 4, which would be equal to summing two items, which scored 2, which equates to "disagree" on the Likert scale, which assumes that two plus two equal four, is meaningless, and requires interval scale data. Further, it is assumed that responses such as "I do not know" or "I do not wish to reply" are not present, and that a score of 3 implies genuine neutrality. The author questioned the appropriateness of this method by asking what the average is of strongly agree and disagree in this context? However, there are other statistical parameters such as mode and median. It appears the appropriate measure is mode, which represents the most frequent responses. Further, measure such as the total number of respondents who registered a reply as "agree" or "strongly agree".

7.5.1.2 Method 2

The author summed up the frequency of respondents who did not agree with each statement (score below four). Any instrument on which a respondent did not agree is not included in the calculation. The author found that frequency of respondents who do not agree are 4, 2, 1, 2, 3, 0, 10, 15, 8, 9, 2, 3, 2 and 0 respectively on the 14 items. In addition, a Likert scale helps to avoid a ranking reversal effect resulting from unrelated and unimportant sub criteria before conducting AHP (Taih et al., 2013, p.433). Method 2 appears preferred as it presents a more reliable assessment of the situation, as it is all-inclusive with no ambiguity compared to the first method. Measurement is achieved through use of scale, which is a measurement tool that can be used to measure a question with pre-determined number of outcomes (Hair, et al., 2016, p.229). Furthermore, some of these strategies need scale that are continuous to measure not only direction but intensity as well (Hair et al., 2016, p.230). In this case, ratio scale appears suitable because it provides highest level of measurement because of distinct characteristics, it possess a unique origin or zero point that makes it possible to compute ratio of points on the scale (Hair et al., 2016, p.236). Typically, when four is divided by 2 result is two, hence it processes all the properties of other sides plus a zero point, that enable the author to complete coefficient of variation as well standard deviation (Hair et al., 2016, p.236).

7.6 Result of Analysis

Seven items emerged as shown below. This result showed that 90 percent of the respondents agreed to these items as improvements strategies in this study.

	Item	Score	Frequency
1	Presence of government officials during crude oil loading operations	93	2
2	A reliable accurate metering system showing metred quantities for use as Bill of Lading data.	96	1
3	Simplifying cargo scheduling and marketing.	86	2
4	Modern technology for capturing shipping documents	82	0
5	Increase in security boats, platform and capacity	86	2
6	Information sharing and synergy between terminal operators and Nigerian security forces in oil and gas security, pipeline security courses and training	87	2
7	Introduction of anti- piracy laws in port performance and crude oil export logistics systems distribution in Nigeria	92	0

Table 7.8 Key Improvement port performance strategies

Source: (Author, 2019)

7.6.1 Nature of problem

Identified improvement strategies derived from both subjective and objective factors. Thus, they need further analysis particularly from a policy perspective since it involves MCDM (Saaty 1980). Moreover, the author needs experts to prioritise these items. Further, to solve a complex problem, researchers and academics have made use of AHP technique in several industries and studies areas, which have been published in peer-reviewed journals (Vaidya and Kumar, 2006).

7.7 Uncompleted/Partial Responses

First, respondent's partial response is of the view that presence of government officials is absolutely more important than a reliable and accurate metering system. Further, reliable metering system is equally important as simplifying cargo scheduling and marketing. Next, simplifying cargo scheduling and marketing slightly important than modern technology for capturing shipping documents. Increase in security boats, platform and capacity slightly more important than modern technology for shipping *documents*. Furthermore, increase in security boats is equally important as information sharing and synergy between terminal operators and Nigeria security forces. In conclusion, introduction of anti-piracy laws is absolute more important than information sharing and synergy between terminal operators. Another respondent judgement is that presence of government officials is important (9) than a reliable accurate metering system. Second, simplifying cargo scheduling, modern technology, increase in security boats are absolutely more important than presence of government officials while presence of government officials is absolutely more important than both information sharing and synergy between terminal operators and introduction of anti-piracy law. These results' implication are clear in essence, though, that these judgements might not be consistent but they clearly showed importance of some of these strategies relative to each other. However, it appears that respondents make sense of the questions based on their social interactions and experience. In conclusion, presence of government officials appears to be understood differently. Some do not see any value in it while some see it as important due to suspicion of oil theft and government

contract in form of oil license such JVC, PSC with IOCs. However, there appears to be consensus on an increasingly need for technological advancement in shipping documentation, information technology and communication systems, security infrastructure and capability and introduction of anti-piracy law.

									Normalised	Percentage	Rank
Criteria	А	В	С	D	E	F	G		weight		
A	0.133	0.052	0.026	0.036	0.030	0.076	0.017	0.369	0.0528	5.28	7
В	0.331	0.130	0.091	0.091	0.091	0.226	0.039	1.000	0.1428	14.28	4
С	0.321	0.092	0.064	0.052	0.075	0.122	0.038	0.764	0.1091	10.91	6
D	0.386	0.151	0.130	0.106	0.087	0.187	0.042	1.088	0.1555	15.55	3
E	0.434	0.139	0.083	0.118	0.097	0.109	0.019	0.998	0.1426	14.26	5
F	0.516	0.170	0.153	0.166	0.261	0.294	0.038	1.599	0.2285	22.85	1
G	0.352	0.149	0.072	0.120	0.167	0.337	0.043	1.241	0.1772	17.72	2
	2.473	0.883	0.619	0.689	0.807	1.351	0.238	7.059	1.008		

7.8 Preference order of group decision makers (DM)

Table 7.9: Preference order of 17 group decision makers (DM) AHP Result <u>Note: Consistency index (CI) =, 0.025568, Consistency ratio (CR) =</u>

<u>0.01937</u>





Source: (Author, 2019)

In this section, the result of analyses are reported on the preference order of major strategies for a combined group "Decision Making (DM)" composed of 17 respondents and four sub groups spanning *crude oil traders, cargo analyst, academics with expertise in oil supply chain, crude oil export regulators and terminal operators managers.* However only group DM and the terminal operators' sub group were consistent. In essence the CR are less than 0.1, hence, consistency matrix is acceptable (Saaty, 1980). Further, it can be useful and acceptable in the decision-making; and selection process (Dagdeviren et al. 2009, p.8144). In addition, other categories show fair idea of respondent intangible qualitative criteria alongside quantitative criteria (Badri, 1999, p.240). For further details see table 7.9 and 7.10 for results of both combined group and terminal operator's sub group DM responses respectively. First, the combined group DM showed that information sharing

and synergy between terminal operators and Nigeria's security forces in oil and gas security courses and training to be highest with a 0.2285 (22.85%) score above all other strategies. In the same vein, one of the interview

supported this finding as seen below.

"However, at times, if there is any communication gap between Nigeria's state oil company and Nigerian Navy (NN), Navy do arrest our export tanker. For instance, if an officer will transmit a message to NN and then probably is on Friday and the person that supposed to send signal to Port Harcourt or Lagos or Warri was not available and then the vessel came during the weekend. If they do not have vessel name on the list, they do arrest. Nevertheless, we do try to make sure they release vessels as at when due" (Crude oil export supply chain manager, February 2017).

Inadequate information infrastructure results in information delay and could

result in demurrage, thus increasing cost of logistics, which impacts all the

stakeholders in the supply chains. Second, introduction of anti- piracy law

with (0.1772) 17.72% score, underpins maritime insecurity. For instance, an

informative quote from a crude oil trader with immense experience on

Nigeria's crude oil flow says:

"Nigeria has a bad reputation even doing vessel fixtures; vessel owners will charge you something known as "additional war risk" even to go Nigeria, this is something reserved for conflict zone areas known as conflict zone. Nigeria has picked up this reputation as unsafe place to load crude may be unsafe; definitely a place to be courteous when loading crude which has been the main problem the country has faced which is understandable. Occasionally, vessels been fired upon offshore/onshore by militants but it is not the norm it is an exception. Still, occasionally bunkering is an issue with complexity from certain authority as well, maritime authority either Navy, customs have been found to be complicit" (crude oil trading manager in one of the world leading trading company, 16/02/2017).

Attacks in the gulf of Guinea account for more than 40% of the global total in

the first half of 2018, according to International Maritime Bureau (IMB). The

impact is that supply chain actors are expected to load cargoes; particularly

the ship owner who wants money, the cargo buyer and receiver would be

disappointed. Because they have scheduled something to happen and it

does not happen due to unavailability this leads to reputational issues, and

discount of Nigeria's crude price despite its quality, which is sweet crude with

low sulphur content. Third, modern technology for capturing shipping

document with accumulated weight of 0.1555 (15.55%). In essence, empirical qualitative study show excessive manual documentation during vessel clearances, information exchange among terminal operators; this is buttress in subjective view of senior official of an export terminal.

The fourth and fifth are a reliable accurate metering system and increase in security boats, platform and capacity with accumulated weight of 0.1428 and 0.1426 respectively, the former is slightly higher than the latter with 0.0002 that is infinitesimal, implying that they are virtually the same in hierarchical structure. Standardising measurement is critical for efficient logistics and in particular, supply chains and this appears will reduced the impact of ship shore differences largely. Thus, increased added value to the value chain by increasing level of trust on agreement on quantity loaded during crude loading operations. The sixth criteria is simplifying cargo scheduling and marketing with a score of 0.1091 (10.91%) and lastly, presence of government officials during crude oil loading operation. This appears the least important one as empirical evidence from qualitative interview showed disagreement within those professionals engaged in crude oil supply chains. For instance, some of the interviewees have divergent opinion on numbers of government/regulatory officials during crude oil loading operation; issues raised are duplication of roles, unnecessary inspection despite presence of agreement of crude oil sales contract among parties. Nevertheless, there was consensus on a few numbers instead of too many people, standard practice requires keeping number of visitors to a minimum and all must be accredited.

[&]quot;At times, you can hear some paper missing; if there is a way that a particular lifting can be trapped. May be; there is a system we can enter some information anywhere it goes, whether this paper got missing, we should not get worry of as nothing is going to happen, it will go a long way as things are changing nowadays".

7.9 Preference order of Terminal Operators Group Decision Makers (DM)

								Priority	Normalise	Accumulat	
Criteria	A	В	с	D	E	F	G	vector	d weight	ed weight	Rank
A	0.027	0.009	0.018	0.019	0.053	0.048	0.021	0.195	0.028	0.028	7
В	0.189	0.062	0.123	0.045	0.075	0.048	0.035	0.576	0.082	0.11	6
С	0.189	0.062	0.123	0.134	0.125	0.143	0.105	0.880	0.126	0.236	4
D	0.189	0.186	0.123	0.134	0.125	0.143	0.105	1.004	0.143	0.379	3
E	0.189	0.310	0.368	0.401	0.374	0.429	0.315	2.386	0.341	0.72	1
F	0.081	0.186	0.123	0.134	0.125	0.143	0.315	1.106	0.158	0.878	2
G	0.135	0.186	0.123	0.134	0.125	0.048	0.105	0.855	0.122	1.00	5
Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000	7.000	1.000	1.00	

Table 7.10: Preference order of Terminal Operators Group Decision Makers (DM)

Note: CI= 0.098, Consistency ratio (CR) = 0.074

For the terminal operator sub-group, *an increase in security boats, platform and capacity* is the main area of concern score = 0.341 because they see maritime insecurity as a pressing challenge in the crude oil export value chains. Hence increasing cost of logistics, from this perspective leads to increase in cost of chartering and likely demurrage, which reflects on the cost of tanker delays in port. In addition, tanker chartering depends on fixed rate differentials stated in US\$S per tonne included in freight payment, as fixed amount in respect of cost incurred, by owners, hence this variable rate is usually added or subtracted to the flat rate, which (Wood, 2000, p.74) *described Nigeria's rate usually calculated with Bonny terminal as a model with flat rate of 6.44 despite been one of the susceptible to militant attacks over the years.* Second, *Information sharing and synergy between terminal*
operators and Nigerian security forces in oil and gas security, pipeline security courses and training score 0.158 and has a link with the first scenario, because effective information sharing is key to curbing maritime insecurity. Next were modern technology for capturing shipping documents 0.143, simplifying cargo scheduling and marketing 0.126 and introduction of anti-piracy law 0.122, a reliable accurate metering system showing metred quantities for use as Bill of lading data 0.082. E-Documentation remains a challenge in international supply chains due to limited trust, regulations and cyber security threat (Mei and Dinwoodie, 2005, p.198). Thus, despite some increasing electronic transfer of some shipping documents, manual documents predominate. Finally, presence of government officials 0.028 was rated lowest.

	А	в	С	D	E	F	G	Priority vector	Normalised weight	Accumulated weight		Rank
А												
	0.022	0.013	0.007	0.010	0.007	0.030	0.040	0.130	0.019	0.019	7.985	7
В	0.160	0.100	0.026	0.039	0.031	0.160	0.180	0.694	0.099	0.118	7.682	5
С	0.147	0.191	0.049	0.009	0.025	0.040	0.132	0.593	0.085	0.203	7.375	6
D	0.164	0.191	0.407	0.074	0.028	0.030	0.148	1.042	0.149	0.352	9.364	3
E	0.179	0.191	0.114	0.154	0.059	0.030	0.045	0.772	0.110	0.462	9.387	4
F	0.164	0.144	0.282	0.562	0.449	0.230	0.148	1.979	0.283	0.745	11.138	1
G	0.164	0.171	0.114	0.154	0.401	0.479	0.307	1.790	0.256	1.001	9.430	2
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	7.000	1.000	1.001	8.909	

Note: CI= 0.318, Consistency ratio (CR) = 0.241

Table 7.11: Cargo Analyst Group Decision Makers (DM)Source: (Author, 2019)

AHP methods appears complicated because a "*matrix estimated*

comparison" may be inconsistent i.e. in discordance (Podvezko, 2009,

p.187). Thus, the author included the analysis result that appear in consistent in this study, as they give fair idea of experts' thought. Further, other group DM such as cargo analyst, academics, and traders are considered. As seen from the table above, the cargo analyst submission included *information sharing and synergy between terminal operator and Nigeria security forces in oil and gas security, pipeline security courses and training* with highest normalised weight score 0.283, followed by *introduction of anti-piracy law* 0.256. Third, *modern technology for capturing shipping document* 0.149. Fourth, *increase in security boats, platform and capacity* 0.110. Fifth, *reliable accurate metering system showing metred quantities* 0.099, sixth, simplifying cargo scheduling and marketing 0.085, and seventh, *presence of government officials during crude oil loading* 0.019.

	А	в	с	D	E	F	G	Priority vector	Normalised weight	Accumulated weight	Rank
А	0.02	0.05	0.01	0.01	0.01	0.01	0.01	0.11	0.02	0.02	7
в	0.16	0.45	0.28	0.35	0.25	0.40	0.64	2.52	0.36	0.38	1
с	0.16	0.09	0.06	0.07	0.08	0.02	0.03	0.50	0.07	0.45	6
D	0.16	0.09	0.06	0.07	0.08	0.08	0.13	0.67	0.10	0.55	5
E	0.16	0.15	0.06	0.35	0.08	0.03	0.04	0.87	0.12	0.67	4
F	0.16	0.09	0.28	0.07	0.25	0.08	0.03	0.95	0.14	0.81	3
G	0.16	0.09	0.28	0.07	0.25	0.40	0.13	1.37	0.20	1.01	2
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.00	1.00	1.01	

7.10 Crude Oil Trader Group Decision Makers (DM)

Note: CI= 0.29, Consistency ratio (CR) = 0.22

Table 7.12: Crude Oil Trader Group Decision Makers (DM)Source: (Author 2019)

The above data summaries the traders' viewpoints regarding this study.

Traders considered a reliable accurate metering system showing metred

quantities for use a Bill of Lading data, as most the important strategy, as discrepancy in the volume of expected cargo differs to actual figure some times and lack of consistency in some of the LACT unit of some export terminal. Second, *introduction of anti-piracy law* is firmly believed will improve efficiency. Third, *information sharing and synergy between terminal operators and Nigerian security forces in oil and gas security*. Fourth, *increase in security boats, platform and capacity*. Fifth, *modern technology for capturing shipping document*. Sixth, *simplifying cargo scheduling, marketing*, and seventh, *presence of government officials during crude oil loading* as least important for effective logistics in order to meet customer satisfaction.

Note: CI= 0.247, Consistency ratio (CR) = 0.187

А	В	с	D	E	F	G	Priority vector	Normalised weight	Accumulated weight		Rank
0.023	0.032	0.005	0.012	0.011	0.023	0.045	0.152	0.022	0.022	7.420	7
0.163	0.226	0.268	0.108	0.399	0.163	0.312	1.638	0.234	0.256	8.235	2
0.163	0.032	0.038	0.015	0.019	0.054	0.062	0.384	0.055	0.311	7.367	6
0.209	0.226	0.268	0.108	0.057	0.054	0.104	1.026	0.147	0.456	8.141	4
0.116	0.032	0.115	0.108	0.057	0.054	0.062	0.545	0.078	0.536	8.328	5
0.163	0.226	0.115	0.324	0.171	0.163	0.104	1.265	0.181	0.717	8.297	3
0.163	0.226	0.191	0.324	0.285	0.488	0.312	1.989	0.284	1.001	8.151	1
1.000	1.000	1.000	1.000	1.000	1.000	1.000	7.000	1.000	1.001	7.991	

Note: CI= 0.165, Consistency ratio (CR) = 0.125

Table 7.13: Preference order of Academic Decision Makers Result

Academic group expert estimates were inconsistent in their judgement. First, the academics believed that *introduction of anti-piracy law* is most important for logistics efficiency. Second, a *reliable accurate metering system showing* metred quantities for use as Bill of Lading data. Third, information sharing and synergy between terminal operators and Nigeria security forces in oil and gas security courses and training. Fourth, modern technology for capturing shipping document. Fifth, Increase in security, boats, platform and capacity. Sixth, simplifying cargo scheduling and marketing and lastly, presence of government officials during crude oil loading. In essence, both academic and cargo analyst, believed that introduction of anti-piracy law is key to effective and efficient port performance in crude oil export logistics. There is unanimous agreement on presence of government officials during crude oil *loading* as the least important strategies. It means, respondents are of the view on non-relevance of these officials in the value chain. However, what it means is that excessive presence of these officials might be hindering effective logistics chain, which appears as common practices peculiar to Nigeria, which is not the norm globally. Therefore, streamlining government agencies, which these officials represent is critical in the value chain; refer to template analysis in chapter 6 for detail explanation on role of government agencies in the value chain.

7.11 Summary

This chapter outlined the result of a Likert scale survey trimmed down from 14 key improvement strategies to seven. Further, the top improvement strategies were a reliable accurate metering system showing metred quantities for use as Bill of Lading data, followed by presence of government officials during crude loading operations. Decision making is complex and is a social phenomenon. It is imperative to rank these items to pave the way for setting priorities to ensure effective decision making; hence the rationale for adopting AHP to incorporate group consensus for comparison of each element. Key findings for group DM relate to requirements for information sharing and synergy between terminal operators and Nigeria's security forces in oil and gas security courses and training. This findings is similar to Hull (2002, p.8)'s study that accurate information must flow among the links in a timely, coordinated fashion which minimizes distortion which offered DFD a template for modelling any supply chain or logistics activity, be it push, pull, or hybrid. Requirements for information technology match requirements in this study, whereby information sharing appears to be difficult due to inadequate information infrastructure as seen in TA findings. However, this study revealed new insights into the logistics system of oil flows concerning a need for timely information sharing along the security value chains among actors particularly terminal operators for both major and indigenous (IOCs/IDOCs) with security forces as the key to minimize distortion in information flows. This is an important factor for efficient and effective SCM to assist prompt delivery and cost-effective delivery of cargo to customers.

The next chapter is discussion of the whole study, which will explain an overview of the research, oil industry business model, review of NNPC business model. Finally, overview of port performance measures and/or strategies.

CHAPTER EIGHT: DISCUSSION

8.1 Introduction:

This chapter will discuss the research overview of Nigeria's port performance and crude oil export logistics system holistically which span contract/business model to the point where cargoes are loaded in the port and shipped to the high sea. Traditionally, Nigeria has been threatened by pipeline vandalism and increasing pirate attacks by crews and vessels in the Gulf of Guinea. More importantly, the study's findings revealed a significant review of NNPC's business model to address insurmountable challenges of energy security concerns such as oil price fluctuations, climate change, and gas flaring management, maritime insecurity and technological advancement. However, basic findings revealed IOCs do extremely well in terms of operations and information sharing unlike the NNPC and key low-cost terminal operators/producers that appear to be struggling. Furthermore, information sharing is critical for effective and efficient port performance, and this appears slow whenever NNPC are the primary suppliers of crude to traders in comparison to IOCs. Finally, key findings include assessing role of PMSC model, a key improvement model derived from TA that answered objective RQ1 and the AHP model answered RQ2.

8.2 Research overview

The findings presented in the previous chapters indicated numerous port performance measures and/or strategies in container, dry bulk and in quite a few oil related transport logistics. However, present study generated key performance measures peculiar to Nigeria which can be tested in other jurisdictions from a developing country context. Being an industry under significant research, evidence of many reports and news in oil value chains are enormous. The study revealed a limited understanding of concept of SCM in Nigeria's crude oil export by few stakeholders. Key findings include assessing role of PMSC model, a key improvement model derived from TA that answered objective RQ1 and revealed key strategies for RQ2 respectively. In summary, the study revealed major fundamental strategies across all the supply chains, and the AHP model derived seen in its rare application specific on key port performance strategies for the whole supply chains in Nigeria's crude oil flows.

8.3 Overview of Oil industry business model and theory

Historically, all COECs appear to have experienced challenges which have spanned crashes in oil price particularly in 2014. And recent Coronavirus pandemic (Covid-19) outbreak in the world that occurred in December 2019 which also led to a crash in crude price, supply chain disruption and impacted on revenue and finances of COECs. In addition, it had huge potential shipping impact that span fluid, short term and full impact which appears uncertain (Clarkson, 2020, p.3), in particular seaborne trade of crude oil export to China which is a buyer of Nigerian crude. The big question here is how truly efficient are these export terminals in managing low crude oil prices despite increasing ET scenarios i.e. attempt to decarbonise the world moving away from fossil fuel? Although, research revealed demand for crude appears high (BP, 2019). Nigeria, like any COECs faced these challenges in order to remain competitive in exporting its crude oil resource to the global market. First, the business model is of strategic importance in E&P. In a sense, Nigeria's business model appears similar to most of the COECs but key differences appears in strategies, for instance, value proposition role for sustainable financing mechanism appears different in agreement and operations. Both primary and secondary data on Nigeria revealed similar findings despite having been generated from different instruments and methods. Second, from production perspective, Nigeria managed to produce 1.8Mbpd, which appears to be low in comparison to its Middle Eastern competitors and other key producers such as Saudi Arabia, Russia, and Iraq etc. Its production output usually comes from different JVs and PSCs fields, where different stakeholders have equity stake such as IOCs, NNPC and

IDOCs. In contrast, empirical evidence showed that dispute over entitlement usually disrupt terminal performance, although sometimes have limited impact on production. Obviously this impact supply chain and in the end might lead to decrease in investment from stakeholders. Overall, seen as a signal for inconsistencies in policy from best practices perspectives. The author believes that inappropriate business models impact port performance via cost, price and risk. It is evident that a *value proposition* which is interconnected with *consumer, as* well as a critical component of (Osterwalder and Pigneur, 2010)'s model to be given special attention, particularly in the adoption of sustainable financial mechanism for production cost and key SCM drivers such as security. Others are investment in operation for efficient and effective crude oil export logistics system distribution in Nigeria.

8.4 Overview of review of NNPC Business model

Firstly, <u>Resource</u> is a component of (Osterwalder and Pigneur, 2010)'s model. As mentioned earlier, Nigeria operates similar contract models to other COECs. However, inadequate funding appears critical from NNPC and a low-cost producers' perspective. Typically, under TA findings: <u>6.2.1-</u> <u>Contract /business model and 6.2.2-Inadequate funding</u> - for JVs which show clearly where Nigeria's ex - state Minister of Petroleum Resources, Dr. Emmanuel Kachikwu stressed the strain in funding government obligations in JVC with IOCs, which shows how the government struggle to pay its share of oil production cost. It is significant to conclude that inadequate funding appears to be linked to the inability to pass the PIB for nearly two decades. Obviously its non-passage has stalled investment in key oil blocks

development like the Bonga west offshore. In essence, key COECs such as Iran and Iraq appears to have a much better regulatory framework, which appears acceptable to all parties. It is evident that this impact on investment in the supply chains are hugely due to inconsistencies in regulatory framework. Furthermore, review of oil licenses and contract appears will apparently bring clarity in the way manner E&P costs have been funded and operated. More importantly, this would improve funding in key operations in the supply chains such as: crude tankers ownership, FPSO, marine vessels and modern infrastructure for improved ICT to name a few. More importantly, the author believes that Nigeria appears to have a huge opportunity to optimise the overall port performance if it borrows the LNG model that operates Gas company 49% stake, Shell 25.6% and Total 15% and 10.4 (NLNG, 2020). The NLNG model appears to be working extremely well because of its key strategies spanning the ownership of vessels, sustainable regulatory framework, crewing and human resource etc. Obviously, Nigeria need to adopt the Value Proposition, which focuses on financial incentives through contract models that would last for twenty years or more, like any other NOCs. However, Nigeria's oil contracts have been contracted since early 90s but it appears to be little or no evidence of the presence of incentives from the Nigerian government. Nevertheless, the author believes it is imperative to borrow from Iran's business models, which appeared pay cost of money for E&P from the beginning of contract. Research shows that sustainable funding appears the most important incentives to motivate knowledgeable IOCs with good financial background to enter markets (Tantau and Khorshidi, 2016, p.488).

In addition, empirical evidence revealed lack of proper regulatory framework, confirmed by all supply chain members, particularly the non-passage of PIB. This appears to be a great area of concern for facilitating port performance in the supply chain. Thus, adopting value proposition may jump start investment drive in the value chains and supply chains, but it appears sustainable regulatory framework, clarity in adoption and its implementation from all key actors is paramount at the moment. Obviously the performance of export terminals or ports appear to be good in Nigeria and are attuned with international standard, but for improved performance, it is extremely necessary to adopt new or improved business model. This will impact security architecture and massive investment in the value chains that transcends to reduce cost of oil E&P, effective maritime transport and logistics, but also increase price of crude to gain competitive edge and reduce risk to a barest minimum (Khorshidi, 2018, p.509). In the end, if the price of Nigeria crude is discounted due to issues such as inefficiency in their business model or lack of security, this could lead to amountable cost due to inefficiency. There are also other areas that do not necessary cost Nigeria money directly out of national revenue but obviously this is a missed opportunity not to be able to maximise this revenue. Nigeria may not see it as a loss, rather as discount, if Nigeria is less reliable whether is for security, poor scheduling or unavailability of cargo because of pipeline issues. All of these work together and give less revenue, which ultimately is still paid for by the Nigerian people at large, chiefly through lower revenues.

