

**Exploring managerial perceptions on sustainability and the use of ICT for sustainable road freight transport**

**By:**

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# Declaration

I, **Abiye C.I. Tob-Ogu**, declare that this thesis titled “***Exploring managerial perceptions on sustainability and the use of ICT for sustainable road freight transport***” has never been submitted anywhere for the award of any degree and all the sources used have been acknowledged.

Signed …………………………

Date …………………………

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# Abstract

This thesis advances on the road freight transport literature to explore Information and Communications Technology (ICT) use for sustainability performance in road freight transportation. It examines managerial perceptions of sustainability and ICT use practices in the Nigerian petroleum downstream industry, adopting a multi-theory perspective to explain the use of ICT as an intervention mechanism for meeting triple bottom line (3BL) sustainability objectives.

Qualitative strategies are employed to design and implement the research inquiry, in line with the moderate constructionist philosophy that identifies with shared community knowledge. A multiple case study design is used to collect data from 13 polar cases using a triangulated approach that included 32 semi-structured interviews, observations and archival documents. Content and thematic analysis of the data was supported by NVivo11 software to establish results.

Research findings affirm the predominant constructs of sustainability within the literature; however, they highlight divergence in the concentration of performance across the different sustainability dimensions. Emphasizing the role of contextual perceptions, the findings also establish integration of the resource based theory (RBV) and the relational corporate social responsibility (RCSR) theories as an adequate theoretical framework for explaining management’s use of ICT to aid 3BL sustainability performance in road freight transportation.

Besides the conduct of a systematic literature review, the research findings contribute to the academic discourse on sustainability hierarchies by empirically demonstrating links between business contexts, managerial perceptions and sustainability focus. Additionally, they address theory gaps in the literature, contributing to the application of strategic management theories road freight transport research. From a practice perspective, the findings establish training and awareness gaps and this supports the development of the Downstream Road Freight Transport Sustainability Assessment Tool (DRoFTSAT); a self-assessment tool to aid managers in the planning, implementation and evaluation of ICT uses for sustainability.

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*Whereas one hand has written, many minds have laboured.*

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I wish to dedicate this thesis to my Mum; Nengi Georgewill and all my family, who have supported me with gifts and with prayers, with belief and with praise, with love and with provision; my story is incomplete without you all!

~Abiye ~

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# Glossary

3BL - Triple Bottom Line

BRICS - Brazil, Russia, India, China and South Africa bloc

CLM - Council of Logistics Management

CSMP - Council of Supply Chain Management Professionals

DECC - Department of Energy and Climate Change (UK)

DEFRA - Department for Environment, Food and Rural Affairs (UK)

DfT - Department for Transport (UK)

DPR - Department for Petroleum Resources

EC - European Commission

EDI - Electronic Data Interchange

EKC - Environmental Kuznets’ Curve

ERP - Enterprise Resource Planning

ERTRAC - European Road Transport Research Advisory Council

EurOMA - European Operations Management Association

FRSC - Federal Road Safety Corps

GDP - Gross Domestic Product

GHG - Green House Gases

HGV - Heavy Goods Vehicles

IATA - International Air traffic Agency

ICCT - International Council on Clean Transport

ICT - Information and Communication Technology

IEA - International Energy Agency

IFRS - International Financial Reporting Standards

IPMAN - Independent Petroleum Marketers Association of Nigeria

LGV - Light Goods Vehicles

MINT - Mexico, Indonesia, Nigeria and Turkey bloc

MOMAN - Major Oil Marketers Association of Nigeria

NNPC - Nigerian National Petroleum Corporation

OECD - Organization for Economic Co-operation and Development

PEF - Petroleum Equalisation Fund

PPPRA - Petroleum Products Pricing and Regulatory Agency

S&D - Supply and Distribution

WCED - World Commission on Environment and Development

WHO - World Health Organization

# Research Dissemination

**Conference Papers**

Tob-Ogu, A., Cullen, J. and Kumar, N., (2016) *Operations and sustainability hierarchy: Sustainability priorities in road freight transport*, paper presented at the 5th World Conference on Production and Operations Management, (P&OM), 6th – 10th September, 2016, Havana, Cuba.