8.5 Overview of review Contribution to Knowledge

The author will summarise contribution to knowledge in three phases which include conceptual, theoretical and empirical contributions. Firstly, the research problem explored information sharing challenges in the supply chains, and research evidence acknowledged its significance in the supply chain resilience (Hull, 2002, Wold and Laumann 2014 and Urciuoli 2014). Hence, the author thought of discipline narrative through collection of empirical data, developed and analysed with various qualitative techniques (Shapira, 2011, p.1315). This presented a basis for the research undertaken, which evolved into generating several empirical themes that finally became strategies that underpinned the basic strategic templates of challenges and opportunities of port performance in crude oil flows in Nigeria. TA technique appears to be the first of its kind and is rare in crude oil flows, findings many template of strategies. For instance, in relation to research problem, notable template of strategies corroborated slowness of information sharing in other operational procedures, particularly between regulators and ship captains, NNPC and IOCs and especially in aspect of availability of cargo and readiness of terminal operators for export purposes.

Secondly, the AHP model is another contribution derived from both qualitative and quantitative data. In summary, the AHP model explained a basic contribution to knowledge, derived predictions based on clearly defined assumption (Shapira 2011, p.1314). Hence, the author's goal of the model was to help policy makers to evaluate trade-offs between all the key strategies for port performance in crude oil flows. In essence, the model can

be vital for both NNPC and IOCs, particularly in reliability of metering systems, speedy need for anti-piracy law and information infrastructure investment in curbing maritime insecurity, and investment in achieving sustainable information sharing to strengthen security between terminal operators and Nigeria security forces. Overall, the AHP model is a contribution to knowledge because of its rare application in crude oil flow, which is derived from data, also formulated in mathematical terms (Shapira 2011, p.1314). It is vital to say that present studies contributed to literature, particularly in one of the AHP findings "information sharing and synergy between terminal operators and Nigerian security forces in oil and gas security, pipeline security courses and training". It also challenged rationale of the presence of government officials during crude oil loading operations to know the exact quantity of crude oil loaded. The author believes that with adequate investment in modern communication technology and metering systems, this will ultimately simplify crude oil terminal operations and facilitate port and logistics performance in crude oil flows in Nigeria.

Third, conceptually, the author derived various conceptual frameworks throughout research phases but the last key strategies to model port performance in Figure 6.8 allowed the author to make sense, understand the study's boundaries, major findings and challenges. In addition, this could lead to model development and theory construction (Shapira, 2011, p.1313). Key strategies to model port performance in crude oil flows reveal critical strategies of under-investment in critical infrastructure and an increase in maritime kidnapping in the Gulf of Guinea. This work corroborated key research on rate of maritime insecurity and a need for urgent legislative

reforms such as PMSC, review of IMO ISPS code, port security and technology in finding sustainable strategies to maritime security that is critical for energy flow and security from Nigeria as COEC to the global oil market. In addition, the role of Nigeria's weather in crude oil flows, due to its friendliness and stability as it facilitates seamless logistics of port performance. However, the conceptual framework might lack strong assumption unlike theory not likely structured but provided new insight into key strategies named above (Shapira, 2011, p.1315). Thus, critical evaluation of this model would likely to lead to better understanding of crude oil flows from Nigeria's perspective, as well as view as a model for developing COEC's case study (Shapira, 2011, p.1315). Finally, these contributions are peculiar to Nigeria, however they could be tested in key COECs in the developing countries and as well as in comparison with developed COECs port performance strategies.

8.6 Summary

First, research overview revealed limited knowledge of SCM concepts among the different stakeholders in theory, but slightly more in practice particularly in the NNPC and smaller producers. Crude oil export port/terminal efficiency depends on a lot of factors but most important is the adequate security and investment in all facets of supply chains, and experience of human resource that are manning the terminal during the crude oil export operations that cut across the crude oil export map in general. Further, this appears linked to an effective business model because an effective business model appears better with dealing out efficient and effective security and investment strategies for overall port performance in crude oil export logistics systems. Despite this, there are numerous performance strategies depending on the method of data collection and analytical technique. Obviously, Nigeria ports/terminals appears to be operating according to international standard but review of business model to increase value proposition for funding of its operations is vital for the sustainability of energy security from Nigeria to the global oil market. Contribution to knowledge highlighted in three phases which span conceptual, theoretical and empirical findings. The next chapter will discuss the whole study by addressing each ROs, RO1 to RO5, including contribution to theory, practice and policy. Finally, limitations, recommendation for future research and conclusion.

CHAPTER 9: CONTRIBUTION, LIMITATIONS, RECOMMENDATIONS AND CONCLUSION

9.1 Introduction

This chapter summarises the findings for each RO. First, the role of ports in crude oil supply chains revealed that onshore and offshore differ in characteristics such that terminals onshore, perform worse, concerning reliability, safety. The onshore terminals have higher capacity than offshore terminals. In addition, the remaining four ROs were explained, with RO2 reveal key characteristic of port systems in Nigeria to be associated with multiple government agencies which leads to bureaucracy. Second, the chapter also highlights the implications of the research in theory, practice and policy respectively. Finally, study considered the research limitations and main conclusion with recommendations for further study.

9.2.1 Research objective one: Role of ports in crude oil export logistics system Distribution in Nigeria

The findings of this research showed that qualitative data revealedprofessionals engaged in crude oil export logistics referred to the port as export terminals, which includes pipelines, offshore facilities, dredged seabed, marine platforms, onshore distribution storage equipment, barges, and metering systems. In addition, the port is a network of organisations of logistics and transport operators and the strategic alignment of these operators, and their processes determines the port performance (Islam, Olsen and Ahmed, 2013), (Bichou and Gray, 2004, p.48).

Although research evidence revealed minimal work on oil flows compared to container terminals (LCCI, 2016, p.3, 2018, p.5). See details in Chapter 2 for SLR. Moreover, due to increasing growth in container trade, which composes 80% of seaborne trade (Churchill and Lacobucci, 2002), more than oil tankers- which estimated that 793.26 million TEUs were handled in container ports worldwide roughly 50% of the total dry and liquid bulk ship tonnage (UNCTAD, 2019). Thus, for most of the studies are on port performance measurement benchmarking (Bichou, 2004), and environment, particularly GHG emission. Furthermore, recent studies focused on the carbon intensity of crude oil production (Masnadi et al., 2018), GHG emission from ports (Olukanni and Esu, 2018, p.1) and sustainability. Notably port sustainability management for smaller ports in Cornwall and Devon (Kuztnesov, 2014), Nigeria's port reforms efficiency and challenges (Akinyemi 2016, Onifade 2020) etc. However, there is a growing interest in oil related transport logistics but limited work on logistics such as maritime oil freight flows

(Dinwoodie et al., 2013, p.553), information flow in crude oil transport (Hull, 2002, p.8), cargo loading operations in oil tanker (Akyuz and Celik, 2016, p.424), spatial aspects of tanker lay-times (Mokia and Dinwoodie, 2002 p.39) etc. Further, a recent study on gas terminal supply chains which focused on risk management in LNG ports and marine terminal supply chains (Brioug, 2013, p.16). In essence, export terminals are strategic assets in logistics performance of crude oil export. Nigeria's 27 export terminals are composed of both onshore and offshore terminals with different sizes, storage capacity/throughput, operators and streams/grades. It is strategic in the sense that without port and export facilities, it is entirely impossible to continue E&P activities and operations. Furthermore, it is vital in the oil business, especially in a country like Nigeria that is not consuming the crude oil locally to a large extent, to remain competitive in the global market. In general, the experts' consensus being in the crude oil export value chain is of the port being a strategic asset, with roles such as the last point the crude oil touches before it leaves the country, crude oil lifting, vessel handling, being an integral part of supply chains. Further, being an important node in global supply chains to transfer crude for shipment and transportation to destination ports/terminals.

Empirical studies revealed a sharp distinction between onshore and offshore terminals.....onshore terminals are less in reliable, safe, although nevertheless are higher in capacity than offshore terminals. Moreover, other findings revealed inadequate investment in infrastructure in logistics operations such as dredging, pipelines systems, service boats, crew/supply vessels, crude oil tankers and subsea lines. Despite export terminals being

managed by JVC, PSC, and Sole risk contracts with a landlord governance model. Furthermore, a lack of maritime security particularly in operational infrastructure in some of the terminals, such as a digital system for maritime security with particularly poor information technology such as NAVTEX, GMDSS etc. The key message here are the implications of these key findings which appear enormous in terms of impact on the price of crude oil, loss of cargo, inefficiency in terminals operations which led to cargo delay to customers, loss of market to competitors, premium reduction on specific stream/grade of crude, loss of revenue and prevalence of distressed cargo. However, Nigerian crude richness in quality is extremely good.

In conclusion, Nigeria's exporting terminals present a golden opportunity for crude oil flows in terms of crude reserves and logistics with a geographical advantage to the international oil market. Furthermore, there is a minimum restriction to a laden VLCC with minor exception, which is a common feature of West Africa exporting terminals. However, major issues span inadequate investment in dredging, dredged seabed, speed and skills of the workforce in vessel clearance during and after loading operation, automation of pipelines security systems, break up of subsea lines, and sustainable maintenance framework particularly for onshore to avoid variations in exporting rates. Effective SC requires a smoothly operating information system (Hull, 2002, p.9). Thus, qualitative evidence revealed absence of good shipping agent/independent evaluator or assessor of the situation for effective and efficient information flow with all stakeholders in the value chains. Adoption of SCM concepts is paramount to accelerate information transfer effectively and efficiently in the value chain, to respond to the urgency of shipping market

dynamics such as chartering, shipping contracts, brokerage fees, freight rates, energy demand and customer satisfaction. However, SCM concept-as defined in the academic literature; is implemented or even misunderstood in practice. Despite its awareness by logistics and SCM academics, it appears that there is apprehension about finding a relevant and unified theory of SCM (Mentzer et al., 2001, 2004; Sweeney, 2011). Furthermore, drawing from the meaning of SCM by (CSCMP, 2019) that defines it to encompass the planning and management of activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers and customers. In essence, SCM integrate supply and demand management within and across company. The author believes that low-cost producers and NNPC appears to be struggling with its adoption and practice. In addition, recent work by Edward et al., (2018, p.852) on strategic adoption of logistics and SCM indicated a divergence between understanding, adoption of logistics, SCM principles and concepts at a strategic level in firms. Moreover, inefficient export terminals are characterised with measurable and immeasurable cost, due to less reliability, poor cargo scheduling and unavailability of cargo due to pipeline issues which include leakages, maintenance, vandalism etc. All these have great impact to give less revenue and reduce premiums on cargo.

Finally, critical investment is required in technological advancement particularly in electronic communication systems by low-cost producers and NNPC. It is imperative that adoption of SCM concepts will be of immense significance in improving the role of port performance in the crude oil export

logistics system in Nigeria, for a move toward a reliable, secure and cost effective crude oil supply to the global oil market. Thus, its understanding and practice has become an essential prerequisite for Nigerian operators to remain competitive in the global market, as well as enhancing profitability (Moberg et al., 2002) aimed to provide maximum customer service at the lowest cost possible.

9.2.2. Research objective two: To analyse the characteristics of port system in Nigeria crude oil export logistics system

First, the main characteristics of port system in crude oil export are multiple government agencies which leads to bureaucracy. Others are strike actions, presence of government officials, slowness in information sharing in the supply chain, lack of maritime security/piracy, change in lifting schedule and slow documentary processes involving exchange of vital shipping documents. Major findings revealed a slow information network from NNPC to crude oil traders during vessel clearance, although this appears faster from major IOCs due to advancing technological investment. See details in verbatim informative quote from an international crude oil trader with wide experience in Nigeria crude oil trading in Feb.2017.

Therefore our experience has been because we have often have to go through NNPC and NNPC go to terminals that is operated as a separate commercial entity, they tend to creates slight delay in vessel clearance being passed down the chain; those are things that can be overcome that is definitely, a key experience as well.

Furthermore, multiple government agencies during vessel clearance before and after cargo loading are more or less the same as with the presence of government officials which leads to bureaucracy, causing unnecessary delay.

Further, the procedures are normally electronic and can be relatively slow. Nevertheless, paper manual documentation is still common, particularly in exchange of vital shipping documents such as export permit, BOL, DI, CQ and vessel contractual procedures/agreement. Some of these issues can be resolved by the application of technology. For instance, multiple government agencies increased bureaucracy during vessel clearance and the exchange of documents which impact effective and efficient logistics e.g. missing documents which could take a longer period of time to retrieve. Both activities are interconnected with the information sharing network which is vital in crude oil flows. Moreover, research has shown that BT appears to be significant in this scenario, as it allows all the value chain members to share and stored information effectively and efficiently. In this case, due to its independent nodes and decentric functions, BT has certain relevance for solving asymmetry of information in the spot market and difficulty of supervision (Khan et al., 2016, p.6239). However, there is always doubt about the authenticity of shipping documents particularly electronic copies, which is why supply chain actors/oil companies prefer to deliver BOL documents subject to banking and postal delay, although more traders trust electronic BOL which requires extensive training and legal status clarification (Mei and Dinwoodie, 2005, p.198). Further, an electronic BOL appears difficult due to its numerous requirements associated with legal, third party internet service provider (IBTPIS) and commercial frame work. The author believes BT application in exchange of shipping documents will improve rapid interaction of information within value chain members that are relatively independent. For instance, a crude oil trader sending DI to NNPC or NNPC

informing the Navy of a NOR of tanker, which sometimes lead to the arrest of tankers which has various implications, incurring demurrage charges, increase operating cost, delay in time, change in date of lifting programme etc. In essence, adoption of BT will minimise these scenarios through faster communication channels and alert all stakeholders of any impending challenges in the supply chains. Thus, increasing the transaction authenticity with a guarantee of reliability and reduced risk, would provide the regulator (DPR) supervision of this action for healthy development of the transaction (Liu and Zou, 2018, p.985). Overall, recent research evidence showed adoption of BT by major IOCs in the industry. For further details, see analysis section of TA in Chapter 6. On the other side of the spectrum, Nigeria's weather is relatively excellent in comparison to most of COECs for its calmness and fewer Harmattan periods from September to December, which is a plus for its efficient logistics operations during loading and vessel movement on the high seas to the international waterways.

9.2.3 Research objective three: To analyse the measure of performance of ports crude oil export logistics system

Measurement of export which usually occurs in the custody transfer unit is significant for the whole port performance and logistics operations. Physical measurement of crude oil is associated with measurement errors (Dinwoodie and Bhatia, 2004). Qualitative research data corroborated this assertion. [First, a senior oil major executive with OCIMF say "Most of the issues between regulatory and operations company will be probably be around the measurement of export"]. Empirical evidence revealed common issues include old metering technology, differences in ship shore figure, outturn on delivery, ship shore difference determinant factors, non-standardised measurement system and differences in standard units of measurement (metric and customary systems). Moreover, archival data and qualitative data revealed regulators use static (manual) and dynamic systems that uses flow metres. See details in (appendix 11 archival analysis). It is important to consider the AHP group decision making and terminal operators group that ranked a need for a reliable accurate metering system for use as BOL data figure of 14.28 % and 8.2 % respectively. In addition, qualitative data findings also confirmed that the latter requires advanced technical knowledge for its operations such as software application and formula. Obviously, different measurement systems will arrive at different metred figures, and this appears obtainable in Nigeria. In essence, logistics efficiency is underpinned by a reliable accurate metering system showing metered quantities for use as BOL data figures. In most cases, the metric is higher than customary with a difference of 500 barrels. For instance, see detail in qualitative data from a supply chain member and a senior oil regulatory official "Difference is in unit, especially like Erha, ExxonMobil, I just came out from

there now. Though there system is metric, however DPR's CQ is in customary, which we usually have difference of 500 barrels between customary and metric. If you use Erha system instead of you to have the same answer like one million barrel, you will have one higher by 500 or 600 barrel, which is because of different in units". Moreover, preliminary survey rated "a need for reliable accurate metering systems showing metred quantities for use as BOL data" with the highest score of 96 (see table 7.8). Furthermore, AHP survey group decision makers rated it to be fourth among the seven key improvement strategies. Consequently, this leads to a difference in ship shore figure occasionally. The empirical data clearly showed that technology and technical expertise of work force are critical in the measurement of exports in the metering value chain, which usually reflects in high ship shore differences. Thus, digitising the metering system is critical at the moment, with the idea of outturn delivery and inspection complicating the logistics chains with huge cost and time wastage implications. Hence, it is imperative to invest in modern metering technology such as dynamic measurement systems, and turbo metres, as this would save time, cost, and cargo loss/theft during loading and off-loading. Obviously a tolerance level of 0.05 is inevitable, hence the reason for meter proofing for accurate repeatability to allow for exact precision during measurement. Thus, building confidence in the reliability and accuracy of metering systems has huge correlation with contractual obligation and agreements such as FOB incoterms. In essence, with a reliable accurate metering system digitised across all LACT UNIT, it appears that there will be a significant reduction in human interface interaction, which usually complicates the logistics systems and operations. For example, a key implication could be seen in reduction in numbers of cargo surveyors, thus, enhancing cost saving for buyers and sellers, with

minimal use of Outturn mechanisms that come with huge cost implication to all parties. In practice, occasionally the workforce often have to visit destination terminal/ports for investigation of actual quantity delivered.

Furthermore, other factors that impacts the ship shore figure are weather, human error, and ship type which can be minimised as these are common natural and global phenomenon. Nevertheless, weather has an insignificant effect on the logistics of oil flow in Nigeria. In fact, qualitative data revealed a consensus among supply chains actors on weather friendliness except in specific times, such as April to September, and as well as the Harmattan season, typically between November and January, which appears to come with limited effects which may last for six hours. Furthermore, squall is a phenomenon in the Gulf of Guinea that comes with a force of 30 to 35 knots, which is well managed via safety procedures. Importantly, qualitative evidence showed little technical knowledge/information on metering operations and management by government representative officials from NNPC and the regulator. Moreover, the implications of these are enormous, such as the possibility of BOL to be overstated or understated, crude oil theft and crude oil loss. Nevertheless, oil loss is a common factor that occurs, accounting for 80% of discharges in the marine crude oil transportation system (Baird and Hayhoe, 1993). However, measurement losses or differences are usually calculated for each stage of the voyage (Harrison, 2001); which could be through spills and leakage. Earlier studies by Bhatia and Dinwoodie, (2004, p.815) addressed factors that aids measurement loss of crude-vessel type, load port effect and variation by crude. Nevertheless, the current study corroborated all these factors (see details in chapter in table

5.7 and 5.8 for TA findings). What is more, Nigeria's non-standardisation of measurement/metering system is a huge challenge for accuracy and reliability of metered figure. Supporting this assertion is a trader verbatim

Quote. "This tends to give a quite significant as much as 6-7% sometimes. Ultimately, on the offshore fields tend to be less, onshore tend to suffer from water falling depends on quality of the crude. Metering may suffered from a bit of old "metering technology" and you might not have inland samplers which measure crude as it goes into tank, if you have to measure by dipping cargo ties, swells and experience of inspector and sort" according to crude trader with experience on Nigerian crude oil sales. On the other hand, the economic cost and reputational risk of non-reliable accurate metering is expected to be significant for all the value chains actors. This study has raised an important component in crude oil export supply chains that needs revisiting in Nigeria's energy supply chains. Importantly, a key component of logistics is actual quantity of goods from point A to B to be delivered accurately at right quantity as agreed. The author is not unaware of various mechanisms put in place which are in tandem with API MPMS. However, standardizing measuring technology and investment in workforce is critical for a sustainable metering system.

9.2.4 Research objective four: To analyse port performance and crude oil export logistics system distribution in Nigeria

Research revealed that vessel repositioning, and awaiting available berth space, may engender port delays as many ports become inaccessible due to draft, quayside, storage or handling restrictions (Dinwoodie et al., 2014, p.65). In this respect, Nigeria export terminals have excellent quaysides, draft, and storage handling capacity (see Appendix 20 and figure 3.1 and table 3.7 for Terminal description and sizeable number of storage capacity for terminal throughput, Nigeria's crude export terminal showing locations, streams and storage capacity).

Importantly, empirical evidence revealed that most of the terminals possessed the characteristics mentioned. Consequently, it allows for easy movement and seamless logistics flow, particularly for offshore that are designed to meet international standards. For instance, Agbami, other offshore terminals and a few onshore have excellent characteristics for limited restrictions where VLCC can load if they are already laden. Only a couple from four had restrictions, except for Escravos due to the stresses generated at the mooring point of the single point mooring (SPM). Nigeria's export terminals are relatively excellent compared to their counterparts in Africa in terms of weather, infrastructure, draft, length etc. Furthermore, this is increasingly evident in investment in offshore terminals, like the recently completed Egina offshore project (Total, 2019) which will surely impact seamless logistics flow. Essentially, shipping involves prompt availability of vessels, but in the case of Nigeria, most major IOCs have trading arms, and list of OIC's trading section (See appendix 6C and 6D for detail) which ease

flow of crude oil export due to their investment portfolio in shipping assets e.g. Crude oil tankers leasing or ownership for efficient and effective SCM of crude oil. However, major key players appear thoroughly efficient except for operational issues such as vessel clearance, information sharing and synergy between terminal operators and Nigeria security forces in oil and gas security, pipeline security courses and training.

In the context of information sharing, particularly between naval security officers, E&P and private security outfits (Affi et al., 2015), empirical qualitative data and survey shows it has not been effective. For more details, see table 7.9 for the AHP preference order of Terminal operators group DM. Furthermore, archival evidence confirmed that information sharing is critical as its absence can lead to incurring demurrages worth millions of dollars. This is evident in the case of Crudesky that involved a charter party demurrage vessel delayed at Port Harcourt by Nigerian Authorities after cargo of crude oil and whether charterers are liable to pay demurrage at full rate or half rate (Lloyd's law report, 2014, Vol 1). In this regard, the major issue that led the defendant to seek redress in the court was inadequate information sharing during crude oil lifting in Akpo oil terminal operated by Total, whereby two different DPR representatives, present at different time, needed to clear vessels for loading, which is usually carried out after receiving notification from DPR Head office in Lagos.

In the end, MPR fined Total requiring them to pay a fine of <u>US\$12M</u> to the DPR's US\$ account in New York and requiring disciplinary actions against the personnel. This was paid by Total on 13th, Oct and vessel was released on 16th, October, and then vessel sailed for the port of discharge. Literature

revealed that information sharing within the overall supply chains is a key issue that required investment, training, partnership etc. The author believed that increase in investment in technological advancement in key areas of the value chains will certainly increase value and the credibility of Nigerian crude oil in the international market.

In conclusion, despite the presence of shipping and trading arms such as NNPC-Duke Oil services and NIDAS which are responsible for marine transportation of crude oil and petroleum product. However, empirical evidence revealed lack of vessels, whether medium or VLCC, which appears the same issue with low-cost producers. Further, Nigeria's 30 ship tanker fleet project faced challenges due to higher taxes and a lack of cargo commitment from the NNPC (Lloyd's list, 17 April, 2018). These are key issues that impact the logistics of oil in Nigeria, which is underpinned in policy somersault, lack of skill set for shipping, inadequate funding and non-clarity in business model etc. Furthermore, information sharing in a timely fashion is critical for SCM. Overall, its impacts are enormous in improving security in the waterways, effective cargo loading, reduced exposure to demurrage and increase the Nigerian cargo market share in the global oil market.

9.2.5 Research objective five: To recommend strategies or policy to optimise the crude oil export logistics system

However, Bichou and Gray (2004, p.48) assert that measures of port efficiency or performance indicators are diverse due to different use of a range of techniques for assessment and analysis. Although many analytical tools and instruments exist, a problem arises when one tries to apply them to a range of ports/terminals where there are various port governances and performance measures or strategies. However, present study main objective is to find sustainable strategies or to recommend policy to optimise in crude oil export logistics system distribution in Nigeria. Furthermore, the study employed various methodologies and techniques ranges from scoping, archival data, SLR, various semi-structured interviews, focus groups, Likert scale and AHP survey to derive a model of key strategies to model port performance and crude oil export logistics systems distribution in Nigeria. The model of key strategies can be applied in countries with similar jurisdiction such as Mexico. A key example is Martin, (2018, p.5)'s work which advocated for restructuring of Mexican energy sector for a new business model for Pemex and the national oil sector, and also, enumerated themes such as lack of technology, insufficient innovation etc. Further, Venezuela, Libya, Iraq, Angola, other West, North and Eastern African COECs could explore this study to serve as a benchmark. The cornerstone of port performance in crude oil flows are chiefly security and investment, stated in the entire model. More importantly, investment in technology across the value chain, incentivizing embracing technology and innovations across the value chain-pipeline automation systems for all the major players

including IOCs, IDOCs and NNPC. Furthermore, technological advancement in documentation processes. For example, application of BT to facilitates effective and efficient information flow network with vital shipping documents exchange and communication technology in the supply chains. It is imperative to adopt SCM concepts because of its immense significance as an integral part of effective logistics chains. Its impact can be seen in a situation where the role of a good shipping agent will coordinate multiple government agencies and key supply chain players for effective and efficient service delivery for customers' satisfaction in the long run. In addition, investment in shipping fleets, crew vessels, supply vessels and boats will ease the logistics challenges as qualitative evidence revealed high cost of supply vessel hiring and limited numbers in the marine industry. In concrete terms, with a rapidly changing global energy outlook particularly from demand and supply perspective. It is imperative for Nigeria to adopt this study's findings to increase production output, so as to attract more investment in the value chain for Nigeria to maintain a truly competitive advantage in the energy market in Africa and in the international oil market. Importantly, the AHP model enumerated in concise manner performance measures/strategies for improved effective and efficient logistics systems in the value chains. In essence, the AHP model has many implications as it presents the author and stakeholders with an understanding of the preference order of major criteria/attributes which will stand as a foundation for proposing sustainable optimisation strategies. Finally, empirical findings attested to less efficient logistic performance measures in Nigeria such as high cost, longer time (delay) and less customer satisfaction compared to

COECs (Bowersox and Closs, 1996), which appears because of issues around the lack of maritime security, inadequate investment, high manual documentation, multiple government agencies, bureaucracy, incoherent regulations, operational inefficiency, marine operations disruption, inadequate training, absence of piracy law, commercial and contractual obligations, poor SCM adoption and cost ineffectiveness either tangible or intangible which reflect in additional cost involved and how not dealing with this effectively is ultimately still paid for by the Nigerian people at large, chiefly through lower revenues.

In absolute terms, Nigeria will have to adopt a more modern business model that accommodates the challenges of the modern day energy market. Model projections of the domestic energy market through 2050, includes different cases and assumptions concerning macroeconomic growth, world oil price, technological progress, and energy policies (EIA, 2018, p.3). Furthermore, there is increasing an evolving ET scenario toward a low carbon energy source in a world of increasingly energy demand. Moreover, there is increasingly competition from COECs, and also from other non-conventional sources like the US shale production. It is imperative for Nigeria to adopt this study's model as an improvement strategies model. More importantly, a new approach to curb maritime insecurity is needed to underpin a passage of antipiracy laws and adoption of PMSC that will serve as deterrent for criminal gangs in illegal acts of violence, particularly with increasing armed robbery, sophisticated vessel hijacking in the Gulf of Guinea mostly concentrated in Nigeria (Lloyd list, 2017). According to a recent priority paper by the Danish government (November 2018), this aimed to showcase Danish efforts to

combat piracy and other types of maritime crime during 2019-2022. Therefore, this study concluded with the fact that a sustainable regional cooperation by countries in the Gulf of Guinea in implementing all the security framework, which included IMO resolutions, regional and national instruments, see detail in section 6.2.11 and 6.2.12.

Finally, the author believes that sustainable legislation, such as passage of PIB into law will enhance the investment climate in all the value chains, particularly offshore exploration, inventory management, crude tankers acquisition, and supply boats etc. Overall, it will boost confidence in security investment by the terminal operators, NNPC and low-cost producers.

9.3 Contribution to Theory

Previous literature revealed information flow has been critical for effective and efficient logistics system distribution. This study explored TA to produce strategies such as slow information and information flow network which answered RO2, which is confirmed by previous existent literature in a few studies by (Hull, 2002, p.8, Urciuoli et al., 2014, p.55 and Wold and Laumann, 2014, p.23) which underpins the present study. AHP findings also confirmed information flow through application of TA technique, which appears obviously flexible in comparison to GT. In this study, the author discovered how reluctant some professionals responded to be interviewed due to the busy nature of their tasks, despite using a purposive sampling. Hence, the rationale for chosen case study methodology instead of grounded theory that requires comparative analysis and coding at the same period of time, which appears difficult to achieve in contrast to a case study that allows multiple methods and approaches for data analysis (Hair et al., 2016, p.302). Importantly, the previous study explored in developed world, while the current study is in the context of a developing country which confirmed information flow network/information sharing as a dominant issue in SCM of crude oil export logistics regardless of COECs across the globe. This study contributed toward producing a model of key strategies to model port performance in crude oil export (see details in Figure 6.8). The model emerged from natural research due to grounding of empirical data which perhaps can give rise to theory in the context of Nigeria and any similar jurisdictions. This study added to the body of literature in regard to knowledge management (KM). Simply put, Bergeron (2003), defines KM as a
deliberate, systematic business optimisation strategy that selects, distils, stores, organizes, packages, and communicates information essentials to the business of a company in a manner that improves performance and corporate competitiveness. This study revealed application of ANT in some studies such as Olsen, Prenkert, Hoholm & Harrison knowledge networks that support knowledge sharing and transfer in information technology projects across different organisations (Alkhuraiji et al., 2016, p.1535). Notable findings revealed information sharing and synergy between E&P operators and security forces which have huge impacts on logistics operation efficiency. New areas worthy of consideration emerged in the logistics operation of crude oil flows including information sharing between terminal operators and security forces, a reliable accurate metering system showing metred quantities for use as BOL data and a need for anti-piracy law specific to Nigeria. Strategies for improvement are grounded in the experts' knowledge, which can be replicated. Further, academic literature emphasized that accurate information flow is central among supply chains links in a timely, coordinated fashion, which minimizes distortion; structured information management lies at the heart of SCM (Singh, 1996, p.28, Hull, 2002, p.8,). Empirically, findings revealed that the highest global weight complemented prior academic literature on information flows, in particular information sharing and synergy among the supply chain collaborators particularly in areas of port or terminal security in Nigeria's crude oil flows scored 34.1%. These quantitative findings were supported by interview data. This study contribution in terms of research technique are AHP, ECA and TA analysis which appears to be the first of its kind to crude oil flows,

particularly in the logistics performance of port. Although, a few studies utilised AHP techniques in port management involving containers, <u>none</u> <u>addressed</u> oil related logistics transport as seen from existent literature. However, with no evidence in the SLR so far, the choice of these techniques is a laudable contribution to knowledge. Furthermore, it is understood that much logistics research has been dominated by quantitative research viewed through a positivist lens (Mentzer and Kahn, 1995).

In addition, there are increasing calls for logistics researchers to more frequently employ qualitative methodologies (Mangan, 2004, p.565). Therefore, the current study did not only use qualitative methodologies; rather it combined both qualitative and quantitative. To develop advanced logistics research has found by researchers in logistics, marketing and operations research - a given field may be underachieving if all the research is conducted within a narrow methodological domain (Dunn et al., 1993, p.2; Naslund 2002). Data and methodological triangulation used different analytical methods in analysing qualitative interviews and surveys, including both secondary and primary data. This lends greater empirical support for theory as well as compensates for flaws, and leverages the strengths of various methodologies (Mangan 2004, p.569) reporting the work of Svensson (2001). In addition, Golicic et al., (2011, p.726) and Fawcett et al., (2014, p.13) acknowledged it is vital in advancing SCM through rigorous application because they present richer understanding and more robust explanation of the phenomenon under study. Finally, good methodological triangulation on the impact of outsourcing on inbound logistics flows used different methods including desk based market analysis, questionnaires, Aaker and Day's

model, several interviews and Delphi respectively. In the same vein, the present study employed different methods and analytical techniques. Essentially, TA works extremely well because it produces a template of strategies that are paramount for effective port performance. For further details, see the template of strategies in chapter 6, as some of these strategies show Nigeria's challenges as well as indicated better strategies Nigeria possess over its competitors such as weather, crude grade/stream, and crude reserves. Overall, RBV impacts operational, financial and legal strategies of crude oil export logistic system distribution. In this study, RBV helps to show Nigeria crude oil resource competitive edge over its competitors. The author believes in choice of pragmatism philosophy that Nigeria crude oil export is a firm resource with firm attributes. *This study* contribution, particularly in theory, revealed that Nigeria possessed friendly climate conditions for crude oil export purposes than most COECs. In addition, good quality of low sulphur crude, which competes with global Brent benchmark for the oil market, and huge offshore wells yet untapped such as Bonga west and recently commissioned egina FPSO in December 2019. RBV show two distinct relationships which are internal capabilities in this study (weather and quality of crude particularly huge offshore fields) and external industry requirement in regards to market demand. Basically, a key external industry demand in this study is financial incentives, Nigeria appears lagging behind and this tied to business model obligation with a huge effect on all of the supply chains that require investment, particularly pipelines and terminal security. Moreover, AHP model strategies appear more effective and efficient in key COECs than Nigeria. To summarise, both empirical and

literature findings focused on need for investment in technological advancement such as turbo metering technology, better equipped ICTs and sustainable regulatory policy. However, IOCs operating in Nigeria are attuned to international standard, but inability of massive investment and unsustainable security framework also impact the performance of all the crude oil export terminal logistics system distribution. This creates need a need for urgent reforms to enable a more sustainable, cost effective and efficient crude oil transport from Nigeria oil wells to the global oil market. Interestingly, Nigeria appears not alone in terms of challenges associated with exchange of vital shipping documents as mostly it is done manually until recent reforms to make it electronically attuned for all supply chain actors. A key example is electronic BOL (eBOL) gaining attention globally from major IOCs and other key actors. For further details see section 6.2.8 documentary process. In conclusion, this study contributed to the development of theory on uniqueness of Nigeria's weather for maritime transport of crude oil export logistics system distribution via application of TA, as well as confirmed information flow which is the basic framework that informed this study as a template among many strategies. Importantly, its application is obviously a rare technique in the context of port management in crude oil flows.

9.4 Contribution to Practice

The author believes that an automation system for pipelines, inventory, communication, security systems and SCM concepts in logistics operation are central for effective and efficient SCM in crude oil flows, which ensures to sustainable, affordable, and reliable sources of energy from Nigeria to the international market. In addition, other key strategies needing improvement are legislation, training, effective electronic communication and information infrastructure. For Nigeria to have an edge over its competitors these empirical strategies are quite essential to optimise port performance and crude oil export logistics system distribution. AHP assists in understanding the preference order of major criteria/attributes and proposing sustainable optimisation strategies. More importantly, SCM adoption by low-cost producers, such as NNPC and DPR can be considered as an integrating function with primary responsibility for linking major business functions and business processes within, and across, companies into a cohesive and high performing business model (Grant et al., 2015, p.8). Furthermore, this improves logistics management as noted by CSMP, (2020)'s definition of SCM; other factors of considerable importance are E&P, which drives the coordination of processes and activities across marketing, sales, automation of security systems, finance, and information technology which is thus more a holistic view of a firm. The implication of SCM to these categories of the supply chain actors is immeasurable in terms of cost and time saving as well as cargo throughput with effective and efficient delivery for customers' satisfaction. However, they operate on limited resources due to capital intensiveness of the crude oil export value chain (see details in the qualitative

TA in chapter 6) which makes CAPEX unsustainable. This is where SCM's contribution is highly relevant in demonstrating a thorough understanding of the concept by these stakeholders.

Secondly, coordination of activities and collaboration is a key element of SCM (CSMP, 2020, p.1). In addition, oil supply chain is multidisplinary in nature. In essence, empirical findings revealed less effective SCM operations between these multi-stakeholders in VC, which is a critical component in the chain, particularly in terms of effective coordination, which has a huge impact on lifting programmes and vessel scheduling. Similarly, SCM manage streams of activities such as storage, warehousing, raw materials and complete goods from source to point of consumption or customers (Chima, 2011). VC effectiveness will hugely impact on the whole SCM due to the dynamics of the shipping market which is susceptible to changes in freight, subject to wide range of external variables such as vessel supply, commodity demand and market sentiment (Baltic Exchange, 2020, p.1). The author believes this requires urgency for speed of business, which is a critical part of the chain. In addition, this is interlinked with technological innovation advancements such as block chain technology (see chapter 6.2.8 for detail). The author believes information management clearly facilitates VC. In essence, having a good shipping agent to coordinate information flow, in terms of vessel clearance with use of modern technology like block chain, will increase the effectiveness and efficiency of SCM. In essence, this has huge impact on demurrage cost. Although qualitative findings revealed Nigeria practiced principle of common basket in order to adhere to first-come firstserved berth allocation policy, nevertheless, delay caused by non-urgency in

vessel clearance certainly lead to demurrage that is obviously at odds with efficient operation of ships, and therefore representing a barrier to improving energy efficiency in maritime transportation (Adland and Jia, 2018, p.6). Charter party plays a vital role in this regard but due to the sensitive nature of this research it appears difficult to evaluate. In conclusion, research suggests that demurrage rates are higher than freight earnings in a poor market (Adland and Jia, 2018, p.6). Obviously, qualitative findings in Nigeria revealed poor market sentiment, and thus it is imperative to continue to improve best management practices in SCM particularly in streamlining vessel clearance due to an increasing need for technological advancement to improve effectiveness and efficiency of port performance and crude oil export logistics system distribution in Nigeria.

9.5 Contribution to Policy

In an era of increasing global oil demand, despite increasing growth in an ET scenario, there is an urgent need to shift from a traditional business model to a more modern model. The model must accommodate challenges including climate change, collapse in oil prices, maritime insecurity/geopolitical risk, investment in infrastructure (information infrastructure, digital technologies for efficient processes), and peak oil demand in an increasingly competitive market and sustainable regulatory framework. The implication of reviewing existing business models is great in terms of impact on earlier stated strategies. The review of the old Business model would improve/optimise effectiveness and efficiency of port performance rather than disrupt it, particularly in a sustainable partnership and consolidation of each component of a supply chain for overall improvement in logistics chain. In this regard, some of the operational aspects in the value chain are outsourced such as supply boats, crew vessels and tankers. It is therefore important if synergy exists among the actors in this category which would impact cost and time, which would ease cargo movement and delivery to the international oil market. Similarly, the author believes the real issues surrounding Nigerian crude export manifest themselves immensely, especially regarding the lack of adequate, comprehensive security framework. See details in (TA 6.11 in Chapter 6), which the country has had difficulty in curtailing over the years. In the first instance, a recent work by Gupte (2019) showed that Nigerian light sweet crude attracts a large number of buyers,' particularly in Europe and India, but amidst the threat of militancy and the long awaited PIB governance bill which must be passed before the oil industry will benefit. These findings

have corroborated current study findings describing a need for a change business of model to include a PSMC security framework adoption as it appears difficult to estimate the cost of insecurity in the value chains. In addition, it is imperative for Nigeria to be decisive in implementing these security strategies, as demand for low sulphur crude appears to increase as IMO's low sulphur cap on marine fuels comes into effect in 2020 (Gupte 2019, p.11). Key policy required in Nigeria for sustainable crude oil flows to the global market. Key among them is the absence of substantial shipping lines or tanker ownership in the country, especially crude tankers, which appears militating against efficient and effective crude oil flow. For further details see section 9.2.4 and 6.2.6, and its impact on vessel clearance and incoterms. In essence, both empirical and secondary sources revealed that Nigeria does not appears among top crude tanker owners in the world (Clarkson 2020, p.9). Key COECs like Kuwait, Iran, Malaysia, and Bahrain in the Middle East are examples. It is imperative to revisit the Nigerian shipping lines or increase investment in the cabotage act that promotes private ownership of tankers through state support funding. In addition, standardization of measuring technology in crude oil export in Nigeria is key for effective and efficient logistics system distribution. In this regard, from a policy perspective, the author believes this gap can be breached through standardization. Empirical data suggests different measurement systems, old metering technology, and inadequate investment. Below is a verbatim quote from key supply chain actors.

 On the offshore side because metering is quite key. Often they are manual and depending on sea conditions, there can be significant errors in measured BOL, which obviously impact a charterer if he sells an item on delivery. NNPC had always more increasingly and DPR actually a programme inspection at

the port where assess the voyage, <u>vessel experience factor (VEF)...</u> the difference between what it load and what comes out at the ports and that gives an idea of really inaccuracies during loading in Nigeria; it tends to be quite significant as much as 6-7% sometimes. In extreme cases definitely but sometimes, that makes massive impact. Ultimately, on the offshore fields tend to be less, onshore tend to suffered from water falling depends on quality of the crude. (Crude oil trader 1, 16 February 2017).

Generally speaking, from above named verbatim quotes there appears apparent inaccuracies in the volume of crude oil for export in some of the Nigeria's export terminals, which this leads to a difference in ship shore figure and impact BOL data, hence loss resulting in the loss of in some quantity of crude oil productions which impact on logistics efficiency. In essence, investment in more modern metering systems is key in the case of legacy terminals and few smaller or low-cost producers. Although it is generally acknowledged from all stakeholders that there is no perfect meter, despite this some of these terminals being designed differently with different measurement systems. For further details, see section 9.2.3. However, there are already existing strategies, such as *outturn delivery*, for reliability and effectiveness. The implications of this scenario are in many folds, and key is diminishing Nigeria's reputation as non-reliable and stable supplier in the international oil market due to the resultant effect of non-accurate and reliable metred figure, oil theft, under or overstated BOL figure data. This has a huge effect on electronic BOL which appears to be gaining ground in the global oil industry. Implications are huge to name a few, which obviously this leads to different figures from different terminal operators because of discrepancies in configurations. In the end, it is the oil industry regulator DPR that appears short changed and this impacts on the country's revenue to a reasonable extent. The idea of metering technology in Nigerian context is basically technology driven. Essentially, it is imperative to have a government

checkmating metering system database that shows declaration of production for each terminal operator, therefore saving time, cost and uncertainty associated with inspection. Further, improve port performance logistics efficiency in the whole supply chain. The author believes that even the "best" metering system has a lot of areas where inaccuracies can occur. For example, ship's figures, especially for older tonnage and operated by reliable, competent staff are in fact just as, if not more, reliable. In short, metering systems are overrated (even good ones) and should only be used as a check in. This studies major contribution to policy is digitisation of metering systems for reliable accurate metering system for BOL data figure. Further, this entails policy change from DPR as a major agency for oil export in Nigeria, through installation of electronic meters for terminals that need improvement to avoid issues such as reading discrepancies. More importantly, the business model still empowers Nigeria (see chapter 3 for further details) to lead this policy reform as the landlord model of port governance is directly linked to JVC and/or PSC respectively, as most production share belongs to Nigeria and as well responsible for effective regulation of the oil export.

9.6 Limitation and Recommendation for Future Research

Notwithstanding current study numerous implications, there also several limitations. First, the study focused on Nigeria, and did not consider other COECs. Further, it focused on the general component of the oil value chains such as business model, commercial agreement, port operation, information flow, licensing, risk management, quality assurance, communication systems, port security, and measurement of export. Thus, it would be noteworthy if future studies considered each component of the supply chains. For instance, the role of information technology in port performance and crude oil export, and the role of commercial contract in crude oil export supply chains. Furthermore, benchmarking of some of the export terminals both offshore and onshore through calculation of data to include input variables (berths, depth, and output (number of calls, throughput and deadweight tonnage). More importantly, the impact of information sharing on port performance and crude oil export logistics such as port security, for sustainable port performance and crude oil export logistics system distribution. Second, the role of artificial intelligence in port performance and crude oil export supply chains. Third, the role of digital technology in port competitiveness in crude oil marine transportation. Fourth, the role of block chain technology in documentation for port performance and crude oil export logistics systems. Moreover, future studies should consider benchmarking the port performance of some of the major terminals such as Bonny, Escravos, Forcados, Qua-Iboe against one another. Crucially, the replication

of this study in other COECs to examine the differences, therefore seeing areas of improvement.

In conclusion, future studies should use quantitative modelling to show the performance of some of the export terminals. For example, the number of tankers calling at each export terminal, gross registered tonnage, and tonnage of crude oil lifted over a specific period of time. For instance, over a year period. This study only focused on crude oil commodity, and so it is imperative for future study to consider gas export terminal logistics performance. More importantly, SCM appears new to some of the producers, and also it is important for future work on supply chain collaboration between these entities. In regards to data collection, the study lacked access to the business model of the state-owned oil company, NNPC and some of the supply chain members declined to talk e.g. ship owners and some ship brokers. What is more, absence of detailed empirical cost data was also problematic. Significantly, future work would benefit from privileged access to such data and as future research will be required to focus possibly on focus groups for monitoring, as well as action research with terminal operators and managers on strategies to curb maritime insecurity and improve the safety of people in port performance and crude oil export logistics systems distribution in Nigeria.

9.7 Conclusion

In respect to RBV, the author believes that Nigeria's crude oil resource for export could improve in its logistics and port performance to gain a competitive advantage through implementation of present study's findings of key complementary resources (key improvement strategies). First, Gritsenko's (2015, p.708) findings appear similar to current study findings in relation to targeted regulation to improve quality governance in maritime oil transportation, which include improve policy making which, in Nigeria's case, include PIB implementation, e-documentation etc. Significantly, findings revealed unambiguous empirical evidence of information flow network challenges in three fundamental operational areas which are sustainable security information, shipping documentation and logistics infrastructure investment. The research problem is about information flow and a key RQ1: What are the fundamental factors that impact port performance and crude oil export logistics system distribution in Nigeria? Thus, the TA findings in chapter six revealed fundamental factors/drivers that impact port performance. Basically, contract/business model review on JV and PSC is critical. For example, increase funding capability by the NNPC, as low-cost producers and clarity in contracting models to all stakeholders is significant. Others are the information flow network and its slowness from the NNPC and low-cost producers. Maritime insecurity appears critical in the disruption of supply chains as increasing threat from global maritime piracy, including Nigeria, appears high in West Africa, as well as the absence of effective legislation for operation and management of private maritime security companies, which is critical for effective and efficient SCM. Further, a need for passage of anti-piracy law and its proper implementation from policy makers and terminal operators which will impact port performance to a great extent. Other drivers are non-reliable metering systems resulting in ship-shore differences and numerous inspections by regulatory agencies, which appears to decrease the value of Nigerian crude.

First, key findings appearing in the AHP conclude key challenges exist which involve information sharing and synergy between terminal operators and security forces. Its implications are huge in terms of attaining a seamless logistics operation in crude oil loading, which might lead to disruption, particularly in the case of pipeline vandalism, loss of crude, theft etc. On the other hand, its importance is critical in vessel clearance, particularly from the NNPC

as the primary supplier, in knowing stock level, terminal readiness and so on. Ineffective information sharing could as well impact lifting schedule and cause logistics performance to be disrupted, and thus, a high degree of investment in the whole logistics system is quite critical. To further this point, investment in modern digital technology such as block chain is important, as evidence in section 6.2.6 for vessel clearance. Finally, a degree of investment in the NNPC and the need for increasing personnel training appears critical to facilitate information sharing in key aspects of the supply chain, as well as effective collaboration with other terminal operators - mainly majors and indigenous producers. Second, shipping documentation is to inform supply chain actors on quantity of cargo and stock level for effective and efficient logistics management which impacts port performance. Electronic bill of lading appears to be gaining attention despite being fraught with challenges of trust, but with the advent of KAT and Komgo platform to hasten information exchange which has been adopted by leading IOCs in order to facilitate shipping documentation due to its importance in the supply chains.

In the case of Nigeria, the implication of non-compliance are huge in terms of losing out in the global market share, as investors and traders will lose confidence in accessing crude at the right time, cost, and coupled with challenges of navigating difficult jurisdiction that has less regulatory strength for effective crude oil logistics system distribution. Third, logistics information infrastructural challenges that require huge investment in modern technology spans metering systems, security boats and capability. Fourth, sustainable regulation such as the anti-piracy law and infrastructure investment to curb maritime insecurity that appears evolving in strategy and dimension by pirates in the Gulf of Guinea in recent years. Infrastructure such as aircraft, helicopters, naval vessels etc. are in dire need. The implication is massive, particularly in increasing the cost of crude which means loss to all stakeholders in terms of operational cost, profit margin and revenue. Nigeria can address this problem by strong and co-operative regulations that are effective and efficient defined, by anti-piracy laws to prevent maritime crimes and kidnapping. More importantly, an increase in military capacity and international co-operation from UN security forces will curb maritime insecurity to a great extent.