Tob-Ogu, A., Cullen, J. and Kumar, N., (2015) *Exploring theoretical perspectives on information and communication technology roles in enabling sustainable road freight transportation: An evaluation of the Nigerian oil and gas industry downstream sector,* paper presented at the European Operations Management Association Conference (EurOMA), June 26th - July 1st, 2015 | Neuchâtel, Switzerland, available at http://www.euroma2015.org/euromapapers/indexauthor.html

Tob-Ogu, A. and Igenewari, P. (2015) *Sustainable transport as a profitable moderator of negative externalities in food supply chains*, paper presented at the European Operations Management Association Conference (EurOMA), June 26th - July 1st, 2015 | Neuchâtel, Switzerland, available at http://www.euroma2015.org/euromapapers/papers/SCM-26\_32943.pdf

Tob-Ogu A., (2014) *Sustainability Practices in Supply Chains*, Paper presentation at the 1st Doctoral Student Conference on Sustainable Operations, Logistics and Supply Chain Management, 5th June 2014 in Sheffield University Management School, Sheffield (UK)

**Journal Publications -** (Working Papers)

Tob-Ogu, A., Cullen, J. and Kumar, N., (2016) Sustainable road freight: Coupling theory and performance: An ICT perspective (manuscript for submission in November, 2016)

*Target Journals – Transport Research Part A: Policy and Practice \*3ABS, International Journal of Sustainable Transport \*3.209 IF*

Tob-Ogu, A., Cullen, J. and Kumar, N., (2016) Sustainability mechanisms for managing road freight transport externalities: A systematic literature review (manuscript for submission in November, 2016)

*Target Journals – Transport Reviews (Theory and Practice) \*2ABS/ 2.452IF*

# 

1. Study Introduction

This thesis explores the use of Information and Communications Technology (ICT) mechanisms for sustainable road freight operations. It addresses the timely matter of sustainability in road freight transport within the Nigerian petroleum downstream industry, highlighting theory and practice implications (Demir et al., 2015; McKinnon, et al., 2014; Lera-Lopez et al., 2014; Furst and Oberhofer, 2012; McKinnon 2007).

Fundamentally, the literature largely acknowledges the triple bottom line (3BL) framework for sustainability and identifies a range of intervention mechanisms for addressing sustainability challenges in road freight transportation (Harris et al., 2015; Demir et al., 2014; Clausen et al., 2012; Perego et al., 2011; McKinnon 2007) yet most empirical studies adopt mono-dimensional approaches to studying sustainability in road freight transport (Wang et al., 2015; Palsson and Kovacs, 2014). This limited approach of empirical investigations has raised concerns regarding the neglect of social sustainability performance in road freight transport, particularly in terms of strategic theory underpinnings that drive practitioner actions in management related studies (Yusuf et al., 2013; Nikolaou et al., 2013; Carter and Rogers, 2008; Ciliberti et al., 2008; Ricci and Black, 2005).

Following a systematic review of the literature, ICT mechanisms are recognized as the most viable options for intervention in road freight transport operations (Wang et al., 2015; Sternberg et al., 2014; Black and Geenhuizeen, 2006). Whilst some studies have advanced conceptual frameworks on the functions of ICT in road freight transport sustainability performance, the number of empirical studies that investigate ICT use in road freight transport operations is still very limited (Wang et al., 2015; Sternberg et al., 2014; Marchet et al., 2012).

This thesis contributes to the extant literature in several ways. First, by adopting a 3BL framework to explore sustainability, this thesis bridges the perspective gap within the literature and contributes to the consolidation of knowledge in this area (Yusuf et al., 2013; Gimenez et al., 2012; Carter and Rogers, 2008). Secondly, it develops and empirically validates a theoretical framework combination that advances our understanding of managerial and firm level actions regarding the use of ICT resources for road freight transport sustainability (Anderson et al., 2005). Practitioner focused contribution addresses training and planning gaps impacting managerial perceptions and this thesis proposes a self-assessment tool for improving ICT use for road freight sustainability.