Further on the RQ2 that relates to optimisation strategies for NNPC and other E&P in port performance in crude oil flows. To start with, NNPC as the terminal operator/NOC produces, sells, buys, trades crude oil and still regulates

its own activities. The author believes in finding optimisation strategies, it is instructive to review NNPC business model at this juncture which has huge impact on all the supply chain actors and operations, particularly in finance, operations, regulations and human capital. The author would like to recommend long-term loans to fund JVCs to be provided by world leading commodity trading houses such as Vitol, Trafigura, and Glencore etc. This is possible with key consideration to PIB review and it final passage into law. The author's plausible assumption and top priority in the study lies in increasing the need for sustainable policy framework, particularly the PIB, as this may accommodate all key areas of concerns in the value chains like governance, financing, contract openness, host community development, oil licensing etc. Obviously, PIB passage would unleash the capacity of Nigeria's export terminals operation toward reliable, stable and dependable crude oil export to the global market because IOCs and NNPC would work better closely in strategic investment and sustainable security, thereby limiting uncertainties with the ease of doing business in Nigeria. Further, key strategic decisions include a change in business model to include value proposition for sustainable financial mechanisms to fund production cost for NNPC and low-cost producers, and investment in the main value chains, as well as supply chain such as pipelines, vessels, boats and security platforms are of utmost importance. Similarly, corroborating and buttressing the findings in the study by (Manley et al., 2019, p.57) which explains the role of NOC as a substantial source of revenue, as well as being associated with huge debts, hence borrowing further to finance new investment in the supply chains. Obviously, this is unsustainable because of inadequate transparency in the management and governance of NOCs. In addition, NNPC shared in all these characteristics mentioned and their work proposed a new and sustainable financial mechanism that would facilitate clear and effective rules on how much NNPC is allowed to spend and borrow and how much government is due in terms of revenue from the perspective of key business models. Finally, a vast majority of issues in the present study appear related to inefficiencies in operational issues in the supply chains, which are linked to inadequate technological innovation and investment in few areas such as information security, ports, pipeline protection and security, vessel scheduling and metering systems to verify exact quantity of crude loaded to name a few. However, performance could be improved with increasing transparency and accountability in oil licences acquisition, crude oil lifting entitlement, profit making etc. In addition, research evidence showed

publishing contract could help the government to maximise revenue from extractive sectors to meet development

needs according to EITI regulations (EITI, 2020, p.5)

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Appendices Appendix 1: Key Systematic literature review

Name of Journal	Theme	Result	Year of publication	Authors
Maritime Policy and Management	A logistics and supply chain management approach to port performance measurement	Proposed a framework through survey of port managers and international experts to contribute to performance measurement of ports as a logistics centre.	2004	Khalid Bichou and Richard Gray
Transportation planning and Technology	Analysis and forecasting of port logistics using TEI @I	Used Hong Kong container throughput series as case study to determine applied TEI @I methodology to decompose port cargo volumes series into three component : Linear, non-linear, effect from irregular and infrequent events	2013	Xin Tian, Liming Liu, K.K Lai &Shouyang Wang
Journal of Urban science	Functional networking of logistics port cities in North Asia	It showed the allocation of logistics functions for each ports and cooperative networking in logistics system vertically and horizontally showing their weakness and strength.	2010	Gyeong Seok Kim & Tae Seung Kim
Maritime Policy and Management	Environmental efficiency of ports: a Data Envelopment Analysis (DEA) approach.	Used slack based measurement –DEA to produce a model for environmental efficiency which is under research. This combined both environmental and economic performance measures.	2013	Young–Tae Chang
Maritime Policy and management	Upstream transport corridor inefficiencies and the implications for port performance: a case Mombasa port and Northern Corridor.	This worked focused on issues affecting effective logistics in East and Southern Africa (ESA). Some of the issues are inadequate transport infrastructure, congested logistics, less sophisticated intermodal etc.	2013	Victor Oyaro Gekara & Prem Chhetri
Transport Reviews	The Greening of ports: A comparison of port management tools used by leading ports in Asia and Europe	Showed that IMO port policy serve as a driving force for implementation of green port policy in Europe in	2014	Jasmine Siu Lee Lam & Theo Notteboom

		comparison to the		
Transport Reviews	Determinants of Efficiency at Major Brazilian Ports Terminals	The author used DEA and SFA which showed that these ports when benchmark to each other, the efficiency of these terminals depends on load of shipment i.e. average volume of cargo loaded per shipment	2011	Peter F. Wanke, Rafael Garcia Barbastefano &Maria Fernanda Hijjar
International Journal of logistics and Research and Application	The prioritisation of service dimensions in logistics centres: a fuzzy quality function deployment methodology	The study presented a systematic approach centred on around an analytic framework on green port management which are pricing, monitoring and measuring market access control and environmental regulations according to the functional activities in ports.	2016	Ceren Altuntas Vural &Okan Tuna
Maritime Policy and management	The Impact of Korea's free trade agreement (FTA) network on seaborne logistics	FTA has impact on the macroeconomic and microeconomic element of the country which in the end impact port cargo and containerised cargo.	2013	Inkyo Cheong and Jungran Cho
International Journal of Logistics and Research and Application	Benchmarking environmental efficiency of ports using data mining and RDEA: the case of U.S container ports	The study focused on environmental performance sustainability using data mining technique and recursive data analysis. It found out that results of EE scores of U.S ports that ranged from 0.29 to 1 and 12 container ports were found to be environmentally efficient and average was 0.77 and 8 container were found to be inefficient.	2018	
Coastal Management	Trends and Opportunities for the Long – term Development of Rotterdam's Port Complex	Data collected from academic due to their wide knowledge and neutrality. It revealed the opportunity in this port and also the needed strategies such as innovations and experiments, public and private partnership for the port to remain competitive.	2005	De Langen, P.W
Maritime Policy and Management	Untangling process complexity in logistics delivery services with unpredictable service sequences: a mixed		2018	Ping Wang & John Vogt

			r	
	method study of chemical tanker ports			
Manifina - Dall	Calls		2014	Drakest O
Maritime Policy and management	Port face inadequate capacity, efficiency and competitiveness		2011	Prakash Gaur, Shivani Pundir &Tarun Sharma
	in a developing			
Safety and reliability	The port as a critical	There is a large part	2017	
	piece of national	to definition of port.		
	infrastructure	The study identified		
		port system wide risk		
		resilience of ports		
		and infrastructure.		
International Journal	Reducing freight cost	In a drive to change	2014	Jan Havenga,
of Logistics Management	risk in a nign oli price	of transport system		Zane Simpson
Management	onvironment	due to increasing		
		externality with		
		negative impact on		
		South Africa. The		
		study found out that		
		the transport cost		
		for oil and the		
		internalisation of		
International Jacum -	The impect of	externality cost.	2002	Marpar
of Physical	electronic commerce	electronic	2002	vverner, Delfmann
Distribution and	on logistics service	commerce, though,		Sascha, Albers,
Logistics	providers	the major change		Martin Gehring
Management		Induced by e-		
		were		
		disintermediation		
		and up- coming electronic market		
		place such as		
		duration relationship,		
		type of goods ,		
		dispersion of		
		customer		
International Journal	An integrated decision	With increasing	1994	Hokey Min
Distribution and	global logistics	business activities		
Logistics	0 0	and diversification of		
Management		system, this study		
		is urgent need to		
		develop integrated		
		decision support		
		communication and		
		planning different		
		firms including		
		logisticians and third		
		party providers		
Maritime Policy and	Modelling port choice		2013	Gi- Tae Yeo, Adolf K V No
manayement	environment			Paul Tae – Woo
				Lee & Zaili Yang
Carbon Management	GHG emission		2017	Misra et al.
manayement	mitigation strategies to			
	reduce the carbon			
	footprint in			
	activities- a case of			
	the Port of Chennai			
Cogent Business and Management	Digitization of maritime logistics –		2017	Markus Fruth and Frank

	what is there and what			Teuteerg,
Maritima Daliay and	is missing?		2016	Shaofeng Liu
Management	government on port		2016	wu et al.
	investment:			
	decentralised port			
	governance			.
Maritime Policy and	Examining		2016	Shan Lu et al.
managomon	performance at ports:			
	port managers			
	developing			
	sustainable supply			
Maritime Policy and	chains Evaluation of pilotage		2018	Min Qui
Management	dispatching operation		2010	Will Gai
	for Dalian ports in			
	AHP method			
Supply Chain	Assessing the Impact		2015	Byung-In Park &
Forum	of Port Charges on Ocean carriers' choice			Hokey Min
	of Vessel size, Service			
	Routes, and Service			
Cogent Engineering	Estimating		August 2018	David
	greenhouse gas		-	O.Olukanni O
	vessel operations at			Esu
	the Lagos and Tin			
Applied Economics	Can ports of Nigeria			Luisa Marti
	logistics performance			Rosa &Leandro
	Index in International			Garcia
Global Journal of	The Impact of Supply	No direct significant	2012	Fauzia Siddiqui,
Flexible Systems	chain management	relationship between		Abid Haleem
Management	quality management	SCM program and SCM practices and		Sharma
	practices and flexible	TQM practices		
	system practices	through observation		
	study in oil and gas	analysis from		
	industry	questionnaire and		
		SURVEY. Best in class		
		supply chains results		
		in steadier and more		
		expansion, such as		
		lower operating cost		
		investment.		
Journal of	From declared asset	Information on cost	2017	Erovie-Oghene
Environmental Management	to a decommissioning	of decommissioning are held		U. Afieroho a, , Shirish I Patil b
Julianagement	cost estimate for	confidentially by oil		, Abhijit
	onshore crude oil	companies. Non –		Dandekar a , Bobort Borking
	neius in Nigeria	gave an insight on		a, Douglas
		the cost which could		Reynolds
		pe used as negotiating tool for		
		operators and		
		government in		
		decommissioning		

Source: Author

Appendix 2A: Literature review on components of port competitiveness

Author date	Component identified
Pearson (1980)	Confidence in port schedules, frequency of calling vessels, variety of shipping routes, and accessibility of port.
Willingale (1981)	Navigation distance, hinterland nearness, connectivity to ports, port facilities, availability of port and port tariffs Collison (1984)
Collison (1984)	Average waiting time in port, confidence in port schedules, port service capacity. Calling frequency, tariffs, accessibility to the port, port congestion and inter-linked transportation networks.
Slack (1985) Brooks (1984, 1985)	Port costs, frequency of calling vessels, port reputation and/or loyalty, ship direct calling and experience of cargo damage
Murphy et al. (1988, 1989, 1991, 1992)	It has loading and unloading facilities for large and/or odd-sized freight, allows for large volume shipments, has low freight handling shipments, provides a low frequency of loss and damage, has equipment available, offers convenient pickup and delivery times, provides information concerning handling, offers assistance in claims handling, offers flexibility in meeting special handling requirements
Peters (1990)	Internal factors: service level, available facility capacity, status of the facility, port operation policy External factors: international politics, change of social environment, trade market, economic factors, features of competitive ports, functional changes of transportation and materials handling.
Murphy et al. (1988, 1989, 1991, 1992)	It has loading and unloading facilities for large and/or odd-sized freight, allows for large volume shipments, has low freight handling shipments, provides a low frequency of loss and damage, has equipment available, offers convenient pickup and delivery times, provides information concerning handling, offers assistance in claims handling, offers flexibility in meeting special handling requirements
Peters (1990	Peters (1990) Internal factors: service level, available facility capacity, status of the facility, port operation policy External factors: international politics, change of social environment, trade market, economic factors, features of competitive ports, functional changes of transportation and materials handling.
	Geographical location, hinterland networks, availability and efficiency of transportation, port tariffs, stability of port, port information system.
UNCTAD (1992)	Port facilities, in land transportation networks, container transport routes.
McCalla (1994)	Geographic location of ports, Inland railway transportation, investment of port facilities, stability of port labour.
Starr (1994)	

Tengku (1995)	Port tariffs, safety handling of cargoes, confidence in port
	schedules.
	Custom service, rapidness, simple documents in port, cargo
Chiu (1996)	damage and skills of port
Notteboom, Coeck	Terminal in hub port on average were more efficiently than terminal
and Van	in feeder port
Den Broeck (2000)	
Cullinane and Song	Private participation on and deregulation have positive impact on
(2003)	technical efficiency
Athanasios (2004)	Scale of operation, privatisation
Tongzon and Heng	Privatisation positively affect terminal efficiency but does not bring
(2005)	greater efficiency improvement
De Oliveira and	Scale efficiency affect terminal efficiency
Carlon (2011)	Our eventies at use and inter next and inter next as most then
Fuen, Zhang and Choung (2013)	Ownership structure and intra- port and inter-port competition
Sequi et al. (2016)	Environmental priorities, environmental management
begui et al., (2010)	environmental monitoring and green actions: air quality water
	quality, bunkering, noise, dredging etc.
Ha et al., (2017)	Core activities, supporting activities, financial strength dimension
	concerns financial profitability,
	Einancial strongth dimension concerns, financial, profitability and
	stability
Cariou et al.,	Fuel efficiency in gram per TEU–km due to general decrease in
(2018)	speed and change in technology.
	Network design leading to less distance travelled -21%
Schoyen et al.,	Efficiency influenced by weather logistics service delivery outcome.
(2018)	Some port such as Icelandic and Norwegian ports appear not
	sensitive to weather logistics service delivery are included or not.
	In addition, some deep-sea transcontinental container liners are
	over-performers and under-performers with regard to technical
	efficiency and scale efficiency.
Lin et al., (2019)	Berth, equipment, employee, cost, throughput and profit.

Source: (The Author: Review and originally adapted from G-T. Yeo et al,

2008, p. 915)

Appendix 2B: Port performance scorecard indicators, 2014-2018

0 1			
Section	Port performance indicators		
Finance	EBIIDA		
	Vessel dues		
	Cargo dues		
	Rents/revenue		
	Labour/revenue		
	Fees and the like/revenue		
Human resources	Tons per employee		
	Revenue per employee		
	EBITDA per employee		
	Labour cost per employee		
	Training cost/wages		
Gender	Female participation rate		
	(global)		
	Female participation rate		
	(management)		
	Female participation rate		
	(operations)		
	Female participation (cargo		
	handling)		
	Female participation rate (
	Other employees)		
	Female participation rate		
	(management +operations)		
	Average waiting time (hours)		
Vessel operation			
	Average gross tonnage per		
	vessel		
	Oil tanker arrival average		
	Bulk carrier arrival average		
	Container ship arrival average		
	Cruise ship arrival average		
	General cargo ship arrival		
	average		
	Other ships arrival average		
Cargo operations	Average tonnage per arrival		
	Tons per working hour, dry or		
	solid bulk		
	Boxes per ship hour at berth		
	Boxes per ship hour at berth		
	TEU dwell time(days)		
	Tons per hour, liquid bulk		
	Tons per hectare(all)		

	Tons per berth metre (all)
Environment	Investment in environmental
	projects/total CAPEX
	Environmental
	expenditures/venture

Port performance scorecard indicators, 2014-2018 Source: (Adapted from UNCTAD, 2019, p.75)

Appendix 3: Prompt sheet for Semi-structured Interview One

Opening statements

I am researching into port performance and crude oil export logistics systems distribution in Nigeria at doctoral degree level at Plymouth University in the UK. As an expert, your professional views offer an invaluable contribution to my research. Your replies are fully confidential but if necessary, could you agree to me quoting you anonymously, or to reproducing a transcript of some or all of your replies anonymously, for example in an appendix to a publication?

The main question is:

Please think of yourself as a professional in the oil industry in relation to ports performance and crude oil export logistics systems distribution in Nigeria. Please discuss the issues that are important to you in this context.

This covers objective 1, 2, 3 and 5 respectively.

Please find below the prompts

1. Please describe your experience regarding the role of ports in crude

oil export logistics systems distribution in Nigeria. ...1

2. Please describe the role of ports in crude oil export logistics systems

distribution in Nigeria in your company...1

3. Are you aware of any issues relating to communication between

terminal operators and officials of Nigeria's crude oil regulatory

agency, Department of Petroleum Resources, DPR? What impacts did these issues have? ----2

- 4. What would the effect if officials were not present during crude oil loading operations? ----2
- Please describe the different component of crude oil exports logistics systems...2
- Please describe how joint ventures impact the quantity of crude oil produced in Nigeria. ...3

- Please describe how port performance in crude oil export logistics systems distribution is linked with terminal capacity, location and production in Nigeria....3
- 8. Please describe how pipeline vandalization may result in
- Changes to planned dates of the lifting programme,
- Level of production,
- Changes in the recorded production of crude oil exports from Nigeria
 ...3

9 How does maritime insecurity impact port performance in crude oil export logistics systems distribution in Nigeria....<u>3</u>

- 10 How do metering systems affect the level of errors recorded in the measured quantity of crude oil exported at the final destination? 3
- 11 How do you think Nigerian National Petroleum Corporation (NNPC's)
 choice of INCOTERMS (e.g. FOB) impacts its risk of financial losses
 during crude oil export in Nigeria?....3
- 12 How do disputes over entitlement impact port performance in crude oil export logistics systems distribution in Nigeria? ... 3

13 Are there any other issues which my research should be aware of? Source: Author

Appendix 4: Prompt sheet for Semi-structured in-depth Interview Two

As an expert, your assistance would be invaluable in contributing to this important research topic. Please could you spend a few moments in answering the following questions?

Firstly, a few details about you:

What is your organisation?

What is your role in the organisation?

How long have you been with this organisation?

The main objective of this interview is to recommend strategies for improvement in port performance and crude oil export logistic systems distribution in Nigeria

Semi-structured in-depth interview

Objective one

- 1. Please what do you think of more floating production storage and offloading vessel (FPSO) or barge for crude oil export logistics systems distribution in Nigeria?
 - (i) How many are there now?
 - (ii) Why do you have them?
 - (iii) Do you think more is required?
- 2. What do you think of situation where no loading can occur without officials of government during crude oil export logistics system in Nigeria?
- 3. Concerning safety of terminal; please compare and contrast offshore and onshore terminals in Nigeria.

Objective two

- 4. Please describe why Nigeria's vessel clearance takes inordinate amount of time compared to others in the rest of the world.
- 5. How often does weather delay affect port performance in crude oil export logistics systems in Nigeria?

6. What do you think of information gap between NNPC/DPR and terminal operators in terms of knowing stock level, requirement for a particular loading needed by a crude oil trader?

Objective three

- 7. What do you think about dispute over entitlement that impact vessel clearance by both NNPC and terminal operators in Nigeria?
- 8. When pipeline vandalism occur, how long does it normally take to restore to normal production.
- 9. What do you think of standardization of measuring technology in crude oil export in Nigeria?
- 10. What do you think of significance difference in vessel experience factor (ship –shore difference) of 6-7% in crude oil logistics systems in Nigeria?
- 11. What do you think of impact of pipeline vandalism to disruption in supply chain in Nigeria on
 - (a) Cost
 - (b) Time.
 - (c) (c) cargo throughput *Objective four*

12. Please evaluate performance of terminal in crude oil export logistics system in Nigeria.

Objective five

- 13. Please what do you think of time charter of vessels to deliver Nigerian crude oil on a long time basis rather than selling on FOB 100%.
- 14. What do you think are the most important element of petroleum Industry Bill (PIB)?
- 15. How can PIB affect port performance in crude oil export logistics systems in Nigeria?
- 16. What is implication of PIB on
 - a. Clarity of business or contract model

b. Investment in Exploration and production (E&P), drilling, port infrastructure, pipelines and vessels portfolio

Source: Author

Appendix 5: A Sample of Documentary Instruction

REF:

CARGO NO:

	PURCHASE OF BONNY LIGHT CRUDE
RE:	OIL, 950,000 NETT US BBLS +/- 5%
	AND CUSTOMS STATUS T1 FOB
	BONNY (SUPPLIED OANDO)
VERSION:	ONE
VESSEL:	M/T SKS SATILLA (9301524) OR SUB
LOAD PORT	BONNY TERMINAL
LOADPORT INSPECTOR	INSPECTORATE ADD (50:50) PLEASE
	CONFIRM AVAILABLE LOADING
	VOLUME), ALWAYS FOR SAFE
	SAILING /DISPORT ARRIVAL DRAFT
CO- LOAD	NONE
LAYCAN:	FROM 11 APR TO 12 APR
AGENTS:	HULL BLTHE
BILL OF LADING MAKE -UP	
CONSIGNOR :	OANDO
CONSIGNEE:	TO THE ORDER OF ING BELGIUM,
	BRUSSELS, GENEVA BRANCH
DESTINATION:	NORTH ATLANTIC COST FOR
	ORDERS
GRADE:	BONNY LIGHT CRUDE OIL
MARKED:	CLEAN ON BOARD
	FREIGHT PAYABLE AS PER CHARTER
	PARTY
QUANTITY:	MT VAC, MT AIR, M3 @15 DEG C,
	BBLS@60 DEG F, ALL BE STATED IN
	NETT

Source: Adapted from NNPC 2018

Appendix 6A: List of Companies in Crude Oil Export Value Chains

Company	Shell	Chevron	ExxonMobil	ENI	ALLIED
name					ENERGY
Brief history	As one of the	Chevron is the	ExxonMobil	Italian oil and	Allied .
	world's leading	third largest oil	has evolved	gas major Eni's	energy is a
	energy	producer in	from a	TIRST NIGERIAN	Nigerian
	companies-it	Nigeria and	regional	subsidiary, the	registered
	has played a	one of its	marketer of	Nigerian Agip	company
	key lole in mosting world's	iargest	the USA in the		foound on
	arowing energy	operates IV	last 125	(INAUC), was	upstream oil
	demand in	arrangement		First oil	and das
	economically	with NNPC for	Nigeria's	followed in	business in
	environmentally	the onshore	second	1965	Nigeria
	and socially	and offshore	largest	operation	First
	responsible	assets in the	producer,	ranges from	indigenous
	ways. Shell has	Niger delta	output as of	onshore to	company to
	been active in	region	2011 is more	offshore in area	hold interest
	Nigeria since	_	than 750, 00	of 44,048	as an
	1937. It has		barrel of oil,	square	operator
	massive		condensate	kilometres.	with
	investment in		and natural	ENI operates	Nigerian
	onshore,		gas liquids per	joint venture	deep water
	shallow and		day through it	with NNPC and	licence and
	deep water			two service	made the
	exploration and		Incorporated		TIFSt
	production. It		upstream	Currently, ENI	discovery in
	first commercial		Began	covers 36 285	deenwater
	export in		operation in	kilometres both	offshore
	Nigeria in 1958		Nigeria in	offshore and	Nigeria on
	rugena in reco.		1955. has two	onshore, with a	OPL 2010
			major IOCs	total 41 mining	in 1995.
			merged under	licence, this is	Allied
			one umbrella	regulated by	brought
			Mobil	PSC and	CONOCO
			Producing	concession	and Statoil
			Nigeria MPN.	contract.	to the
			Began		offshore.
			production of		
			crude oil in		
			1970; noid		
			significant		
			shallow		
			waters off the		
			coast of south		
			eastern		
			Nigeria.		
			encompassing		
			90 platforms		
			and more than		
			300 wells,		
			which produce		
			some 550,000		
			bpd of oil		

Company in Nigeria by number	50 oil producing fields on JV with state oil company, network of approximately 5,000 kilometres of oil and gas pipelines and flow lines, five gas plant and two major oil export terminals (Bonny and Forcados). Bonga is a water project with production capacity of 200,000bpd and 150 million standard cubic feet of gas per day	Chevron has interest ranging from 20% to 100%, in three operated and six non- operated deep water blocks in Nigeria. Some of the fields are Agbami (113Km), with depth of 4800 feet, 67.3% interest in the field, net daily production averaged 129,000 barrels of crude oil and 14 million cubic feet of natural gas. Others are Usan (2,461 feet) with net daily production in 2015 averaged 30,000 barrels of crude and 3 million cubic feet of natural gas.	In 2006, MPN and NNPC signed \$600 Million deal to develop 3 satellite fields and non- producing field in offshore Akwa Ibom. MPN managed Qua Iboe terminal, which gathers crude oil from a number of offshore oil field, is one of Nigeria's main export point – with 9 crude oil storage tanks as well ability to berth tankers weighing up to 312,000 deadweight tonnes. It operates PSC with NNPC, major activity are the Erha and Erha North field in	Some of the oil mining licence are OML 60, 61, 62, 63, 120 and 121 (Oyo) and 125 (Abo), also shareholder in OML 118 (Bonga), 119 (okono/okpoho) and the Shell Petroleum Development Company JV	Allied energy and partners' investment has reached \$2billion in Nigeria since mid- 1990s.
Number of export terminals	Bonny, Bonga, Forcados, Sea eagle and also hold 25.6% share in Nigerian liquefied natural gas export terminal in bonny together with NNPC (49%), Total (15%) and ENI (10%).			Bonga, Oyo, Okono–6 wells, Okpoho–6 wells, Abo. All wells have being drilled, completed and tied to Floating Production Storage and Offloading vessel mystras, all these are in production.	Currently working to develop OYO field in OML 120, about 75 Km,
Contribution					
	It is a major contributor to the economy not only through energy they produce and revenue they generate	It has global memorandum of understanding approach for community engagement in the delta.	ExxonMobil's investment in Nigeria's oil industry is about \$11 billion as of 2012.	Its produce gas having six train Nigeria LNG plant on Bonny Island. As of 2012 Eni anticipate building a	Member of an international oil consortium, with increasingly

	but also via the supply chains, local content and social investment.	venture has spent \$100,00 million on roughly programs that have provided more than 40,000 scholarships, schools, medical facilities and supplies, and housing and that have supported agriculture development and projects improving water bridges, jetties, drains and roads.		190,000 barrel per day.	in Nigeria.
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Company Name	ADDAX	TOTAL	STERLING	ORIENTAL	AMNI
			OIL	OIL	
Brief history	Addax	Total Nigeria	Sterling oil	Purely	AMNI
	petroleum	is a French	Exploration	indigenous oil	international
	began	oil giant	and energy	and gas	petroleum
	operation in	company that	production	exploration	development
	Nigeria in	has been	company	and production	company
	1998, has	operating	(SEEPCO)	company in	limited (AMNI)
	two	since 1956 in	is a venture	Nigeria.	is an
	production	the	from the	Awarded oil	independent
	sharing	downstream	Sandesara	producing	indigenous oil
	contract with	sector.	group. It	licence (OPL	and gas
	NNPC.Addax	Discover	has	224) in	company in
	is a	Usan	business in	September,	Nigeria. AMNI
	subsidiary of	offshore oil	four	1990 by	have been
	Chinese	field in 2002,	continent	Nigerian	operating
	owned	and also	namely	government.	since 1993,
	Sinopec	partner with	Asia, North		focuses on
	Group.	ExxonMobil,	America,		offshore
	Assets and	Chevron, and	Europe and		environment
	acreage has	Canadian	Africa. It		in the last 17
	11 with	based	ventured		years.
	operatorship	independent	into		
	of five	Nexen.	exploration		
	offshore		and		
	concessions		production		
	(OML 123,		in 2006 by		
	126,137 and		establishing		
	291) and one		sterling's		
	onshore		footprint as		
	concession		an operator		
	(OML 124)		in an OPEC		

	Overall working interests in 3,520 square kilometres of Nigerian		country, Nigeria.		
Company in Nigeria by number	Addax has 80 production wells in concession OML 123, 2 fields with 15 producing wells OML 124, 2 fields wells in concession OML 124 and 2 fields with 17 production wells in concession OML 126	Total established three lubricant blending plant at koko delta state, Kaduna and Apapa Lagos. Also invested in bottling of Liquefied petroleum gas and 5 LPG bottling plant located in different part of the country with coastal storage in Apapa.	Possess 250 million barrel certified crude oil reserve, the okwuibome crude is an established Brent and 1 trillion cubic feet of gas reserve at the field.	Oriental oil energy resources have three basic offshore fields Ebok field (OML 67), Okwok field (OML 67) and OML (115), all these fields are in various stages of development. Oriental has 60% working interest with partner Afren. Production currently 35,000 barrel per day. 508 mmbbls gross	Okoro and Setu East field are OML 112, appraised 2006 and production commenced in 2008. Ima field has 10 metres depth with gas reserve as well. 36.9 million Barrels so far as of 2012, Total licence area 926 square kilometre.
Number of export terminals	Antan and Okwori both offshore terminal	Maintained three offshore terminals– Amenam/ Odudu, Akpo and Usan respectively. Usan is located in OML 138, Akpo field is OML 130 in 1,300- 1500 metres of water, has been producing since 2009	Okwuibome crude stream from TULJA offshore oil export terminal.	Ebok export terminal	AMNI has 10 producing wells and 1 FPSO at Okoro setu.
Contribution		Total is Nigeria's largest downstream product marketer which is quoted on		Oriental oil resources involved in programmes that have impact on several stakeholders,	AMNI is socially responsible for construction of jetties, boreholes, drainage,

Nigeria's	maximise	culvert,
stock	positive impact	installation of
exchange	over time,	500KVA
and evolved	create	electricity
local	community	transformers,
companies in	ownership and	speed boats
Usan	focus on	and engines.
development	capacity	On capacity
and local	building	building –
content	initiative such	awards of
quotient,	as training and	scholarship,
showing	improved	youth
rapid	education.	empowerment
capacity		programme
building in		etc.
engineering,		It has been
offshore		supporting
services		Nigerian
segment and		professionals
helping		through the
Nigeria to		relevant
indigenise its		professional
oil and gas		bodies –
industry.		NAPE, SPE,
		NMGS, and
		NAIPEC
		respectively.

Company name	Express/Atlas	Nigerian Petroleum Development Company (NPDC)
Brief history	Michigan based exploration and production company, involves in logistics, refining and services of oil and gas	NPDC is a subsidiary of NNPC, engages in oil exploration and production activities in the hydrocarbon rich region of Nigeria and Gulf of Guinea.
Company in Nigeria by number	It operates and managed one of Nigeria crude oil export terminal UKPOKITI and having a storage capacity 2,000,000 barrel	OML 119 is NPDC concession on the continental shelf, has okono and okpoho fields are currently producing about 70,000 barrel per day. Offshore asset–involves 9 deep water acreage OPL 214, 223,242,244,251, 256, 318, 32 and 332 respectively. Onshore assets includes – OML 65 (Abura field, and OML 111 (Oredo and Oziengbe fields, production is approximately 12000bpd found in field.
Number of export terminal	One export terminal	Okono offshore oil field with FPSO facility with storage capacity of 1,055,000 barrels.
Contribution	Socially responsible to Nigerian local content policy that encourages employment of indigenous professional in the oil industry.	Adhered to local content policy of Nigerian government.

Appendix 6B: Nigeria crude oil company's traders/lifters as of 2016/2017

Company name	Televeras	Trafigura	Mercuria Energy	Emirate national oil company(ENO C)	Vitol
Brief history	Established in 1998 offers a wide range of integrated and strategic solution in field such as energy, power and logistic on global scale. Located in London, Abuja, Cape town and Dubai.	Founded in 1993 from five partner by late Claude Dauphin, as one of the world's independent commodity trading and logistics firm, operation spans from m physical trading, investing in infrastructure	Established in 2004, is a global energy firm that transacts energy and commodity in the world. Trade physical oil, energy product and other commodities from business hubs from Geneva, London, Singapore and Houston. Also supports growing production, logistics and storage asset.	Established in 1993, as Dubai state oil company as a global player in oil and gas involved in supply, trading and processing, terminal, marketing, retail and exploration and production. ENOC has 112 service station and over 60 markets.	Founded in Rotterdam in 1966, an energy and commodity company, involved in physical trading, logistics and distribution forming the core of the business, but complement ed by refining, shipping, terminal exploration and production, power generation, mining and related business.
Locations	Head office in Maitama, Abuja founded in 2004	Head quarter in Amsterdam, Netherland, present in North America, Latin America, Europe, Africa, Middle East, Asia and Australia.	Present in 27 countries with 38 offices and trade in more than 50 countries. Presence in Europe, Asia, North America, Africa. South America.	Dubai	Over 40 offices worldwide, with largest operation in Geneva, Houston, London and Singapore.
Nigeria	is in trading crude and fuel, condensate and liquefied petroleum gas LPG, as well refined	BEHEER BV entered in to Agreement with Nigerian state oil company NNPC through its	percent of the share capital of forte oil Plc, an indigenous oil company through a	As a reining company, it has been operating in Nigeria since December, 2015 when it was awarded contract as	been operating in Nigeria for some years, constructed Navgas terminal, state of the

	petroleum products such as gasoline, dual purpose kerosene, and gas oil and jet fuel. Awarded two offshore oil block by the Nigerian government.	agency PPMC in 2010, standard international trading contract govern by incoterm commercial rule. Also won 2016/2017 crude oil lifting according to NNPC.	structured transaction that represent total consideration of up to 200 million. This would strengthen forte working capital and allow expansion of its services in oil and gas industry.	part of crude oil lifters.	art LPG facility constructed to serve growing Nigerian population with domestic gas as well its foundation supports programme in health, water and sanitation throughout the country.
Quantity of crude oil lifted	Quantity starts from 32000bpd upward depending on contract terms.	Term allocation of 32,000 bpd	Contract to lift 32,000 bpd of crude oil	60,000	
Company name	Indian oil corporation	Cepsa refinery Madrid	Sara SPA refinery		
Brief history	Established in 1959 by Indian government, is Indian largest commercial enterprise with sales turn over \$61 billion and it is one of first Indian enterprise in prestigious fortune global 500 listing for the year 2016.	Founded in 1929 as a Spanish oil and gas company, operating in several European countries as well as Algeria, Canada, Columbia, Morocco and Brazil.	Founded by Angelo Moretti in 1962 as a refinery and began crude distillation and catalytic cracking plant in 1968. In the 70s and 80s started operation of refinery unit, increase in conversion capacity, environment new technologies and expansion in the whole market. Finally in 2000s further investment in high		

			technology and environment.	
location	Headquarter located in New Delhi with subsidiary, having subsidiary in Sri Lanka, Mauritius and UAE and is continuously scouting for business opportunity in Africa and Asia energy market.	Headquarter in Madrid, Spain.	Headquarter in Italy.	
Operation in Nigeria	Awarded crude oil contract to lift crude oil of 60,000 bpd in Nigeria as a refiner.	Awarded crude oil contract to lift crude oil of 60,000 bpd in Nigeria as a refiner.	Awarded crude oil contract to lift crude oil of 60,000 barrel per day in Nigeria as a refiner	
Quantity of crude oil lifted	Quantity of crude to be lifted is 60,000 b/d in Nigeria from October 2016.	Quantity of crude to be lifted is 60,000 b/d in Nigeria from October 2016.	Quantity of crude oil to be is 60,000 b/d in Nigeria from October 2016.	

Appendix 6C: Trading affiliate of International oil companies (IOCs)

Company Name	Eni trading and shipping SPA	Total oil trading SA (TOTSA)	Exxon sale and supply LLC	Shell western supply and trading
Brief history	Established in 2007 by the parent company ENI. It is present in 66 countries, managing the sale of 54 million tons of crude oil and	One of the active player in the international oil market. Trade with all member of oil supply chain, including oil majors, traders, national oil	This is the trading arm of ExxonMobil integrated oil and gas company, responsible for marketing the company's global	First discovered oil commercial quantity in 1956 in Nigeria, since has been proactive in oil E&P for more

	19.2m tons of refined and semi-finished products (Annual report 2015).	companies, distributor and end users.	production of Crude oil and condensate.	than 6 decades.
Location	Located in about 66 countries, including Nigeria.	Activities in 120 countries and 7 offices worldwide. Geneva, Singapore and Houston are the major trading offices.	Headquarter in the USA, plus major offices in Europe, Asia pacific etc.	Shell is a global oil major present virtually in oil producing nation in the world.
Operation in Nigeria	Operating in Nigeria for many years as IOC engage in oil exploration and production as well as trading.	Operating in Nigeria for many years as IOCs engage in oil exploration and production as well as trading.	Operating in Nigeria for many years as IOC engage in oil exploration and production as well as trading.	Operating in Nigeria for many years as IOC engage in oil exploration and production as well as trading.
Quantity of crude oil	Awarded crude oil contract to lift crude oil of 32,000 bpd in Nigeria as a subsidiary of trading company.	Awarded crude oil contract to lift crude oil of 32,000 bpd in Nigeria as a subsidiary of trading company.	Awarded crude oil contract to lift crude oil of 32,000 bpd in Nigeria as a subsidiary of trading company.	Awarded crude oil contract to lift crude oil of 32,000 barrel per day in Nigeria as a subsidiary of trading company.

Appendix 6D: Indigenous Oil trading companies in Nigeria

Compny name	Emo oil & petrochemi cal company/c hina Zhenhea	Northwest petroleum &Gas limited	Forte oil	Oando	Sahara energy
Brief history	Incorporate d in January 1993 as a member of Ojei group of company,in volve in oil exploration and production, pipeline	Founded in 2007, basically operating in the field of mineral, oil and natural gas Exloration and production, also invloved in refinery	Forte oil is the former Bristish Petroleum incorporated in 1964,metam orphosed in to Zenon and later Forte oil passing through various	Oando is an IDOC engage in E&P company with broad operation in both upstream and downstream sector, with hold interest in 16 licences.	Founded in 1996, is a leading privately owned power, energy,gas and infrastructure conglomerate. With 20 operating companies spanning the entire energy value chain.

	constructio n, oil services and consultancy .It has subsidiary of 5 company,it is truly an indigeneuo us firm in Nigeria with oversea affliation.	project in Northern Iraq. Also proposed oil trading with Libya and UAE.	agreement and Nigerian government privitisation programme.		
Location	Head office in Nigeria and other are located in Germany and UK.	Nigeria	Located in Nigeria and Ghana.	Nigeria and Sao Tome and principle.	Located in Nigeria, other Africa countries,Caribbean, Asia and Europe.
Operation in Nigeria		Focusing on forming alliance on the advanced GTL Gas to liquid technology as well as unique cold cracking technology for refineries in connection with its JV partners SRE Smart refineries enterprises Itd.	Focusing on upstream operation and downstream sector of the petroleum industry. In addition,its operation spread to power generation division, which has completed the acquisition of a majority stake in the 414mv Geregu power plant located in kogi state Nigeria.	Key asssets is in 3 phases, production asset- Qua Iboe OML 13, Ebendo field (OML 56), OML 60, 62, 63 and 125.Development asset–OML 134, 90,131, 122 and 125 and finaly is exploration asset- OPL 321, 323, EEZ Block 5 and 12 respectively.	Sahara group has asset in the oil hub of Nigeria, such as OPL 274, 284, 286 and Tsekelewu marginal field OML 40). In addition to reviewing new ventures for other opportunities.

Quantity of crude oilAwarded crude oil contract to lift crude oil of 45,000 bpd in Nigeria.Awarded crude oil contract to lift crude oil of 45,000 bpd in Nigeria as of 2016.	Awarded crude oil contract to liftAwarded crude oil contract to lift crude oil of 60,000 bpd day in Nigeria as of 2016.45,000 bpd in Nigeria as of 2016.Awarded crude oil contract to lift crude oil of 45,000 bpd in Nigeria as of 2016.	Awarded crude oil contract to lift crude oil of 60,000 bpd in Nigeria as of 2016.
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Source: Author 2019

Appendix 7: Focus Group/Semi-structured Interviews Security Prompt sheets

Please think of yourself as a professional in the oil industry in relation to ports performance and crude oil export logistics systems distribution in Nigeria. Please discuss the issues that are important to you in this context.

- 1. Please what do you think of security situation in terminals in crude oil export logistics systems distribution in Nigeria.
- Please describe your experience regarding security in port/ terminal performance and crude oil export logistics systems distribution in Nigeria.
- Please describe different component of security measures in port performance and crude oil export logistics system distribution in Nigeria.
- 4. What do you think of inadequate maritime security for export tanker in port performance and crude oil export logistics systems distribution in Nigeria?
- 5. What do you think concerning improvement in port/terminal performance and crude oil export logistics system distribution in Nigeria?
- 6. Are there any other issues, which my research should be aware of?

Source: Author
Appendix 8: Focus Group/Semi-structured Interview Investment Prompt sheet

The main question are:

Please think of yourself as a professional in the oil industry in relation to ports performance and crude oil export logistics systems distribution in Nigeria. Please discuss the issues that are important to you in this context.

Please see focus group/interview prompt sheet below.

- What is your view of the need for investment in port/terminal performance and crude oil export logistics system distribution in Nigeria?
- 2. (a)Please describe important component in port/ terminal performance in crude oil logistics system distribution in Nigeria that need investment.
 (b)What is your view of Nigeria expectage set in part/ terminal

(b)What is your view of Nigeria cabotage act in port/ terminal performance and crude oil export logistics systems distribution in Nigeria? Are these cost justified?

- Please what do you think of cost of investment needed to improve port/terminal performance and crude oil export logistics systems distribution in Nigeria.
- 4. What is your view of investment in information communication technology (ICT) in port performance and crude oil export logistics systems distribution in Nigeria?
- 5. What investment do you think is needed for E&P infrastructure from field to field to terminal as key investment in port performance and crude oil export logistics systems distribution in Nigeria?
- 6. What are your views regarding the need and priorities for human capital development in port performance and crude oil export logistics system distribution in Nigeria?

7. Are there any other issue, which my research should be aware of? Source: Author Appendix 9: The Author's Observation of Crude oil Export Terminal Operations in Oil-rich Niger Delta, Nigeria





Source: Author, 2019

Appendix 10: Flow Chart of Data Collection



Souce: Author 2019

Appendix 11: Metering System and Strategies to Grow Nigeria Oil Industry

Metering system composed of metering manifold, ancillary facilities and its throughput capacity, is one of the general requirement for project execution. DPR procedure guide explained in detail the procedures for determination of quantity and quality of petroleum production in Nigeria. In this case, metering system is key in the SCM of crude oil export logistics system due to quantity and quality of crude must reflect what the customer ordered in the documentary instruction and contractual agreement. More importantly, unit of measurement played an important role during design of metering facilities, which could be either customary or metric systems. In this study, the author recognised the importance of determination of quality and quantity of liquid petroleum at custody transfer points. Application of measurement of quantities and qualities of petroleum product at all approved facilities, which include but not limited to the following: all export terminals, special purpose vessel storage, third party injection and supply point, loading and discharge jetties, refineries tank farms/product, production facilities and flow stations. In Nigeria's crude oil value chain, the primary measurement method for determining fiscal quantities of petroleum product. Further, manual tank gauging which is also known as static measurement is the secondary method of measurement. The design of meters to be install and approval is responsibility of regulatory agency DPR, which must meet international standard particularly API manual petroleum measurement standard (MPMS). This study main concern is accuracy of metering system either manual or dynamic. First, the DPR procedure guide enumerated the accepted reading for manual gauging sequence to be 6m 400mm is the tank dip. In addition,

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specification for manual sampling of tank, contents, apparatus, tank sampling and temperature, temperature measurement. However, the major challenge appears to be operation of automatic sampling system with minimum frequency bbl./grab = 0.001233D2, sometimes this figure fluctuates due to failure of sampler, temperature, human error etc. In addition, ullage appears to be make figure less accurate but it recognised in the 0.05% difference at the destination port, detailed in NNPC GT&C. Furthermore, the author observatory and qualitative evidence revealed inadequate knowledge of regulatory and NNPC personnel as a challenge toward an accurate and reliable metering system for efficient logistics flow of oil from the exporting terminals from offshore and onshore in Nigeria.

SEVEN BIG WINS STRATEGY TO GROW NIGERIA OIL AND GAS

Nigeria over the years have been churning out policy to improve crude oil output, reduce cost transparency, efficiency, stable investment climate and a well-protected environment. The seven big wins is a short and medium term priorities to grow Nigeria's oil and gas industry from 2015- 2019. Further, divided into seven core strategies, which include the following: 1. *policy and regulation, 2. business environment and investment drive, 3. Gas revolution, 4. Refinery location production capacity, 5. Niger Delta and security, 6. Transparency and efficiency, 7. Stakeholder management and international coordination.*

Source: Author

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Appendix 12: Survey of key strategies to improve port performance and

crude oil export logistics system

A survey of possible strategies to improve port performance and crude oil export logistics systems distribution in Nigeria.

As a doctoral researcher in International Shipping and Logistics at Plymouth University, UK, I am researching into strategies to improve port performance and crude oil export logistics systems distribution in Nigeria.

As an expert, your assistance would be invaluable in contributing to research topic. This short survey aims to identify the issues that you think are the most important.

Please could you spend a few moments in answering the following questions?

Firstly, a few details about you:

What is your organisation?	

What is your role in the organisation? -----

How long have you been with this organisation? ------

In the questions below, please tick one box to show how strongly you agree that the item is a vital strategy to improve port performance and crude oil export logistics systems distribution in Nigeria. Use the scale:

Strongly Disagree (SD); Disagree (D); Neutral (N); Agree (A); Strongly Agree (SA)

Item	Please tick one:
A need for Nigerian owned crude oil tankers.	SD_ D_ N_ A_ SA_
Presence of government officials during crude oil loading operations	SD_ D_ N_ A_ SA_
A reliable accurate metering system showing metred quantities for use as Bill of Lading data.	SD_ D_ N_ A_ SA_
Simplifying cargo scheduling and marketing.	SD_ D_ N_ A_ SA_
Annual metre proofing maintenance.	SD_ D_ N_ A_ SA_
Modern technology for capturing shipping documents.	SD_ D_ N_ A_ SA_
An oil derivation fund to be managed by an investment corporation for Niger Delta development.	SD_ D_ N_ A_ SA_
A need for government owned export terminals.	SD_ D_ N_ A_ SA_
Unbundling of the monopoly of using one company for crude oil logistics.	SD_ D_ N_ A_ SA_

Time chartering of vessel to deliver Nigerian crude oil rather than on an FOB basis	SD_ D_ N_ A_ SA_
Increase in security boats, platform and capacity	SD_ D_ N_ A_ SA_
Effective communication between security officers and registered anglers.	SD_ D_ N_ A_ SA_
Information sharing and synergy between terminal operators and Nigerian security forces in oil and gas security, pipeline security courses and training	SD_ D_ N_ A_ SA_
Introduction of anti- piracy laws in port performance and crude oil export logistics systems distribution in Nigeria	SD_ D_ N_ A_ SA_

Appendix 13: Pilot test survey for improvement strategies

The author carried out pilot test to assess question of validity for likely reliability of the data that is collected to enable investigative question to be answered (Saunders et al., 2016, p.473). More importantly, the pilot test composes of 12 experts' spanned NNPC officials, traders, academic and analyst. More importantly, the author ensured that (Bell and Water 2014)'s suggestion were adhered to completely which includes clarity of instruction in the beginning of the questionnaire page, in case any question were unclear or ambiguous. It is concluded that these questions attained face validity which appears to make sense in relation to research objectives (Saunders et al., 2016, p.474). The first pilot test explored Likert scale to evaluate seven key strategies that were glued from experts' viewpoints. More importantly, it is acceptability by 90 per cent of respondents showed that these strategies in the port performance and crude oil export logistics system distribution in Nigeria.

Pilot test AHP survey

The author's first questionnaire for AHP survey as seen below. The author used the following 9-point rating scale below to compare the importance of each listed strategy to improve port performance and crude oil export logistics systems distribution in Nigeria. First, the author showed the questionnaire to academics and some members of supply chains which they recommended changes to layout and clarity of questions (Saunders et al., 2016, p.474). Firstly, 14 key strategies were trimmed down to seven initially from the first survey (see table 8.2) and change of wordings in rating scale to

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convey the message succinctly, see refined AHP questionnaire in appendix 11. In strictest sense, new refined questionnaire helped the respondents to answer the questions easily and effectively. Some of the strategies that appears less important which experts recommended for omissions were (1). *Nigeria should have more offshore terminals because they are safer than onshore terminals in crude oil export logistics system distribution*, (2) *Nigeria should encourage reputable international hedge fund/investment management corporations such as Aberdeen asset management or Black rock, in order to develop its oil producing regions, (3). Officials from immigration services and the Ministry of Finance should be present during vessel clearance and crude oil lifting, (4) the monopoly created by logistics companies such as Intels logistics should be broken up to raise port performance and crude oil export logistics system distribution in Nigeria.* Essentially, the author believe that this might implies a policy angle which requires a structured analysis and the rating appears not appropriate in answering the central research question. Below is rating scale and main strategies for evaluation for importance of each one.

Rating scale	Score
This strategy is equally as important as all others	1
The strategy is of moderate importance	3
The strategy is of strong importance	5
The strategy is of very strong importance	7
The strategy is of extreme importance	9
The strategy is moderately less important	1/2
The strategy is of little importance	1/4
The strategy is very little importance	1/6
The strategy is of no importance at all	1/8

•	ould h	ave mo	re offsl	nore teri	minals b	ecause the	y are sa	fer than	onshore terminals in crude oil logistics system distribution
mportant									Unimportant
Score:	9 _	7_	5_	3_	1_	1/2_	1/ 4 _	1/6 _	1/8_
ligeria sł	nould h	ave gov	/ernme	nt officia	als prese	ent during l	oading o	peratio	ns in crude oil export logistics systems distribution
Importar	nt								Unimportant
Score:	9 _	7_	5_	3_	1_	1/ 2 _	1/4_	1/6 _	1/8_
ligeria sł ading	nould h	ave mo	re relia	ble and	accurat	e metering	systems	to ens	ure that metered use is the same as that shown on the bill of
Importar	nt								Unimportant
Score:	9 _	7_	5_	3_	1_	1/2_	1/4_	1/6 _	1/8_
ligeria sł	nould u	ndertak	e mete	er proofii	ng annua	ally to impr	ove port	perforn	nance and the crude oil export logistics system distribution
Importar	nt								Unimportant
Score:	9 _	7_	5_	3_	1_	1/ 2 _	1/4_	1/6 _	1/8_
ligeria sł	nould ir	ivest in	moden	n techno	ology to	record ship	ping doo	cument	5
Importar	nt								Unimportant
Score:	9 _	7_	5_	3_	1_	1/2_	1/4_	1/6 _	1/8_
ligeria sł or Black r	nould e ock, in	ncourag order to	ge repu o devel	itable in op its oi	ternatior I produc	nal hedge f	und/inve	stment	management corporations such as Aberdeen asset manageme
Importar	nt								Unimportant
Score:	9 _	7_	5_	3_	1_	1/ 2 _	1/4_	1/6 _	1/8_

Important	Unimportant
Score: 9 7 5 3 1 1/2 1/4 1/6	1/8_
L Nigeria should have a government owned crude oil export terminal	
Important	Unimportant
Score: 9 7 5 3 1 1/2 1/4 1/6	1/8_
The monopoly created by logistics companies such as Intels logistics sho	uld be broken up to raise port performance and crude oil export
logistics system distribution in Nigeria.	
Important	Unimportant
Score: 9 7 5 3 1 1/2 1/4 1/6	1/8_
Given the ship portfolio, vessels should be time chartered to deliver Niger	ian crude oil on a long term basis rather than sold free on board
(FOB)	
Important	Unimportant
Score: 9 7 5 3 1 1/2 1/4 1/6	1/8_
Nigeria should have more security boats, platforms and capacity to make	security more effective and improve port performance and crude
oil export logistics system distribution	
Important	Unimportant
Score: 9 7 5 3 1 1/2 1/4 1/6	1/8_
Nigeria should have more effective communication between registered an	glers and security officers for intelligence gathering during crude
oil export logistics system distribution.	
Important	Unimportant
Score: 9 7 5 3 1 1/2 1/4 1/6	1/8_
Nigeria should encourage information sharing and synergy between termi	nal operators and security forces in oil and gas security, and
offer pipeline security courses and training.	

	Importa	ant								Unimportant	Ī
	Score:	9 _	7_	5_	3_	1_	1/ 2 _	1/ 4 _	_ 1/6 _	1/8_	
^	ligeria s	should	introduc	e anti-	piracy l	aws to in	nprove por	t perforr	nance al	nd crude oil export logistics systems distribution.	T
Ir	nportar	nt								Unimportant	
S	core:	9 _	7_	5_	3_	1_	1/ 2 _	1/4_	1/6 _	1/8_	

Pilot test AHP initial survey questionnaire

Source Author 2020

A pilot testing was carried out to assess, and refine the questionnaire so that respondents will have no problems in answering the questions and there will be no problem in recording the data (Saunders et al., 2016, p.473). 13 experts engaged in the crude oil supply chain were contacted for this study, which falls under minimum number for pilot study (Fink, 2013).The questionnaire trial run helped the author to drop two of the items. First, *Nigeria should have more offshore terminals because they are safer than onshore. Second, officials who are from Immigration services and the Ministry of Finance should be present during vessel clearance and crude oil lifting.* Hence, this evidence added face validity to the questionnaire and ensured that (Bell and Water, 2014, p.156) suggestions were adhered to.

Appendix 14: AHP Survey Questionnaire

As an expert, please could you spare a few moments to answer the following questions. As a PhD researcher in Plymouth Business School (<u>www.plymouth.ac.uk/schools/plymouth-business-school</u>), my research aims to recommend strategy for improvement in port performance and crude oil export logistics systems distribution in Nigeria.

This survey will identify and analyse seven possible improvement strategies obtained through interviews and preliminary survey by developing a pairwise comparison for each item and finally arriving at a rating scale that allows priorities to be made to assist in proposing strategies to improve port performance and crude oil export logistics systems distribution in Nigeria.

Any information you offer will be used only for academic purposes and all information will be treated in the strictest confidence.

If you have any questions about this survey, please contact me. If you would like to receive an executive summary of my findings, please enter your email address in the box below:



Pairwise comparison of possible improvement strategies for port performance measures and crude oil export logistics system distribution in Nigeria

- Please tick one option from the pairwise questionnaire below to indicate the relative importance of the following possible improvement strategies for port performance measures and crude oil export logistics system distribution in Nigeria.
- As an example when comparing the "presence of government officials during crude oil loading operations" to "a reliable accurate metering system showing metred quantities for use as Bill of lading data" as improvement strategies if you think that:
- Presence of government officials is strongly more important than a "reliable accurate metering system showing metred quantities for use as Bill of lading data"; please tick "5" on the left hand side.

	•	Equal	→ More important							
	9	7	5	3	1	3	5	7	9	
Presence of government officials during crude oil loading operations			~							A reliable accurate metering system showing metred quantities for use as Bill of Lading data.

- "A reliable accurate metering system showing metred quantities for use as Bill of lading data" is absolutely more important than "Presence of government officials during loading operations", please tick "9" on the right hand side
- If you think that the two options are equally important, please tick "1 "
- Please do not respond to any option that you do not understand or do not have any opinion about.
- Key: 1 = Equally important, 3 = Slightly more important, 5= Strongly more important, 7= Demonstrably more important, 9= Absolutely more important

Section 1	Importance or preference of one possible improvement strategy for Port performance in crude oil export logistics systems distribution in Nigeria over another.										
More important						Equal		► Mo	re imp	ortan	it
		9	7	5	3	1	3	5	7	9	
Presence governme during cru loading oj										A reliable accurate metering system showing metred quantities for use as Bill of Lading data.	
Presence governme during cru loading oj	of ent officials ude oil perations										Simplifying cargo scheduling and marketing.