In line with its aims and objectives, qualitative methods underpin this study and associated strategies are adopted to design, implement and evaluate this thesis. Using a multiple case study framework that is informed by ‘polar type’ considerations, triangulated instruments are employed for data collection. Content and thematic analyses are conducted to establish data findings, which are discussed in apposition with the extant literature. As a result of the identified outcomes, a draft version of a management tool is designed to aid 3BL sustainability planning, implementation and evaluation within the industry. Below is a summary of the thesis’ outline in three phases.

## 1.1 Design

The design phase of the thesis is covered in chapters two, three and four. In chapter 2 the background and scope for the study is established. This addresses academic and industry rationales for the research, the research aims and objectives as well as the effective research questions for guiding the empirical process.

Chapter 3 presents a dual review of the extant literature. It establishes the research position on road freight transport as an important sub-discipline of the generic logistics and supply chain management literature. Here I examine the common notions of freight transport using a funnelling technique to establish road freight transport as an area of contemporary and relevant research investigations. Discussions on sustainability and externalities in road freight transport lead to a systematic review of literature to identify common intervention strategies for managing road freight externalities and ICT is identified as the best option for meeting the sustainability objectives in the Nigerian petroleum downstream industry context. A number of theoretical and practical gaps are consequently highlighted in the chapter, which concludes with a presentation of a conceptual framework that captures guiding assumptions regarding ICT use for road freight sustainability as explained by the combined resource based view (RBV) and relational corporate social responsibility (RCSR) theoretical framework.

Chapter 4 links the design phase of this thesis with the implementation phase, discussing the research methodology in terms of the philosophical paradigm, methods, instrumentation and intentions for analysis. The case for the moderate constructionist paradigm as the most suitable paradigm for the empirical inquiry is argued and effective links between the methods, design, analysis and ethical strategies are accentuated.

## 1.2 Implementation

The implementation phase captures the fieldwork process and analysis stages of this thesis.

In chapter 5, I re-examine the research protocol and pilot study outcomes, with clear indications of their impact on fieldwork. Field reflections relating to time, planning, data saturation and analyses are also discussed in this chapter.

Chapter 6 captures the data analyses and presentation of findings section of this thesis. Closely aligned with the contents of chapter 5, the data is integrated into discussions relating to the research objectives and questions from a balanced standpoint. The data from the three polar case types; small, medium and large cases is discussed in detail, with ample infusion of the rich data that stimulates qualitative studies. The data concentration allows for a case-by-case analysis of the large firms’ data and an aggregated approach is adapted to discussing the small and medium cases. Importantly, ICT use is discussed from a cross case analysis with indications of patterns and trends across the different 3BL dimensions.

## 1.3 Evaluation

The evaluation phase sees an expansive appraisal of the reported results in chapter 6 and provides a summative view of the research’s significance as well as contributions against the extant literature.

In chapter 7, the reported findings from chapter 6 are recapped and then subjected to evaluation in line with the research objective, questions and the extant literature. Key outcomes are identified where unique insights are developed. The balance between subjective interpretation and meaningless objectivity is achieved through the systematic examination of the results against the extant literature. Following the revision of the conceptual framework of the research, a working draft of a downstream road transport assessment tool for sustainability planning, implementation and evaluation in the industry is then presented.

Chapter 8 discusses the summary of the thesis and outlines its contributions to theory and practice. As customary, a number of research limitations and areas for future research inquiries are identified for post-thesis development. See Figure 1.1 overleaf for a diagrammatic overview of the thesis structure.

Design

Implementation

Evaluation

Outcome

Demonstrates ICT use for sustainable road freight transport within emerging country context, highlighting links between managerial perceptions and sustainability performance, influences on priorities within the 3BL framework, ICT use and theoretical validation

Phase 2

Phase 1

Phase 3

**Chap. 2**

Background & Scope

**Chap. 3**

Literature Review

**Chap. 4**

Methodology

Design

Captures research foundation, rationale and strategy for empirical inquiry

Captures the research strategy performance and sets the structure for evaluation and reporting

**Chap. 5**

Methodology

Field Work

**Chap. 6**

Within and Cross case

Analysis and Findings

**Chap. 7**

Discussions

**Chap. 8**

Conclusion and Future directions

**Chap. 1**

Introduction

Figure 1:1-Thesis Overview Map

## 1.4 Chapter Summary

This chapter has set the tone for the rest of this thesis. It has previewed and provided an overarching perspective of the research problem, research scope and thesis’ arrangement.

The next chapter (2) will build on this introduction to offer a more detailed discussion of the research background and industry characteristics, with specifics on the research scope, aims and objectives, research questions and the justification for the study, in terms of academic relevance and timeliness.

# 

2. Background and Scope

## 2.1 Introduction

This chapter presents information on the research rationale, addressing academic and practice justifications for this study. The research problem, information about the empirical context, i.e. the Nigerian oil and gas petroleum downstream industry, research problem, research questions and objectives are all discussed in this chapter.

## 2.2 Contextualising the research

The importance of freight transport as a sub-function of the wider operations management, logistics and supply chain management literature is acknowledged in the academic literature (Palsson and Kovacs, 2014; Sternberg et al., 2013). Despite its importance, the reality of everyday life depicts a dire compromise between performance and wellbeing, i.e. the operationalization of freight transportation leads to significant social, economic and environmental consequences for our planet (Harris et al., 2015; Demir et al., 2014; Eng-Larsson et al., 2012; Richardson, 2005). Academia is already demonstrating leadership in this area by contributing seminally to practice and policy frameworks for managing associated challenges in this area (Nikolaou et al., 2013; McKinnon, 2007). However, as far as these contributions go, they have been mainly focused on western and Asian contexts and often fail to apply strategic management theories. It is imperative that as our understanding of global markets and interactions increases, including the recognition of differences that influence sustainability performance in local and emerging markets be included in the focus of academic inquiries on road freight transportation. Emerging markets are often characterised by rapid development and there are links between developmental growth, freight transport and externalities, underlining the timeliness and relevance of targeted research within contexts like the MINT bloc comprising of Mexico, Indonesia, Nigeria and Turkey.

In his pivotal work, Kuznets (1955; 63) investigated and demonstrated correlations between gross domestic product (GDP) growth and income inequality. Although his inverted u-curve relationship findings between economic industrialization and income inequality have been critiqued severally on the basis of data bias (Fields 2000; Deininger and Squire, 1998; Oshima, 1991), Kuznets’ theory principles have been extended to sustainability studies vis-à-vis the environmental Kuznets’ curve (EKC) framework (Stern 2004; Grossman and Krueger 1995; Shafik, 1994). The EKC framework hypothesises on the relationship between environmental degradation and economic development and this has influenced debates on the best strategic choices for achieving sustainability. Not without criticism, the work of Shafik (1994) was very instructive in this regard, with specific reference to the variations in correlations for different countries depending on the level of development attained at the time of EKC studies. He argued that the relationship between economic development and environmental experience factors was “*influenced by the prevalent benefit expectations”* of the empirical context (p.770). Despite the questions, pivotal consequences of this debate stem around the understanding that a) sustainability can only be achieved through conscious global efforts at various theoretical, policy and empirical levels (Stern, 2004), and b) that consequential implications from industrialisation activities are significantly influenced by contextual dynamics (Shafik, 1994).