Presence of government officials during crude oil loading operations Presence of government officials during crude oil loading operations Presence of government officials during crude oil loading operations Presence of government officials during crude oil loading operations Presence of government officials during crude oil loading operations Presence of government officials during crude oil loading operations Presence of government officials during crude oil loading operations Presence of government officials during crude oil loading operations Presence of government officials during crude oil loading operations Presence of government officials during crude oil loading operations loading operations loading operations loading operations log loading operations log loading operations log log log				
Presence of government officials during crude oil loading operations Presence of government officials during crude oil loading operations loading operations loading operations Presence of government officials during crude oil loading operations loading operations loading operations Presence of government officials during crude oil loading operations loading operations loading operations Presence of government officials during crude oil loading operations loading operations loading operations	Modern technology for capturing shipping documents			Presence of government officials during crude oil loading operations
Presence of government officials during crude oil loading operations loading operations i Presence of i government officials i during crude oil i loading operations i Presence of i government officials i during crude oil i loading operations i Presence of i government officials i during crude oil i loading operations i	Increase in security boats, platform and capacity			Presence of government officials during crude oil loading operations
Presence of government officials during crude oil loading operations	Information sharing and synergy between terminal operators and Nigerian security forces in oil and gas security, pipeline security courses and training			Presence of government officials during crude oil loading operations
logis syst dist. Nige	Introduction of anti-piracy laws in port performance and crude oil export logistics systems distribution in Nigeria			Presence of government officials during crude oil loading operations

S2	Importance or preference of one possible improvement strategy for Port performance in crude oil export logistics systems distribution in Nigeria over another											
	More important & Equal — More important											
		9	7	5	3	1	3 5 7 9					
A relia accura meteri systen showin metred quantit use as Lading	ble ate ing ng d ties for ties for Bill of data.										Simplifying cargo scheduling and marketing	

A reliable accurate metering system showing metred quantities for use as Bill of Lading data.					<i>Modern technology for capturing shipping documents</i>
A reliable accurate metering system showing metred quantities for use as Bill of Lading data.					Increase in security boats, platform and capacity
A reliable accurate metering system showing metred quantities for use as Bill of Lading data.					Information sharing and synergy between terminal operators and Nigerian security forces in oil and gas security, pipeline security courses and training
A reliable accurate metering system showing metred quantities for use as Bill of Lading data.					Introduction of anti- piracy laws in port performance and crude oil export logistics systems distribution in Nigeria

S3	Importance or preference of one possible improvement strategy for Port performance in crude oil export logistics systems distribution in Nigeria over another										
	N	Iore	impo	rtant	;	Equal		→ M	ore iı	npor	tant
		9	7	5	3	1	3	5	7	9	
Simpli cargo schedi marke	fying uling and ting										Modern technology for capturing shipping documents
Simpli cargo	fying										Increase in security boats,

scheduling and					platform and
marketing Simplifying cargo scheduling and marketing					capacity Information sharing and synergy between terminal operators and Nigerian security forces in oil and gas security, pipeline security courses and
Simplifying cargo scheduling and marketing					Introduction of anti- piracy laws in port performance and crude oil export logistics systems distribution in Nigeria

S4	Importan performa	nce or ance i ther	r pref n cru	èrenc Ide oi	e for l exp	one pos ort logist	sible ics sy	impro vstem	ovem s dist	ent s ribut	trategy for Port ion in Nigeria
		Mor	e im	porta	ant 🖣	Equal		→ M	ore i	mpo	rtant
		9	7	5	3	1	3	5	7	9	
Mod tech for d ship doc	lern hnology capturing pping uments										Increase in security boats, platform and capacity
Mod tech for a ship doc	lern hnology capturing ping uments										Information sharing and synergy between terminal operators and Nigerian security forces in oil and gas security, pipeline security courses and training
Mod tech for d ship doc	lern hnology capturing pping uments										Introduction of anti- piracy laws in port performance and crude oil

export logis systems distribution Nigeria

S 5	Important performat another	ce or p nce in	refere crude	nce fo oil ex	or one j port lo	possible i ogistics sy	mprov vstems	emen distri	t strate bution	egy fo i in Ni	or Port geria over
	Μ	ore im	porta	int	•	Equal		► Mo	re imj	portai	nt
		9	7	5	3	1	3	5	7	9	
Increa secun platfo capao	ase in rity boats, orm and city										Information sharing and synergy between terminal operators and Nigerian security forces in oil and gas security, pipeline security courses and training
Increa secur platfo capao	ase in ity boats, orm and city										Introduction of anti-piracy laws in port performance and crude oil export logistics systems distribution in Nigeria

S6	Importan performa over ano	Importance or preference for one possible improvement strategy for Port performance in crude oil export logistics systems distribution in Nigeria over another									
	Ν	lore	impo	rtant	4	Equal		➤ M	ore ir	npor	tant
		9	7	5	3	1	3	5	7	9	
Inform sharing synerg betwee termin operat Nigeria securit in oil a securit pipelin securit course	ation g and y en al fors and an ty forces und gas ty, ne ty sa and										Introduction of anti- piracy laws in port performance and crude oil export logistics systems distribution in Nigeria

Source: Author 2019

Appendix 15: Research Ethical Approval Form

RES		culty of	(For FREC use o Application No	nly) D:	
WI1 PLY	MOUTH Aci	ademic tnerships	Chairs action (expedited)		Yes/ No
UN		culty search ics mmittee	Risk level -if high refer to UREC chair immediately		High/ low
		PLICATION R ETHICAL PROVAL	Cont. Review Da Outcome (dele	te ete)	Approved/ Declined/ Amend/ Withdrawn
	RE	SEARCH			
1.	Investigator/student *Note: Ishaka Shitu			Stud <i>Proje</i> and logis	lent - <i>please name your Director of Studies or</i> <i>ect Advisor</i> : Professor John Dinwoodie Course/Programme: PhD in international tics, supply chain and shipping management
	Contact Address: Room 5, 22, Cecil avenue, of	f saint Jude, F	PL4 8SG, Plymouth.		
	Tel:07471604274			Ema	il:Ishaka.shitu@plymouth.ac.uk
2.	Title of Research: Port performance and crude	oil export log	istics systems distri	bution	in Nigeria
3.	Nature of approval sought (Please tick re	elevant boxes) * <i>Note</i>	e:2	
	a) PROJECT:			b)	PROGRAMME * (max 3 year s)
	If a) then please indicate whic	ch category:			
	Funded/unfunded Research (MPhil/PhD, ResM, BClin Sci Masters	staff)	*		Undergraduate Or Other <i>(please state)</i>
4.	Funding:				
	 a) Funding body (if any): Pet b) If funded, please state any university and how they be 	roleum Techn ethical implic	ology Development	Fund e of fur	(PTDF) Nigeria. nding, including any reputational risks for the
5.	a) Duration of project/program	nme: <i>*Note:</i> 4			b) Dates: 23/6/2015 to 30/03/2018
6.	Has this project received ethic a) Please write comm b) Are you therefore c	cal approval fi ittee name: nlv applying f	rom another Ethics	Comm w? Y	ittee? No /es
7.	Attachments (if required)	<u>, «pp.)g .</u>			
	 a) Application/Clearar b) Information sheets c) Consent forms d) Continuing review a e) Other, please state 	ice Form for participant approval (if re :	ts quested)		Yes Yes Yes / No
*1. Princip techn descr *2. In mos comp	l pal Investigators are responsible icians and clerical staff) act in a ibed in this proposal and any co st cases, approval should be so rises an ongoing set of studies	e for ensuring ccordance wi onditions attac ught individua or investigatic	that all staff employ th the University's e ched to its approval. Illy for each project. ons utilising the sam	red on thical µ Progra e meth	projects (including research assistants, orinciples, the design of the research amme approval is granted for research which hods and methodology and where the precise

number and timing of such studies cannot be specified in advance. Such approval is normally appropriate only for

- number and timing of such studies cannot be specified in advance. Such approval is normally appropriate only for ongoing, and typically unfunded, scholarly research activity.
 *3. If there is a difference in ethical standards between the University's policy and those of the relevant professional body or research sponsor, Committees shall apply whichever is considered the highest standard of ethical practice.
 *4. Approval is granted for the duration of projects or for a maximum of three years in the case of programmes. Further approval is necessary for any extension of programmes.

·	
8.	Aims and Objectives of Research Project/Programme:
	This study aims at examining port performance in the crude oil export logistics system distribution in Nigeria.
	This study is needed in view of some operational challenges in port and crude oil logistics industry in Nigeria for instance, one day lost because of a logistics error means millions of dollars lost, cost of logistics in countries like Nigeria could be as much as 30% of a project total cost (Volpi, 2013). Nigeria's cargoes for tanker are occasionally disrupted through shutdown due to pipeline leaks/sabotage (Lloyd's list, 2011, p1). Industry experts believed that it cost 40 per cent higher to explore and produce oil in Nigeria than other oil producing countries (Avuru, 2013).
	Consequently, my research objectives are to:
	 Define the role of ports in the crude oil export logistics system in Nigeria. Analyse the characteristics of the port system in Nigeria's crude oil export logistics systems. Analyse the measures of performance of ports in crude oil export logistics systems in Nigeria. Evaluate performance of the ports in the crude oil export logistic systems in Nigeria. To recommend strategies to improve the performance of ports in the crude oil export logistics systems in Nigeria
	It is aimed to achieve how Nigeria can improve it its crude oil export logistics system distribution.
9.	Brief Description of Research Methods and Procedures:
	The researcher is considering using grounded theory to build a substantive theory; through the use of focus group
	that is to be conducted with port terminal operators, OICs logistics operators, operating in Nigeria and in London.
	Although, the focus group would help the researcher to know more about the issues; thereby helps in grouping them
	in to themes, category and the aim of the focus group is to achieve general consensus.
	Grounded theory; served as at the front of the "qualitative revolution" (Denzin & Lincoln, 1994) It is aimed at building
	substantive theory that faithfully illuminates or explains the area under investigation, through data collection and
	analysis in relation to pre-existing theory and practice (Howell, 2015, p2). It is underpinned by self-indication which
	involves movement of communicative process in which the individual notes things, assesses them, give them
	meaning, focus group appears to fit in perfectly here and this will be decided to act on the basis of meaning
	(Blumer, 1962:183). One specificity of grounded theory is that it takes in to cognisance, theories that already exist or
	formal theory.
	The focus group would consist of 6-8 people at least, 2 or 3 focus group will be undertaken, and participants will be
	drawn from oil companies that have port terminals such as Chevron, Royal Dutch Shell, Nigerian National Petroleum
	Corporation and other logistics service providers in Lagos, Nigeria. The researcher would request for 10 participants
	each, this to overcome the challenges of no show rate (Bryman and Bell, 2015, p527). The language in the questions
	set up are clear and comprehensible. The author has practiced the focus group sessions recently; these skills would
	offer a great opportunity in doing the main one effectively. In selecting participants careful consideration would be
	given to length of service, occupation, age gender etc. (Bryman and Bell, 2015, p519). The moderator/researcher will

	allow a free flow and intervening to bring out salient point during the sessions, ensuring that good ethical code of
	conduct for the focus group is maintained.
	However, grounded theory allows the use of several methods of data collection, displayed through its flexibility with
	continued refining rather than dogmatic prescription, the focus group would provide the opportunity of summarising
	the main issues in to themes, which will lead to further research.
	Specify subject populations and recruitment method. Please indicate also any ethically sensitive aspects of the methods. Continue on attached sheets if required.
10.	Ethical Protocol:
	In ensuring protection of participant's right, the research will be carried out in a transparent manner during the fieldwork and as well throughout the research; the company's practices and respect for university code of conduct and ethics will be abide by accordingly, this is to ensure an honest and open environment to conduct the research successfully. Consent form will be distributed to participants for the purpose of making the exercise voluntary, and also the researcher will ensure there is no imposition for participation.
	Records of the research obtained from these procedures will be kept in paper and electronic formats. Moreover, anyone assisting in this research directly or indirectly will be properly acknowledged for their contribution. Furthermore, participants would not receive any financial incentives to take part in this research; hence, it will be on a voluntary basis.
	Please indicate how you will ensure this research conforms to each clause of the University of Plymouth's <i>Principles for Research Involving Human Participants</i> . Please attach a statement which addresses each of the ethical principles set out below.
	(a) Informed Consent:
	All participants will be informed in written about purpose and application of this research. Also, as I had mentioned in the beginning section, a focus group would be conducted; consent form and information sheet will be provided to each of the participants about the aims and objectives of this research.
	No participant will be forced to take part but rather the researcher would ensure that a clear objective of the research is communicated to them politely, and this a fundamental content of the consent form.
	(b) Openness and Honesty:
	Participants will be provided with an open and honest idea about the purpose of the research, this will help in showcasing a clear vision of the topic, and moreover this helps in seeking their support and decision to be a part of the research.
	The researcher would use few minutes during introduction to explain the degree of openness and honesty of this research, for instance telling them its practical implication, e.g. for research purpose and to improve Nigeria ports and crude oil logistics systems distribution.
	Note that deception is permissible only where it can be shown that all three conditions specified in Section 2 of the University of Plymouth's Ethical Principles have been made in full. Proposers are required to provide a detailed justification and to supply the names of two independent assessors whom the Sub-Committee can approach for advice.
	(c) Right to Withdraw:
	All participants have the right to withdraw at any time without penalty and their records will not be used in any way during the data analysis and will be immediately destroyed.
	The researcher hope to perform more than one focus group to ensure that in case some participants tend to withdraw from the session at any time, more options is available (2 or 4 focus group sessions will be administered, there is high probability that at least 2 or 3 would suffice. The researcher is hoping to use Dictaphone for all the sessions and this will be transcribed later, diligently.
	In case, some of the participants do not allow the researcher to record sessions, the researcher is suggesting using short notes to record sessions as quickly as possible or ensure that someone help the researcher with recording the sessions, it might be difficult for the researcher to perform the role of facilitator and at the same time recording a session. The use of a secretary will be a welcome development.

with best practice.	ial participarit s'dat	a will be destroyed should they w	
(d) Protection From Harm:			
Participants will be protected from any ha confidential, and as well by assuring them relating to whistle blowing and complaint, nterest disclosure act 1998 would be give	rm during the resea that the purpose o appropriate proced n premium conside	arch; by keeping their identities and this research is purely academic ures would be followed and In ad stration.	nonymous and c, for instance issue dition as the public
(e) Debriefing: The concerned companies or individuals hrough the company's appropriate contac course of this research.	participating in this t and as well the re	research will be briefed on the ou searcher will acknowledge their s	utcome of this research support during the
(f) Confidentiality: When conducting field's research, particip dentity and data provided by the participa 'or locked cabinets accessible to only the Jniversity's general principle of data confi accordingly.	ants and company nts; all the data col researcher and the dentiality and acces	s names will be protected to ensu lected will be kept in in a passwor team. The researcher is quite co ss from section 86 to 91; all these	ure confidentiality of the rd protected drive and inscious of Plymouth e will be abided by
(g) Professional Bodies Whose Ethical	Policies Apply to th	nis Research:	
Research Councils UK (RCUK)			
Research Councils UK (RCUK) Social Research Association (SRA)			
Research Councils UK (RCUK) Social Research Association (SRA) The committee strongly recommends that ethics regardless of whether or not they a <u>http://www.the-sra.org.uk/ethical.htm</u> Ma British Sociological Association <u>http://www</u> the "Relevant Professional Bodies" section be no professional/academic code of ethic other sections of the form, FREC consider and then the Committee may make its cor	prior to application re members of that rket Research Soci <u>v.britsoc.co.uk/equa</u> n of the Ethical App cs relevant to a give rs a particular profe nsultation and adhe	, applicants consult an appropriat body (for example, Social Resea ety <u>http://www.mrs.org.uk/standa ality/</u>). Applicants may choose to v lication Form. However, it is very en research project. If based on th ssional code to be of relevance, rence a condition of acceptance.	te professional code of arch Association . <u>rds/codeconduct.htm</u> write "not applicable" in or are that there would ne information written in
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Research Councils UK (RCUK) Social Research Association (SRA) The committee strongly recommends that ethics regardless of whether or not they a <u>http://www.the-sra.org.uk/ethical.htm</u> Ma British Sociological Association <u>http://www</u> the "Relevant Professional Bodies" section be no professional/academic code of ethic other sections of the form, FREC consider and then the Committee may make its cor Declaration*: To the best of our knowledge and belief, th Jniversity and by the professional body sp	prior to application re members of that rket Research Soci <u>v.britsoc.co.uk/equa</u> no of the Ethical App cs relevant to a give rs a particular profe insultation and adhe his research confor pecified in 6 (g).	, applicants consult an appropriat body (for example, Social Resea ety <u>http://www.mrs.org.uk/standa ality/</u>). Applicants may choose to v lication Form. However, it is very en research project. If based on th ssional code to be of relevance, rrence a condition of acceptance. ms to the ethical principles laid do E-mail (s)	te professional code of arch Association . <u>trds/codeconduct.htm</u> write "not applicable" in or are that there would be information written in own by Plymouth Date
Research Councils UK (RCUK) Social Research Association (SRA) The committee strongly recommends that ethics regardless of whether or not they a http://www.the-sra.org.uk/ethical.htm Ma British Sociological Association <u>http://www</u> the "Relevant Professional Bodies" section be no professional/academic code of ethic other sections of the form, FREC consider and then the Committee may make its cor Declaration*: To the best of our knowledge and belief, th Jniversity and by the professional body sp	prior to application re members of that rket Research Soci <u>v.britsoc.co.uk/equa</u> n of the Ethical App cs relevant to a give rs a particular profe nsultation and adhe his research confor pecified in 6 (g). Name Ishaka SHITU	, applicants consult an appropriat body (for example, Social Resea iety <u>http://www.mrs.org.uk/standa</u> ality/). Applicants may choose to v dication Form. However, it is very en research project. If based on th ssional code to be of relevance, rence a condition of acceptance. ms to the ethical principles laid do E-mail (s) Ishaka.shitu@plymouth.ac.Uk	te professional code of arch Association . <u>irds/codeconduct.htm</u> vrite "not applicable" in rare that there would he information written in own by Plymouth Date <u>(</u> . 25/02/20 16
Research Councils UK (RCUK) Social Research Association (SRA) The committee strongly recommends that ethics regardless of whether or not they a <u>http://www.the-sra.org.uk/ethical.htm</u> Ma British Sociological Association <u>http://www</u> the "Relevant Professional Bodies" section be no professional/academic code of ethic other sections of the form, FREC consider and then the Committee may make its cor Declaration*: To the best of our knowledge and belief, th Jniversity and by the professional body sp ^D rincipal Investigator:	prior to application re members of that rket Research Soci <u>v.britsoc.co.uk/equa</u> n of the Ethical App cs relevant to a give rs a particular profe nsultation and adhe his research confor pecified in 6 (g). Name Ishaka SHITU	, applicants consult an appropriat body (for example, Social Resea iety <u>http://www.mrs.org.uk/standa ality/</u>). Applicants may choose to v vlication Form. However, it is very en research project. If based on th ssional code to be of relevance, rence a condition of acceptance. ms to the ethical principles laid do E-mail (s) Ishaka.shitu@plymouth.ac.Uk	te professional code of arch Association . <u>rrds/codeconduct.htm</u> vrite "not applicable" in r rare that there would he information written in own by Plymouth Date <u>C. 25/02/20</u> 16

Appendix 16: Consent Form for Participants

Research Title: Port performance in the crude oil export logistics systems distribution in Nigeria

Participant Volunteer: Please read this if you are pleased to proceed, sign below.

The researcher has given me my own copy of the information sheet which I have read and understood the information sheet clarifies the nature of the research and what I would be asked to do as a participant. I comprehend that the research is for a PhD student project and that the confidentiality of the information I provide will be safeguarded unless subject to any legal requirements. He has discussed the contents of the information sheet with me and given me the opportunity to ask questions about it.

I agree to take part as a participant in this research and I understand that I am free to withdraw at any time without giving any reason and without detriment to myself.

Name: Signed: Date:

<u>Researcher</u>

I confirm that I have discussed with the participant the contents of the information sheet.

Signed:

Date:

Appendix 17: Participant Information Sheet

PARTICIPANT INFORMATION SHEET
Research scope: Port performance and crude oil export logistics systems
distribution in Nigeria.
Name:
Age:
Gender:
Occupation:
Company:
Position:

Appendix 18: Confidentiality Agreement with Shell Petroleum Development of

Nigeria

BETWEEN

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED

AND

Ishaka Shitu Plymouth Graduate School of Management Plymouth University, UK

CONFIDENTIALITY AGREEMENT

This **Agreement** is made this 13th day of April 2016 ("Effective Date") between:

The Shell Petroleum Development Company of Nigeria Limited, a company incorporated under the laws of the Federal Republic of Nigeria and having its registered office at Shell Industrial Area, Rumuobiakani, Port Harcourt, Rivers State, Nigeria, in its capacity as a partner in and operator of the SPDC JV ("<u>Disclosing Party</u>")

And

Ishaka Shitu

, of [...Department of International Logistics, Plymouth University] and whose permanent address is . (No BP 14b Independent Street, Enugu road, off Kaduna Polytechnic road, Panteka, Kaduna, Nigeria.").

WHEREAS

- The Disclosing Party is the operator of the SPDC JV, by virtue of which it operates the concessions and contract area of the SPDC JV, while the Receiving Party is a [Student of Plymouth University.].
- The Disclosing party is willing to avail the Receiving party with the required information and/or grant access to such information

 In consideration of the disclosure of such information by the Disclosing Party to the Receiving Party, the Receiving Party undertakes to keep the disclosed information strictly confidential in accordance with the terms set out in this Agreement.

IT IS HEREBY AGREED AS FOLLOWS;

DEFINITIONS, INTERPRETATION

Definitions -As used in this Agreement, these words or expressions have the following meanings:

"Affiliate" means a company which, directly or indirectly through one or more intermediaries, controls or is controlled by, or is under common control with either of the Parties. For this purpose, control means the direct or indirect ownership of in aggregate fifty percent or more of voting capital, or if there are no such voting rights, ownership of fifty percent (50%) or more of the equity share capital of or other ownership interests in such entity, or the right to direct the policies or operations of such entity

"Agreement" means this Confidentiality Agreement.

"Authority" has the meaning given in section 4

"Business Day" means any day, when the banks in Nigeria are normally open for business, generally on days other than a Saturday, Sunday or public holiday.

"Confidential Information" means any and all visual, written or other proprietary information in whatever form or medium and wherever provided in any manner under the Contract, whether belonging to the Disclosing Party or any of its affiliates, including, but not limited to, all technical specifications, gas specifications, affiliated hydrocarbon reserves, well or production profiles, well reports, pressures, temperatures, infrastructure designs and development planning, geological, geophysical, commercial, legal, business, financial, technical, operational, strategic or promotional information and, where relevant, processes, maps, models, concepts, interpretations and other know-how, and all notes, data, analyses, compilations, studies, rulings, judgements, arbitration awards, recommendations, proposals, executive summaries, opinions, minutes or records of any meetings, agreements, contracts, invoices, correspondences or communication with government agencies or any other person or any other documents whatsoever and howsoever prepared, disclosed to the Receiving Party, whether such information is disclosed directly or indirectly by Disclosing Party to the Receiving Party and whether or not such information was disclosed in writing or

other visual form, oral, recorded on tape or any other media or disclosed through magnetic or other electronic displays or by any other means, or which the Receiving Party accesses in the course of the internship, youth service or project work, regardless of whether such information is identified or labelled as confidential, private or proprietary, and also includes the services provided in the course of the internship, youth service or otherwise and the existence of this Agreement.

"**Dispute**" means any dispute or controversy arising out of this Agreement, including a dispute or controversy regarding the existence, construction, validity, interpretation, enforceability or breach of this Agreement.

"Gross Negligence" or "Wilful Misconduct" means any act, omission or failure to act (whether sole, joint or concurrent) which seriously and substantially deviates from a diligent course of action or which is in reckless disregard of or indifference to foreseeable harmful consequences.

"Notice" means a communication by one Party to another Party that complies with the provisions of Section 10 of this Agreement.

"**Party**" means Disclosing Party or Receiving Party and "<u>Parties</u>" means both of them.

"**Permitted Purpose**" means use of Confidential Information for the sole purpose of completing the Receiving Party's Project Work as described in this Agreement.

"Person" means any person, company, firm, educational institution, university or college partnership, association, body corporate, governmental agency, or other legal entity, which is not a Party to this Agreement including without limitation, natural persons, groups of persons and legal entities.

"**Project Work**" means the Receiving Party's Post graduate university project titled "Port Performance and Crude Oil Export Logistics System Distribution in Nigeria"

"Representative" means directors, officers or employees of a Party.

"SPDC JV" means that certain joint venture governed by the Joint Operation Agreement dated 11th July 1991 between the Nigerian National Petroleum Corporation, The Shell Petroleum Development Company of Nigeria Limited, Nigerian Agip Oil Company Limited and Total E&P Nigeria Limited.

- **1.2** Interpretation Unless the context clearly requires otherwise;
- Words denoting the singular shall also include the plural and vice versa;
- Words denoting the masculine shall include the feminine, neutral and vice versa;
- The headings in this Agreement are included for ease of reference only and shall not be deemed part of, or be taken into consideration in the interpretation or construction of this Agreement and;
- References to sections or an exhibit shall, unless otherwise stated, be references to sections or exhibit of to this Agreement;
- References to Persons include reference to their successors in title and permitted assigns;
- Unless the context otherwise requires, any reference to a statute, by-law, regulation, rule, delegated legislation or order is a reference to such as amended, modified or replaced from time to time by other statutory provisions.
- Reference to a day, month or year is a reference to a calendar day, month or year.
- Reference to either party shall include reference to their Affiliates, and Representatives and its permitted successors and assigns.

CONFIDENTIALITY OBLIGATIONS

- The Receiving Party acknowledges the fact that the Confidential Information is technically and commercially sensitive, and that divulging it to any Person other than as permitted under this Agreement will result in a substantial exposure for the Disclosing Party.
- In consideration of Disclosing Party disclosing the Confidential Information to Receiving Party, Receiving Party agrees to keep the Confidential Information strictly confidential in accordance with the terms of this Agreement. The Confidential Information disclosed pursuant to this Agreement includes but is not limited to those described in exhibit 1 to this Agreement.
- The Receiving Party shall keep all Confidential Information strictly confidential and not disclose, trade or otherwise divulge the Confidential Information to any Person, without the prior

written consent of Disclosing Party, except as permitted by this Section 2.

- The Receiving Party undertakes and agrees not to make copies or extracts of and not to disclose any or all of the Confidential Information communicated to it hereunder, except as provided in this Agreement:
- Subject to the prior written consent of the Disclosing Party, the Receiving Party shall ensure that all Persons to whom the Confidential Information is disclosed under this Agreement keeps such Confidential Information confidential and does not disclose or divulge the Confidential Information to any unauthorized Person.
- The Receiving Party shall use the Confidential Information solely for the Permitted Purpose.
- The Receiving Party shall indemnify the Disclosing Party and its Affiliates from and against any and all claims made by any person to whom the Receiving Party discloses the Confidential Information howsoever such claim may arise, including but without limitation; the negligence, breach of duty and or breach of contract by the Disclosing Party and or its Affiliates

EXCEPTIONS TO SCOPE OF CONFIDENTIALITY OBLIGATIONS

The Receiving Party may disclose any of the Confidential Information without Disclosing Party's prior written consent only to the extent that the Confidential Information being disclosed satisfies any of the following conditions:

- The Receiving Party can show it was already in its possession at the time of disclosure, as evidenced by written records in existence at that time, and was not acquired by it under an obligation of confidentiality.
- (b) The Confidential Information being disclosed is already in possession of the public or becomes available to the public other than through the act or omission of Receiving Party or of any other Person to whom the Confidential Information is disclosed pursuant to this Agreement
- (c) The Confidential Information is required to be disclosed under applicable law, stock exchange regulations or by a governmental

order, decree, regulation or rule or by order of any competent court. In these circumstances, Receiving Party shall make all reasonable efforts to give prompt written notice to Disclosing Party before the time of disclosure.

- (d) The Confidential Information being disclosed was acquired independently from a third party (other than one disclosing on behalf of the Disclosing Party) that represents that it has the right to disseminate the information at the time it was acquired by Receiving Party.
- (e) The Confidential Information being disclosed was developed by Receiving Party independently from Confidential Information received from Disclosing Party.

Appendix 19: Lloyds's Law Report showed Effect of Poor Information System in Nigeria Crude Oil Export Value Chains

Nigeria is one of the global crude oil exporters over the years, this reports entails a brief summary of Lloyd's law report edited by Michael Daiches, Barrister, and Professor Robert Merkin involving a vessel called "Crudesky" that was chartered by Trafigura from claimant owner Great Elephant Corporation.

This case is reported in part 1 2014 Vol 1 of Lloyds law report.

Key items of trading transaction

- 1. Trafigura chartered the vessel Crudesky from the claimant owner on amended BPVOYY3 form.
- Firstly, Trafigura purchased a quantity of Akpo crude oil from Vitol on free on board (fob) terms, second, Vitol had itself purchased it from on fob terms from China Offshore Oil Singapore international Pte Ltd (COOSI).
- Trafigura ordered Crudesky to proceed to Akpo field FPSO terminal in south –south west of Port Harcourt in Niger delta Nigeria, to load the oil.
- 4. Production right were held by a consortium including COOSI.
- 5. Terminal operator is Total Upstream.
- There is always concerned about possible oil theft by Nigeria and this what made it to always have in attendance a senior official of DPR during crude oil loading.
- Sales of goods act 1979 was used alongside with Incoterms 2000 in this transaction.
- 8. NNPC terms and condition regarding sale and purchase of Nigerian crude oil sales, key among them is article 18 and article 21.
- 9. Article 18 deals basically compliance with laws, regulation and further assurance.
- 10. Article 21: basically deals with Force majeure.

 Relevant contractual provision, charter party incorporated the terms BPVOY3 ... taking in to consideration section 15 – loading and discharge of cargo, lay time and force majeure respectively.

What transpired during Crude oil lifting in Akpo field oil terminal in Port Harcourt?

 Crudesky arrived at the Akpo oil terminal at 3.00 on 29 August, 2009 but unfortunately this day, the DPR representative was not present at the terminal, he left without informing Total and as well without permission from the DPR in Port Harcourt or Lagos head office.

At exactly, 10:20 am, vessel gave a notice of readiness (NOR) at 13:00, at this time hose connection was made but without loading taking place, because export valve was padlocked/ sealed and no DPR representative was present with key to unlock the padlock.

- 2. Lifting supervisor for Total Mr Bankole, arrived on scene, between 12.00-15.00, 29 Aug, he contacted the DPR office in PH to ask when will DPR representative will arrive at the terminal, He was told Mr Idoniboye will arrive on 1 September, 2009, later he spoke with DPR head of operations in PH, Mr pepple, and asked if it possible to begin loading without DPR representative in attendance. *In addition, Mr Pepple gave Mr Bankole verbal authorisation* to severe the padlock and commence loading operation.
- 3. At 16.12,29 August, 2009 on Mr Bankole's instructions, the padlock on the export valve was cut and loading began.
- 4. However, a new DPR representative Mr I Idoniboye arrived at about 12.15 on 1 September, about the same time Total's office in Lagos requested for clearance for loading from DPR Head office in Lagos. Clearance was granted between 15.00 and 18.00, and Mr Idoniboye was told to print it out and he could not due to glitch on his computer. I think this what supposed to be done before and it is being done now, meaning right channel was not followed from the beginning of the operation.

- At 21.00 loading was completed and at about that time Mr Idoniboye received a notification that the DPR in Lagos had revoked the clearance it had given earlier.
- 6. At 21.54 hoses were disconnected and at about 22.18 the vessel was unmoored from Akpo FPSO and began to drift.
- Crudesky could not leave the terminal as documents evidencing the loading of the cargo have not been received.
- 8. At 09.19 on 3rd September, the laytime allowed by the charter party expired and the vessel was thereafter on demurrage.
- On 7th September DPR head office in Lagos sent two letters, detailing, first that action of Total in loading crude oil without perquisite clearance termed as an economic crime by the Nigerian government.

Second, letter to chief of naval staff, requesting Nigerian Navy assistance to stop Crudesky from leaving Nigerian waters. There was no investigation before this sanction.

- 10. On 9 October, Ministry of Petroleum Resources wrote to Total requiring them to pay a fine of US \$12million to the DPR's US\$ account in New York and required to discipline the personnel of Total involved in the act, Total paid the fine on 13 October and vessel was released, on 16 October, vessel sailed for the port of discharge.
- 11. The judge held that vessel is on full demurrage from 3 September until 7 but from sept, 7 it was on half demurrage by reason of "a restraint of princes" clauses in the charter.
- 12. Judge is of the view that Trafigura could claim that their vendor fails to give them quite possession of cargo from 1 to 7 September, in essence this will give Vitol and COOSI to rely on force majeure clauses (article 21) of NNPC terms, that could exclude them from major interference or unforeseeable consequences as from September 7 to October, 16.

<u>Critical incidence analysis report</u>: This would show a list of what went wrong on the course of crude oil export Akpo terminal in Nigeria.

Critical incidence analysis technique (CIT) has been widely used in qualitative research methods and today is recognised as an effective exploratory and investigative tool, common areas of discipline that applied it are communication, job analysis, performance appraisal, organisational learning (Butterfield et al., 2005:475) but for this purpose of this work, attention would be centre on communication, performance. Chell (1998) pointed out, the CIT was developed during a period when the positivist approach to scientific investigation was the dominant paradigm in the social sciences, indeed, in all the sciences. Although it is a qualitative research method, the CIT was initially posed as a scientific tool to help uncover existing realities or truths so they could be measured, predicted, and ultimately controlled within the realm of job and task analysis–ideas that are rooted in the predominant quantitative research tradition of the day.

To gain acceptance, early researchers utilizing the CIT often used quantitative language and in some cases used quantitative validity and reliability checks [...]. However, we currently find ourselves in a post-modern [...], some would say post-structural [...] research paradigm where qualitative methods are now commonly in use and accepted [...]. Butterfield et al. 2005: 482

Below is basic incidence the author believed to have occurred.

- There is always suspicion of crude oil theft in Nigeria.
- Total prefer to deal with DPR representative in PH instead of head office in Lagos, which is a choice carried at their own risk, having familiar with terms and condition of crude oil sales and purchase involving seller and buyer.
- Selling of the crude followed properly NNPC terms from all the key value chain members, there was transfer of cargo

from one party to another under the same NNPC terms, cargo is sold from one party to another on incoterms 2007 terms and sales and purchase of goods terms act 1979.

- Major issue is that on arrival date of Crudesky in Akpo field oil terminal, the disappearance of DPR representative without appropriate information of where about and no permission given to any senior official before this incident, this shows complacency in carrying out assigned duty.
- Verbal instruction given to Mr Bankole of Total terminal operator, by DPR head of operation in Port Harcourt Mr pepple to severe the padlock and commence loading appears not to be proper. On whose instruction did he say that? Is that action complied with NNPC terms, the action looks suspicious?
- There is absence of effective communication from all officials involved for instance, loading was completed as of 21.00 on 1st September, 2009, but Mr Idoniboye could not print out the written clearance from Lagos head office due to glitch on his computer, despite this loading was carried out and completed at 21.00, on the contrary, Mr Idoniboye received a notification that the clearance granted earlier is revoked. Why the sudden change of action from DPR head office in Lagos? This shows inconsistencies in policy and operation.
- Nigerian authority through the minister of petroleum resources fine Total US \$12million as it viewed the incidence as an economic crime and ordered the vessel should be restricted from sailing out of Nigerian waters through the Nigerian navy. Did the Minister do a thorough investigation before fining the terminal operator? This action led to unending arbitration and in which each party contributed by their inaction.

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- It is believed that vessel was on full demurrage from 9.19 on September 3 until 7 September.
- Severing the padlock was one key event that made it liable for Total as terminal operator to act illegally, since the operator is aware of Nigerian law regarding crude oil theft, although verbal instruction is not enough as evidence for this action from a DPR representative. Communication channel appears not effective and strategized.
- NNPC's terminal operation guide for determination of quantity and quality of crude oil, this provide for inward clearance whereby customs, task force and immigration have to clear a vessel before issuing a clearance certificate, it appears there is a breach of contract, as inward clearance was not granted prior to loading, padlock severed and absence of government official from department of petroleum resources.
- It appears that channel of communication is not duly followed, what made it for Total in Lagos not to consult DPR in Lagos, this appears a better channel of communication but was not used.
- I think the delay was caused by inappropriate channel of communication and ineffectiveness in action of Nigeria petroleum regulatory agency DPR.

Source: Author

Appendix 20: Nigeria's Export Terminals Description

Ownership	Draft and Location	Capacity	Offshore	Berth	Block	Daily production +-10% kbd
ABO		·	•	•	•	
Operated by NAE and Oando E&P under PSC	Water depth ranges between 500m and 800m	148,188M3 storage capacity of 900,000 barrel Max size:350, 000DWT	Deep offshore First producing deepwater oil field in Nigeria		OML 125 &134. OPL 245	26,266
AGBAMI		1		1		
Operated by Chevron and FPSO, and has 67.3% concession. Statoil (18.85% 0 and Petrobras (13%) holds the remaining working interest. PSC between Chevron and Famfa	70 miles Offshore Nigeria. 48000 ft. water depth	2.15 million Barrels	Nigeria's largest deepwater discoveries.	SBM located 1.2 miles from Agbami FPSO	OPL 216 & 217	200,00 bbl.
ANIAN Operated by	Loootod 20	Troffic figure	OFESHODE	Anohora		11 field
Operated by Addax petroleum. It is an offshore terminal.	Located 20nm, off the SE coast of Nigeria in the bight of Biafra, S of the Calabar River.	I raffic figure- approximately 35 vessels visit port annually.	OFFSHORE	Anchorage is 23m Max Size is up 500 feet in length	OML 123.Ot her are OML 124 and 2 fields with 17 produc tion wells in conce ssion OML 126	11 field complexes with around 80 wells. 43,200
BONGA						
It is operate by Shell with 55 % on the behalf of NNPC and its co- venture partners, ESSO 20%, Total 12.5%, Agip 12.5%, Export commenced in Q4 2005 with first shipment of crude oil from the Bonga field reported January 2006. SPM is located 1 Mile from FPSO, about 50 Nautical miles of Lagos	Located in the Bonga Oil field at OML 118 approximately 133nm SE of Lagos. Bonga Terminal FPSO is located in position 04 33. 3N, 004 37 0E. Water depth 1000metres. Draft 21.2 Beam 58 metres	FPSO consist of large, barged vessels spread moored to 12 suction pile anchors in orientation of 185. Summer DWT: 350,000 tones. Storage capacity of 2 Million barrels.	Offshore	Approximate Maximum dimension of tanker loading at Bonga Offshore terminal SPM are: Length 360 meters Bow to Manifold 170 meters	OPL 212 which is former ly 118	Production is approximately 150 kbd. A maximum loading rate of 47,000 per hour and is designed to produce 225,000 bpd. Normal cargo size is 1million
BONNY INSHOR	ETERMINAL					
SPDC (30%), NNPC 55%,	Located on the bank of the	120, 000 DWT				All crude oil is exported from

·	_		1				1
ELF (10%), Eni (5%).	Bonny River, S of the Port Harcourt. 15km length with a width of 215m in the seaward channel, which opens up to 296m at 21 and 22 Buoys, 389 at No 23 and 24 Buoys and 482 at no 25 and 26 Buoys					the offshore single buoy moorings	
BONNY OFFSHORE TERMINAL							
SPDC (30%), NNPC 55%, ELF (10%), Eni (5%).	Maximum offshore Draught: 22.8m. It is located 14nm off the coast of Nigeria. Consist of 2 SBM fed by submarine pipelines. Anchorage 32.2 over. Oil terminal depth 23.2m over	Crude oil tanker type ULCC. 300, 000 DWT. There were no length of beam restriction	Offshore	Water depth 26-28 Maximum size – over 500 feet in length	OML 11, others are OML 67, 68 and 70	-269,720	
Brass Terminal Frha Terminal							
ErxonMobil entitlement of 44%	Terminal is about 85 nautical miles south of Lagos port. FPSO designed	Storage capacity design of 2.2mbpd.	Offshore	Crude oil is transferred to the export tanker via two 16" floating hose strings at an offloading		140,000- 180,000	NAOC is the operator of 2 onshore exploration leases OPL 282(90%) and OPL 135(48%) interest.
Sea Eagle Termin Managed by	al Anchorage	300 000 dwt	Offshore			40.00	
Shell/Snepco. Located south west of the mouth of dodo river in Bayelsa.	depth 23.2m over. Terminal depth 17.1m- 18.2m					40,00	
JV between	Draught is	Consist of fixed	Onshore	Consist of	OPL	173.769	1
NNPC (60%) and chevron (40%). It is situated approximately 9.5nm offshore, close W of the River Niger.	15.8m, Depth 20.7. Maximum displacement at SBM no 3 is 350,000t	platform with two SBM's for loading export crude and LPG FSO.		fixed platform with two SBM's for loading export crude and LPG FSO.	341, 336		
Forcados Oil Term	ninal		Quet	0		050.004	
JV between NNPC and Shell. Situated off the mouth of	Anchorage 23.m – over		Onshore	Served by a 22km submerged pipeline from		259,884	

the Forcados	Oil terminal			the shore to		
River	depth 23m –			the SBM via		
	over.			a production		
Ima offebora torm	inal			platform		
	Draught 7 3nm		Offshore	ESO.	OM	10 780
licence interest	Draught 7.5him	-	Olisilore	Consist of	112	10,700
/working 100%.				calm buov	OML	
It is about 13nm				and 0.9nm.	117	
SSE of the W						
entrance of						
Andoni River.						
Odudu terminal						
Total petroleum	Located	Offshore fields	Offshore	Calm Buoy	Odudu	72, 242
in partnersnip	approximate	CONSIST OF		340,000DW		
	40KIII SSE UI	PPSO unity a		1	100), Ofon	
F30.	offshore	barge and a				
	Nigeria	calm offloading			102)	
	Ingona	buov			and	
		20.09			Amen	
					am	
					(OML	
					99)	
Okono						
Operated by	Located in	Consist of	Offshore	Field with	OML	21,000
Agip Energy on	Delta State,	FPSO Mystras		depth of	119	
Denair of NINPC	from Dort	01 138,930 DWT		72m		
- NPDC)	Harcourt	Divit. Draught 13.2m				
	Tharcourt	Largest vessel				
		handle "Portos"				
		LOA 228.7m,				
		65,549DWT				
Okoro terminal						
Managed by	14 metres	This field is still	Offshore		OML	-
AMNI interest.	depth	undergoing			112	
		field				
		Apothor field				
		setu located				
		6.5km north of				
		Okoro				
		discovered by				
		AMNI.				
Okwori	140metres		Offshore		OML	
Terminal					126	
Managed by						
Qua Iboe						
terminal						
ExxonMobil as	Located on the	Total capacity	Onshore	Maximum	OML	Maximum
a field operator	eastern side of	of 4.5 million		draft at berth	13	loading rate is
holds 40%	the Qua Iboe	bbls. Vessels		is 72 feets.		approximately
interest in the	river	are loaded		Restriction		50,000 barrel
field production		through SPM		312, 000MT		per hour through
mix with NNPC		23 miles		Max draft:		a 42-inch
romaining 60%				Z1.90m		the SPM
With extension		accommodate		342m		
of marginal field		ships up to 312		042111		
managed by		000 DWT				
Oando						
Ukpokiti						
terminal				1		
Managed by	It is a small port	Terminal	Offshore	Maximum	OML	-
Express/Atlas/	IOCATED			size of	108	
Exploration	approximately			vessel		
	Escravos	1730				
	terminal.			Τ		
					1	
Yoho Terminal						

PSC between NNPC and ExxonMobil.	Located 25 miles offshore in eastern Nigeria. Overall length: 359m Beam: 54.5m	Consist of turret moored FSO Yoho (FPSO) which accommodate offloading tankers up to 300kdwt. Moored	Offshore	2 *16 inch cargo hose tails can load tanker.	OML 104	Minimum bulk loading rate is 40,000 barrel per hour
Ebok terminal						
Managed by NNPC, ExxonMobil. Also Oriental managed part of the Ebok offshore since 2007.Located within Gulf of Guinea off Nigerian coast	Terminal consist of a 12 point spread moored FSO and off take unit that has a designed storage capacity of 1.2 million barrel of crude.	Export tanker up to maximum DWT of 300,000mt can be loaded at the FSO.	The FSO is about 55 kilometres south east of Qua Iboe terminal.	Offloading of crude from the FSO to vessels is via single 20" floating hose system at a maximum rate of 40,000bbls.h our	OML 67	Currently produce at the rate of 30kpd
TULJA	-		-	-		
Terminal operator is Sterling		1,76245		FSO	OML 143	-
Brittania -U	The	The capacity is 1,814,044	Offshore			
OBE	-		-	-		
Cavendish is the terminal operator		224,176	FPSO			Not active

Source: (Author, Adapted from Ports and Terminals Guide 2009-2010)

Appendix 21: Analysis of Focus Group Using Thematic Analysis

It is great analytic technique due to its flexibility and accessible approach to analyse qualitative data (Braun and Clarke 2006). It provides the author the confidence to analyse focus group that is a large qualitative data sets leading to rich descriptions, explanations and theorising (Saunders et al., 2016, 579). Further, to understand factors underpinning actions in crude oil export value chain and as well to different interpretation of phenomenon (Saunders et al., 2016, p.579).

Analysis procedures

The author used Braun and Clarke's (2006) framework phases for thematic analysis that includes familiarisation with the data *(immersion with data through listening to audio and reading transcript several times*), coding data (labelling *each unit of data within the transcript*). The codes were label developed by the author which described unit of data coded (Saunders et al., 2016, p.582). Further, some codes with small number of units were merged with similar ones. More importantly, manual approach was use to code these data. Next, searching for themes and recognising relationship and lastly refining themes and testing proposition themes (Saunders et al., 2016, p.582). This includes searching for themes, patterns and relationship during data collection and coding process, in this case, research questions, research aim and objectives was central in data analysis. *First, the characteristics of port performance and crude oil export logistics system and second, what are the recommended improvement strategies to optimise port performance and crude oil export logistics system distribution in Nigeria? The*

author searched for theme, which helped to condensed raw data, which was carried out by coding and then grouping these coded data into analytic categories (Saunders et al., 2016, p.584). The author made judgement of the data by immersing in them through search for key concepts in these codes, finding relationships between them. In addition, some of them appear to be main themes and sub themes. In conclusion, refining themes appears most important part of this analysis. The author reorganised coded data under relevant themes and sub-themes. In this case, some of the initials themes to make a new theme while other were separated into different themes.

The author recognised the role of reflexive objectivity about what the research data mean. Further, to gain greater insight during the analysis (Brinkman and Kvale (2015, p. 278). Moreover, Roditis and Felsher, (2015, p. 179) used thematic analysis in understanding of perceptions of risk and benefit of conventional cigarettes, E-cigarettes and Marijuana. It implication in this study is significant as the former is qualitative also similar which composed of six small group discussion ranging from two to six participant in each group. Further, it would help to know about stronger connection between themes agreed by participants in the focus group.

Appendix 22: Focus Group on Empirical Findings Presentation

This shows thematic analysis findings of four focus groups convened during this research.

FOCUS GROUP NNPC 1

THEMES AND EXAMPLE OF QOUTES

Themes	Illustrative quotes
Role of government	Participant1: After all those were certified, the vessel can be cleared to come to
agencies in crude oil	Nigerian waters, at the same time all the Nigerian agencies such as Nigerian
export value chain	Navy (NN), Customs, immigration, Law enforcement agencies, Terminal
	operators, mainly the IOCs , NNPC and DPR. More importantly, they have to be
	there before any loading can take place. When the vessel tender notice of
	readiness (NOR), the inspectors, customs and naval officers will do the
	inspection to confirm all the information that the master has communicated to be
	true, thereafter, they will also check the tanks, whether they are empty or you
	come with a load and so on.
	P2: Exactly that is to the point.
	P3: Yes
	P1: As government, we cannot compare PSC with JV, government need money
	to offset debts. Therefore, PSC is more important as most of them are offshore
	and close to their block. The facility are placed within FPSO and the only issue is
	about their investment. We have passed that time now. Further, technology is
	not issue nowadays.
	P2, P3, P4, P5, P6: All agreed with above statement.
Smaller producers	P1: Actually, they are the avenue for legal bunkering anywhere else is illegal. I
use barges for	think the only exception is SEEPCO. SEEPCO is one small company that works
effective export	in Small River in Imo state, Nigeria. We try, as I know there is a lot of push to
logistics	see if they can use the NAU facility, so that they can send their barge. However,
	the ullage issue and whatever, they could not secure, so it was agreed they
	could have a barge as their store, they use a barge, produce and store crude oil
	In the barge. When time is for lifting, they can now drag the barge to main water
	where the vessel can be able to take it. Luckily, as small producer they do not

	have a standard cargo of 950,000, so whenever they accumulate like 450,000 or
	500, 000 barrel they just move it out, that is the only exception.
Information barrier	P1: The challenge is that terminal operators do not want to give you access to be on their own system because
	they have integrated system that you can be able to see everything. Therefore, if they give, you access; your
	email can come through them, it means you are one; you have access to information that they may not want you
	to know. Therefore, it gives a challenge; we have to look our own way i.e. independent communication. I believe
	now, may be staff of crude oil shipping department (CST) may know because they know how they communicate
	with them, the only manual thing is transmission of document.
There is	P1: Actually, I will talk on impact, because in logistics you may have issues one
increasingly shift to	day. I think the only issue is communication issue because in those days, I do
a more modern	not know of now, I believe there is improvement. We use fax, we do things
communication	through radio message, and we call it radio message from headquarters Abuja.
technology	They will send it to zonal office and the zonal office will transmit information to
/infrastructure	terminal. Moderator: You made mention of a radio message in those days.
	Please what do you use now to communicate now?
	P2: Now, there is improvement even before we leave Nigeria, there is effort to
	put like a satellite that we can access. The challenge is that terminal operators
	do not want to give you access to be on their own system because they have
	integrated system that you can be able to see everything.
Production obsring	D1. In the 70e and 80e, virtually all the production is from isint venture but to day
	12 are producing now trailing the production contribution of IV L know BSC has
	attributed contributing minimum of 34% to the national production. Even the
	autobaled contributing minimum of 54% to the national production. Even the
contract.	
	Moderator: Is PSC sustainable?
	P1 : PSC is highly sustainable
	Moderator: PSC financial cost lies with operators while JV it is both NNPC and operator that shared the cost. What do
	you recommend for Nigeria, PSC or JVC?
A need for investment	a lavestment on boots, supply vessel, security boots, noval officers, training
as critical factor for	P1: Investment on boars, supply vessel, security boars, flaval onicers, fraining. P1: Lam telling you with the asset today if there is commitment you can move
effective and efficient	Nigerian production from this 2.1 to 4Mbpd within six, seven menths. Simply out
logistics	conservatively within one year you can migrate to this, if there is money because
	is just DPILLING most of them need, and short singlings in place that will
	Connect to trunk line virtually, we have major pipelines all over the Niger Delta.
	we have the trunk line, we have Trans Niger Pipeline (TNP), and whatever,

	these entire one they are across a very large kilometre, the development you
	can do a little and move on.
	P2, P3, P4, P5, and P6: This is the fact. Nigeria has huge opportunities, looking
	at reserves yet untapped.
SUB-THEMES	
Pipeline investment	P1: Most of the investment are pipeline such as short pipelines that will connect to trunk.
	In addition, we have major pipelines all over Niger Delta. We have trunk line, Trans Niger
	Pipeline (TNP). They covered a very large kilometre and they just need little development.
	P3, P4 P2: Yes exactly.
Security infrastructure	P4: Apart from that, let go the way of emergency that is one key area Nigeria
	have to invest on there is what we call GMDSS. Global maritime distress safety
	system (GMDSS) is like having coverages those maritime coverages whereby
	there are dedicated frequencies that are good for (1) Safety (2) urgency and
	distress.
	P2: Moreover, you have to invest on search and rescue (SAR) Component of
	GMDSS. Search and rescue is part if we invest on IT, I am still talking on IT
	transmission and reception. It is easy. Investing on IT is not something we need
	not to think about that is where the world is going. If you go to LIK, SAR is hig
	The to think about that is where the world is going. If you go to ork, SAK is big
	thing, they even have helicopter in case something happen they can come. Even
	thing, they even have helicopter in case something happen they can come. Even Bristol is part of it. SAR, Frequency is key.
Onshore terminal are	thing, they even have helicopter in case something happen they can come. Even Bristol is part of it. SAR, Frequency is key. P5: I think Forcados even as we speaking now is still on hold as to pipeline
Onshore terminal are susceptible to pipeline	thing, they even have helicopter in case something happen they can come. Even Bristol is part of it. SAR, Frequency is key. P5: I think Forcados even as we speaking now is still on hold as to pipeline infrastructure. I think about 42-inch pipeline still not in service because of issue
Onshore terminal are susceptible to pipeline vandalism	thing, they even have helicopter in case something happen they can come. Even Bristol is part of it. SAR, Frequency is key. P5: I think Forcados even as we speaking now is still on hold as to pipeline infrastructure. I think about 42-inch pipeline still not in service because of issue of vandalism. It has become like a culture in terms of Forcados site, you repair,
Onshore terminal are susceptible to pipeline vandalism	thing, they even have helicopter in case something happen they can come. Even Bristol is part of it. SAR, Frequency is key. P5: I think Forcados even as we speaking now is still on hold as to pipeline infrastructure. I think about 42-inch pipeline still not in service because of issue of vandalism. It has become like a culture in terms of Forcados site, you repair, they punch it back, and that is multiple problem.
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Onshore terminal are susceptible to pipeline vandalism	 Indexto think about that is where the wond is going. If you go to on, sarris big thing, they even have helicopter in case something happen they can come. Even Bristol is part of it. SAR, Frequency is key. P5: I think Forcados even as we speaking now is still on hold as to pipeline infrastructure. I think about 42-inch pipeline still not in service because of issue of vandalism. It has become like a culture in terms of Forcados site, you repair, they punch it back, and that is multiple problem. P1: Infact this location is the greatest issue now. If you see the terminal that are offshore, there is no issue, because the criminals cannot reach their areas. No
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Onshore terminal are susceptible to pipeline vandalism	 Indition that its where the wond is going. If you go to on, shrins big thing, they even have helicopter in case something happen they can come. Even Bristol is part of it. SAR, Frequency is key. P5: I think Forcados even as we speaking now is still on hold as to pipeline infrastructure. I think about 42-inch pipeline still not in service because of issue of vandalism. It has become like a culture in terms of Forcados site, you repair, they punch it back, and that is multiple problem. P1: Infact this location is the greatest issue now. If you see the terminal that are offshore, there is no issue, because the criminals cannot reach their areas. No issue, for instance an Exxon Mobil terminals because of the area they are, have more sanity, less criminal activities, they hardly have issues P1: Actually is one of the thing we hate to hear about vandalism. This disrupts
Onshore terminal are susceptible to pipeline vandalism	thing, they even have helicopter in case something happen they can come. Even Bristol is part of it. SAR, Frequency is key. P5: I think Forcados even as we speaking now is still on hold as to pipeline infrastructure. I think about 42-inch pipeline still not in service because of issue of vandalism. It has become like a culture in terms of Forcados site, you repair, they punch it back, and that is multiple problem. P1: Infact this location is the greatest issue now. If you see the terminal that are offshore, there is no issue, because the criminals cannot reach their areas. No issue, for instance an Exxon Mobil terminals because of the area they are, have more sanity, less criminal activities, they hardly have issues P1: Actually is one of the thing we hate to hear about vandalism. This disrupts the lifting programme and takes a minimum of six months to come back to
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Onshore terminal are susceptible to pipeline vandalism	thing, they even have helicopter in case something happen they can come. Even Bristol is part of it. SAR, Frequency is key. P5: I think Forcados even as we speaking now is still on hold as to pipeline infrastructure. I think about 42-inch pipeline still not in service because of issue of vandalism. It has become like a culture in terms of Forcados site, you repair, they punch it back, and that is multiple problem. P1: Infact this location is the greatest issue now. If you see the terminal that are offshore, there is no issue, because the criminals cannot reach their areas. No issue, for instance an Exxon Mobil terminals because of the area they are, have more sanity, less criminal activities, they hardly have issues P1: Actually is one of the thing we hate to hear about vandalism. This disrupts the lifting programme and takes a minimum of six months to come back to normal at a particular terminal. P2: Many attacks P3: It is a chain reaction
Onshore terminal are susceptible to pipeline vandalism	thing, they even have helicopter in case something happen they can come. Even Bristol is part of it. SAR, Frequency is key. P5: I think Forcados even as we speaking now is still on hold as to pipeline infrastructure. I think about 42-inch pipeline still not in service because of issue of vandalism. It has become like a culture in terms of Forcados site, you repair, they punch it back, and that is multiple problem. P1: Infact this location is the greatest issue now. If you see the terminal that are offshore, there is no issue, because the criminals cannot reach their areas. No issue, for instance an Exxon Mobil terminals because of the area they are, have more sanity, less criminal activities, they hardly have issues P1: Actually is one of the thing we hate to hear about vandalism. This disrupts the lifting programme and takes a minimum of six months to come back to normal at a particular terminal. P2: Many attacks P3: It is a chain reaction P1; It is one of the difficult thing

	P5: It is difficult to realign the lifting programme
	P1: It has many impact such oil spill, loss of revenue
Drilling	
Insecurity is the	P4: Whatever you are doing, you have to secure first before you can progress,
biggest factor	and therefore, insecurity is a big issue.
militating against	P1: Is a big issue actually, number one issue is that it escalates our cost of
miniating against	operation seriously beyond reasonable doubt.
port performance	P5: That is key.
	P3: That is very important, any vessel coming to Nigeria shore have to factor this possibility in.
	P1: Number one issue; it escalates our cost of production. If you take it on vessel
	issue, if you are NNPC, representative or IOCs employee, anywhere they are
	moving you, whether you are alone or in-group that is why they prefer you to
	move in a group. There must be police sometimes; if it is coaster bus, there must
	be a Hilux in front and back, with fully armed men present, all these are serious
	cost.
	P1: Continuedand the movement become virtually difficult, the cost of doing
	everything you see a lot of fence, barbed wire, and cameras infact there is a
	security upgrade project just to make sure environment is secured. The cost of
	project also escalates because you have to factor all these issues of security. It
	is not only maritime insecurity, even the neighbourhood is an issue because any
	particular village have their own right even if government give you the right, they
	have their own, which you have to adhere to, you can never satisfy those rights.
	However, you can quench them temporarily, they will come back because is just
	way of having food.
	Moderator : Is that a communal issue
	P1: Yes
	P2, P3, P5, P6 : Yes
	P6; Yes
	<i>P</i> 4. Correct. <i>P</i> 1: Yes, insecurity is the first issue that stems investment growth. When SA
	AKPO they are relatively secured because they are offshore. When SAPETRO
	want to sell its offshore licence how many days, does it take to sell to Chinese?
	He sold an equity: you see business is growing. Now, because of insecurity Shell
	is divesting from onshore nevertheless offshore is secure.
	P5: What we are saying in essence, insecurity come first.
	P4: After insecurity the next is investment

Findings of Focus Group Interview One

ROLE OF GOVERNMENT AGENCIES

In Nigeria's crude oil export value chain the role of government agencies is extremely important in terms of checking quantity loaded, compliance of vessels to IMO procedures and guidelines, stakeholder's interest and so on. All the participants recommended presence of government officials although there is no evidence that a reduction in the numbers of these agencies will improve efficiency in the value chain. However, the template analysis explains more on this theme. Furthermore, there is a growing need for reduction in numbers of these agencies for effective and efficient SCM of crude oil export logistics systems in Nigeria.

INSECURITY IS THE BIGGEST FACTOR MILITATING AGAINST PORT PERFORMANCE

The entire participants agreed with insecurity as the biggest challenge militating against effective logistics. As one of the participants simply put, it escalates the cost of production, since the cost of maintaining auxiliary security apparatus, police and the settlement of the indigenous people of oil rich region appears to be the main issues that increase cost. However, there are increasing efforts from all the supply chain partners to stem this, but it appears that more effort is needed in terms of security infrastructure and application of modern technology for pipeline security.

INFORMATION BARRIERS AMONG SUPPLY CHAIN PARTNERS

Despite operating internationally accepted forms of contract such as PSC and JVC, stakeholders in Nigeria do not share an integrated information platform to facilitate effective logistics operations. However, there is evidence of email exchange from the part of crude oil shipping and terminals from the state oil company perspective. Therefore, provision of a standard integrated information system for interaction among supply chain partners will influence the effective and efficient SCM of port performance and crude oil export logistics system distribution.

A NEED FOR INVESTMENT AS CRITICAL FACTOR FOR EFFECTIVE LOGISTICS

Pipeline investment is critical particularly in the oil rich region. Pipeline transport is the cost-effective means of transporting crude oil. Although Nigeria has pipelines it appears that they are of limited use for an effective SCM of crude oil value chain.

Themes	Illustrative quotes
Inadequate security platform and capability	
	P2: Looking at peculiar security situation
	then it was not adequate there are many
	challenges especially the boats themselves,
	most of the machinery are not adequate. I
	had issues with radar, navigational system
	on board etc. the only that was adequate are
	the arms monitored on board.
	P1: Do you have a situation where Navy
	tankers was attack
	P1: Do you think those security measures
	were adequate.
	P3: No
	P1: Nigeria maritime domain is wide with
	many oil-loading terminals dispersed all over
	the place. We have 84,000 nautical miles of
	shorelines extending up to 200 nautical

FOCUS GROUP 2 ON SECURITY WITH NAVAL OFFICIALS

	· · · · · ·
	exclusive economic zone. Therefore, you will
	look at how many security boats/platform
	does the navy have to protect maritime
	domain. For e.g. Escravos to Agbami is 156
	nautical miles. There was a time we left
	Agbami very early as 5am going to
	Escravos, only to receive a call from Naval
	Headquarter that militants or pirates attack
	Agbami at 0600hrs, that was the time you
	are leaving that place (Agbami) and they are
	coming to attack.
	In addition,
	P5: Some of the service boats do not have
	night vision at times.
	P1: A kind of night vision capability.
	P6: If possible a camera that can snap a
	picture at night.
	P1: We are talking of equipment for security
	 boats. P2: An incident happened in Forcados and we have only one security vessel stationed there, and number of personnel are five or seven with riffles. Some will argue this is enough, is not. I am advocating more need to be done by IOCs, at times conflicts occurred during loading in the case of sudden attack. There are certain things oil companies supposed to be assisting the security architecture provided by the military in order to boost efficiency, which they are not doing. It is only when things happen they will be running helter skelter. In addition, one of the officer corroborated P1: The major thing I will say is infrastructure, equipment. However, there are other thing we talk of protecting Nigeria's maritime domain, the platform the Navy has is grossly inadequate. Even with oil companies, private security companies is still inadequate. P1: Acquire technology, train personnel to man platform effectively. If you do not use technology where will you get people to secure entire pipelines
Inadequate security training for Nigerian navy officer on oil	P1: You know oil and gas security, when we
and gas security	talk about offshore, those in oil industry, there is understanding of issues like health and safety, professional oil and gas security. They study that in detail, but when you talk to security services, there is no specific kind of training (specialised) in oil and gas security for military officers. P: 1 <i>I am not talking of general security</i> <i>services. How they use ensure security of oil</i> <i>terminal, if you do not have the knowledge</i>

	an average military officers. You are not specialist there is no form of specialised training on nitty gritty of oil and gas security. P4: There are so many courses ISPS courses, Vessel security officer courses, Ship security officer's course. P1: Many courses are specific to oil and gas, security that people in the sector health and safety courses that you supposed to be efficient, security personnel like police, navy coming from outside do not have detail of that. If there, is kind of training, either initiated from the side of IOCs or military that will rather synergise this operation? The military will know what exactly that is happening. In addition, what they need to do to remain conscious, this will improve security" P2: An incidence happened in Forcados and we have only one security vessel stationed there, and number of personnel
Inadequate information sharing /synergy between Navy and	P1: The oil companies also have their own
Oil companies	security design, all these issues that one
	should not come more than five nautical
	miles close. They know how they organise
	their escort up to the terminal and a way
	from terminal, however, their security officers
	decided how they organise their security
	sector.
	P6: Therefore, there is no kind of synergy
	between the Nigerian Navy and OICs to
	understand what they are doing and how
	they can utilise those assets they have for
	benefit of information sharing and so on.
	Moderator: the security system is in two
	types: IOCs and government security
	apparatus.
	P1: OICs have their security officers at all
	level, even at terminal level, with security
	boats apart from navy boats even on that
	security boats they have security personnel
	there. However, sometimes the navy might
	have enough platform themselves, the
	company bring security boats, but the
	company cannot carry arms.

Findings of Focus Group Interview Two

FOCUS GROUP 3 ON INVESTMENT

Themes	Illustrative quotes
Investment in pipeline automation security	P2: What I think here is that there is a lot of
system	opportunity for pipeline investment especially the
	cross-country pipeline investing in Nigeria; with
	a proper automated security system and with
	help of Nigeria security forces. For example if
	we can lay a pipeline from Southern to Northern
	Nigeria, so that one pipeline can save
	transportation cost. It will be a 24hrs operation,
	any time you can pump oil from Lagos to Abuja.
Investment in dredging	P1: As we told you yesterday, dredging, you
	can add dredging even though we do it
	ourselves. We pay operational cost; the hiring
	charges are not there. Dredging is very
	important.
	Moderator: Do everyone agreed.
	The entire focus participant agreed in
	affirmation.
Insecurity is the biggest factor Militating against Port performance	 P1: The security is the main issue that blocks investment in this Nigeria. If you improve security situation, obviously more investment will come to this country. As far I go through some article, they are willing to come except for security concern. Moderator - You mean effective maritime security. P2: Yes, excellent, more investment, all the
	sector will improve excellently
Inadequate information communication	P1: Although communication system are. Some
technology	are really toward international standard.
	Nevertheless, they should look at internet
	phones to 24 hrs connectivity, satellites in case

1
internet fails. Radio signal very high frequency
VHF
P3; For example, Port Harcourt, Warri, Lagos
signal is good, 3G,4G in remote locations is
difficult, hence government should concentrate
on mobile connection.
P1: A single mobile line, most oil industry are in
remote location. Therefore, investment
opportunity in telecommunication.
Moderator: You mean investing in remote areas.
P6: Travelling from location A to B,
communication breaking e.g. phone calls.
P6: Telecommunication company can invest in
this

Findings of Focus Group Interview Three

SECOND SECURITY FOCUS GROUP (4)

Themes	Illustrative quotes
Community agitation	P1: You might have piracy attack as well as
	militancy because of agitation and neglect of
	these communities along the seashore, they are
	not benefitting from government, thereby they
	vexed anger on those vessels. Some of the
	owners do settle by building hospitals, schools
	and some give money.
	P2. The terminal operator must have community
	relation officer as contact group to relate with
	host community for effective engagement for
	implementation memorandum of understanding,
	employment opportunities, social amenities etc.
	P4: Public relation officer have to relate with
	community to avoid blockade.
	At times the companies contact security forces
Pipeline vandalism /Vandalization of pipelines	when this happen to unleash, leads to conflict
	which might lead to stop operation which take
	longer time to return to normal.
Piracy/kidnap	P5: They look for things to take from vessels,
	demand ransom which at times appears
	unpredictable as company go with security
	escort to prevent unwarranted attack.
	P1: They use money generated for their
	livelihood.
Strategic Information sharing between fisher	Terminal operators usually disrupt their nets, this
men and terminal operators	resulted in blockage of barges movement, this
	affect operation. In addition, they also invade
	export terminal.
Ineffective implementation of corporate social	P3: Militancy is as a result of negligence by all
responsibility to host communities	crude oil export stakeholders, hence militant

	-
	agitating for good roads, electricity, housing, all
	these are not there.
	P6: Example Olobiri where oil first found is still in
	tatters, however, there is gradual improvement.
Communication breakdown between workers	P2: This normal leads to operation shut down
and Management	between workers and management in terms
	agreement on allowances, lead to frustration. It
	leads to loss of time and money.
	P2: Good working relation is vital.

Findings of Focus Group Interview Four

Appendix 23: Selected Interpretation of Template Analysis of strategies for improvement

6.2.18 Incoterms and Contractual Obligation

Delivery terms is one of the essential terms of an international commercial agreement which regulates the transfer of goods and risk from seller to buyer including legal and economic consequences generated (Bergami, 2012, p.1). Nigeria's choice of FOB is to shield it from legal and economic consequences of the terms of commercial agreement. In this regard, most of the crude cargoes are usually sold on FOB as mentioned in each case above. Due to incessant pipeline attacks and sabotage and with shipping flow routes not static as they used to be in formative years to the USA. The author firmly believe that FOB appears the best option that allows NNPC and key low-cost producers to avoid huge financial losses as most of them lack crude tankers unlike the IOCs. There appears a unanimous agreement on FoB, however, in most part of the globe except in the North Sea where the condition is different to other producing countries, FoB appears predominant in its application in crude oil flows.

6.2.19 Transparency and Accountability

EITI is a global standard to promote open and accountable extractive resources. Furthermore, it is aimed to distribute information along the extractive industry value chain from point of extraction to the ways in which revenues make their way through the government and how they benefit the public (EITI, 2018, p.1). Nigeria joined EITI in 2003 and established a national agency under supervision of the presidency. Nigeria Extractive Industries Transparency Initiative (NEITI) is an integral part of global EITI, which is a 51-member nation's body. Major variables in the value chain mentioned in EITI report are contract and licenses, production, revenue collection, revenue allocation and socio-economic contribution (EITI FACT SHEET, 2018, p.2). These variables appears critical in the current study. Besides, the author's inability to access the business model (BM) of NNPC and as well confidentiality agreement signed with a major IOC (SPDC), Nigeria revealed how difficult it was to access data in the supply chain. The author assumed that publishing of oil trading contracts across the value chain would surely increase logistics efficiency. Further, there is increasing effort in publishing oil and gas contracts. According to the Financial Times report, some 30 countries in the Extractive Industries Transparency Initiative have together disclosed more than 800 contracts while 16 EITI supporting companies have stated their support for contract disclosure (Reinfeldt, Financial Times19 July 2018, p.1). There appears increasingly effort in implementation of EITI missions since 2004. Nigeria's oil industry is

perceived to be corrupt. However, the NEITI tool provided Nigeria with a great opportunity to show the world its strong commitment to openness and adherence to international best practices. Its implications are enormous as it builds trust by showing E&P companies and government that they have nothing to hide. Thus, this appears to spur investment in all the value chain such as oil field, pipeline automation, technological innovation for documentation, IIC to mention a few. Hence this will improve the crude oil flows, as more customers will have trust in the system. For detail refer to table below for some of Nigeria's published resource contracts in recent times.

1	Allied energy PLC, CAMAC
	International limited, Nigerian
	Agip Exploration Limited,
	CAMAC Petroleum limited,
	Oyo Field, PSA, 2011
2	The Shell Petroleum
	Development Company of
	Nigeria Limited
	(SPDC),NNPC, Nigerian Agip
	Oil Company(NAE) Limited,
	Universal Energy Resources
	limited, OML 14, Other farm
	out, 2003
3	Allied Energy PLC, CAMAC
	International (Nigeria) limited,
	NAE, CAMAC, Oyo field, PSA,
	2010
4	NPDC, Atlantic Energy Drilling
	concepts Nigeria, OML, 30,
	PSA, 2011
5	Septa Energy Nigeria Limited,
	NPDC, OML4, OML 38, OML
	41, PSA, 2010

Nigeria Published Oil contract for Transparency Extractive Industry Source: (Adapted from Resource contract, 2019)

6.2.20 Strikes/Labour dispute

Strikes appears to be a common feature in Nigeria's crude oil flows as this usually led to supply disruption in the value chain which huge impact in terms of cost, time and terminal throughput. Empirical cases span case 1 to 5 are a clear indication of incessant supply chain disruption over a couple of years with huge socio-economic impacts. For instance, the economic impact of strikes is described when a coordinated strike by ExxonMobil employee cut 550,000 b/d of light crude loadings for around a week. The cost of crude at this time was approximately \$64. In essence, 64*550*7= £246,400. This is huge for a country that depends on oil receipts. To date, strike action by the Petroleum and Natural Gas Senior Staff Association of Nigeria (PENGASSAN) in the oil industry is increasing due to contract related issues such as non-clarity in contracts for labour services providers' expiration. Furthermore, other issues include short changing of Nigerian oil workers by major IOCs and IDOCs. In conclusion, issues span clear contract terms specification and good conditions of service, which cut across all the supply value chains. Improving clarity in these terms would surely improve logistics flow of oil from Nigeria to international markets.

6.2.21 Presence of Government Officials

In Nigeria's crude oil export logistics system, presence of government officials during crude oil loading operation is paramount and has huge legal implications. Similarly, this appears obtainable in other places across the globe. However, the model in figure 6.3 on "*streamlining government agencies*" addressed this scenario. Obviously, there was consensus by all

respondents in this present study for a need for Nigeria to reduce number of government officials during crude oil loading or vessel clearance to a minimum, as this appears the global best practices in international shipping and supply chain. Moreover, this would facilitates VC as these officials would be well trained in metering systems for cargo measurement, documentary activities, cargo surveyor interaction that are the basic operation during cargo loading operation. Collaborating this assertion in a discussion (see case 3 for detail in appendix 22) with senior oil executives member in OCIMF that emphasised role of cargo surveyor to curb cargo theft by representing interest of key members in the value chain, specifically, traders and terminal operators. Finally, this implies only those officials that have expertise relevant to oil flows, and hence enforcing minimum number of officials to be present during operation would mean adhering to international best practices.

6.2.22 Crude Oil Price

Qualitative data from cases 1 and 2 from crude oil traders that happened to be the main customer in the value chain are unanimous that there is apparent reduction in the premium of Nigerian crude despite its quality, being light sweet crude that requires less refining than heavy crude of other OPEC nations, Russia or USA. However, this applies to major onshore susceptible militancy export terminal and these terminals have higher capacities than offshore which appears stable terminals with lower capacity (see table 5.8 final template for details). Furthermore, archival resources corroborated a fall in price. In October 2016, NNPC slashed the November official selling price (OSPS) due to a glut of sweet crude in the Atlantic basin, when Forcados

and Qua Iboe came on stream after a long period of absence due to force majeure. Furthermore, Forcados was accessed at dated Brent minus \$0.25/b in October 2016 compared with plus \$0.30/b in early February when attack first took place (Bunkerworld, 2016, p.2). In addition, the official selling price for Forcados also reduced significantly for November as NNPC lowered the OSP by 48 cents from October to dated Brent minus \$0.41/b (Adugbo, 2016).

6.2.23 Dredging

There is research evidence that lack of proper dredging has a profound effect on efficient and effective crude oil flows. In reality, this cut across all the key E&P companies in Nigeria. Furthermore, empirical data from all the cases, show that inadequate dredging appears key in the crude oil flow in Nigeria. Its impact on logistics cost is enormous especially for lower cost producers, as the costs of hire, workforce maintenance and port charges are huge and hence drives logistics cost. Indeed, there are few scholarly publications on dredging, nevertheless, for the current study, what is important, appears is the ability to find a sustainable strategy whereby all the stakeholders can improve the state of the seabed. This is paramount for oil flow and seamless operation for ocean vessels or tankers that requires deep draft particularly the VLCC or the Suezmax ships. Further, environmental impact of dredging in a larger scale? However, there is a shift toward building with nature in the dredging and port development (Vikolainen et al., 2014, p.1). In addition, port development and economic activities in general regularly conflict with the desire to conserve estuarine and habitats (Mink et al. 2007, p.3). The study basically deals with both of the above variables as the author observed a

terminal operator who dredged some portion of the marine ocean before arrival of barges for transhipment during a loading operation in the oil-rich Niger Delta. The key message here is that cost cutting by these operators appears common due to incoherent government policy regarding dredging, despite presence of port authorities and landlord model of port governance that allow investment in this venture. Furthermore, Vikolainen et al., (2014, p.13) raised the apparent weak enforcement mechanism of building with nature –which deals with working out best practices of preserving estuary and coastal zones despite growing appreciation among policy makers and stakeholders that a sustainable way of designing water infrastructure is needed. Finally, Nigeria's export port crude oil export logistics system requires more port/terminal infrastructure layout and investment for dredging facilities. The environmental impacts of infrastructure expansion were put into consideration, as environmental requirements are part of investment cost. Finally, archival evidence collaborated need for investment in entire Africa countries which Nigeria is key and hence dredging appears to be a significant component for effective and efficient flow of cargoes (Lloyd list, 2011, p.1) 6.2.24 Smaller Offshore capacity

In essence, having a bigger capacity tends to be useful in times of supply disruption and high oil price, especially if there is effective energy security apparatus. Nevertheless, Nigeria's offshore capacity tends to be small compared to other fields in other climes as indicated above. However, archival data revealed bigger offshore fields such as Egina (200,000 b/d) due soon, also Bonga west, and so on are due in not too distant future. Another

key point, is the US Strategic Petroleum Reserves (SPR) model which has been held for nearly a century as a formidable natural security asset with favourable characteristic compared to similar stockpiles in other parts of the world, given the degree of uncertainty about supply and demand of oil market (Bordoff et al., 2018, p.7). Given Nigeria's geographic advantage due to its proximity to Europe and Asian market. Thus, from the SPR perspectives, Nigeria is well- placed to increase the quantity of export, which normally fluctuates between 1.8M bpd to 2.1Mbpd, and thus, the elusive dream of 4Mbpd could be achieved with strong investment in inventory.

6.2.25 Govt Incentives for Offshore Terminals

In this theme, both case 1 and 2 (see appendix 22) revealed that it is abundantly clear from these cases that there is a need for more investment in the offshore upstream sector from all the supply chain actors, although it is capital intensive. However, it is safer for seamless crude oil flow due to environment, terminal design, protection from maritime insecurity and incessant pipeline vandalism. Furthermore, an improved tax regime and/or incentive for the offshore blocks would spur enthusiastic competition for Nigeria's crude oil flow among COECs, and hence improve the port performance and crude oil logistics system distribution and further ensure secure, reliable and sustainable supply of crude oil to the international market from Nigeria.

6.2.26 Oil Terminal dues and charges

Due to high port charges and oil terminals dues, cost cutting appears common place across supply chains and this impact the supply chain and it appears extremely difficult for value chain to be effective and efficient. However, oil big majors particularly the IOCs can adapt to this, unlike the low-cost producers, according to senior marine supervisor with a major IOC, 26 September 2017). In the logistics chain, several processes take place as mentioned in the empirical cases in the appendix 21. In this case, it is appears apparent presence of multiple charges impact many low-cost indigenous producers. Finally, it is vital to devise a new holistic taxation model for port and terminal charges as critical decision for efficient and effective crude oil flows in Nigeria Appendix 24: Process Flow Diagram of a Crude Oil Export Logistics System in Nigeria