Consequently, economic development has been linked to road freight intensification with corresponding externalities (Alises et al., 2014; McKinnon, 2007; Gray, 2006; Bennathan et al., 1992). Research around this area has led to the development of decoupling strategies within the EU and America (McKinnon, 2009; McKinnon; 2007; European Commission, 2007). Decoupling is a policy mechanism that is aimed at achieving economic development whilst reducing transport emissions growth at the same time. Although useful, it is a limited approach since extraterritorial carbon transfer and emissions, social hazards and contamination effects cannot be completely localised (M’raihi and Harizi, 2014; Garnett, 2010). The rise of the BRICS bloc (Brazil, Russia, India, China and South Africa) in the late 1990s and early 2000s, also a relative increase of sustainability inquiries on these economies. In terms of sustainability, China is noted to have fallen short on many fronts. For example, the International Council on Clean Transportation estimates that emissions from China’s transportation sector doubled between 2000-2010, with projections for a 54% increase on the 2010 figures by 2020; contributing to air pollution levels that are double the World Health Organisation (WHO) recommended standards (ICCT, 2015). According to Bergsten et al., (2009), in China’s case, mistakes were made by focusing on economic and infrastructure development without paying attention to other sustainability issues and this is indicative of the need for a more proactive approach to prevent the replication of such mistakes across countries in the MINT bloc. As a major contributor to externalities, it is imperative to investigate and contribute to the effective management of road freight transportation emerging economics like Nigeria.

Accordingly, the academic literature is increasingly reflective of a range of intervention mechanisms being exploited by academics, policy makers and practitioners with the aim of sustaining freight efficiencies whilst at the same time mitigating externalities (Wang et al., 2015; Palsson and Kovacs, 2014; Ballantyne et al., 2013; Sternberg et al., 2013; McKinnon, 2007). ICT mechanisms are regarded as one of the prominent mechanisms for addressing freight externalities underpinning operational and strategic tactics (Wang et al., 2015; Sternberg et al., 2013; McKinnon, 2007). The viability and pervasiveness of ICT tools increases its attractiveness as an intervention tool and the outcomes of this study will be contributing to the literature on the use of ICT as an intervening mechanism in road freight transport.

Theoretically, the application of management theories to logistics and transport problems is still relatively thin. Author like Sternberg et al., (2013) and Defee et al., (2010) highlight these gaps in the literature, emphasizing the need for increased uptake in the application of management theories to road freight transport problems (See also, Mentzer et al., 2004). The importance of theory is particularly underpinned by the connection between environments and managerial decisions to the effect that they promote insight on how and why management strategize for success in their business environments (Anderson and Paine, 1975). It is therefore essential that logistics and transport studies place stronger emphasis on identifying, applying, testing and moderating management theories by increasing theoretical uptake in empirical research.

### 2.2.2 Industry Rationale

The academic literature places industry activities at the heart of road freight activities and this translates to the corresponding interest by management and other policy makers to explore avenues for addressing externalities (Wang et al., 2015; Christopher, 2011). Indeed, academic discourse without industry impact negates positive research relevance. Ambrosini and Routhier’s (2004) review of the literature on freight transport calls for replication studies to help bridge gaps relating to the role of different actors in functional logistics, citing differences between the USA and UK contexts. More so, it would seem that despite its contribution to global externalities, insight about sustainability management in many emerging and developing economy contexts is still lacking. Little is known about road freight transport sustainability in economies outside the European/ American/ ASEAN context yet countries like Brazil, South African, Nigeria and Mexico are rapidly developing with serious consequences for the planet and the people.

Nigeria is a viable emerging economy context with relatively high GDP growth (average of 6.03% between 2006-2015; World Bank, 2015). With such high growth levels, the aim is to explore road transport practitioner perceptions on sustainability and use them to inform a template for future practice improvements through ICT use. The specific empirical locus is the petroleum downstream industry, which is road freight intensive as firms depend on road transportation of products to fulfil the distribution and marketing value chain comprising millions of litres of products daily. In simple terms, the 1,046,000 road freight trips taken annually will have some severe consequences on people, profits and the environment. These consequences may be largely local but in a globalised world, the implications are also universal. The next section provides further relevant information on the industry context and rationale for its selection.

## 2.3 The Nigerian Petroleum Downstream Sector

Nigeria’s hydrocarbon resources account for one of Africa’s most robust oil and gas industry (Iwayemi et al., 2009). The petroleum downstream sector is characterised by post-refinement activities like by-product conversion, gas treatment, marketing and distribution of refined products, with over 700 participating companies (NNPC, 2014; Ehinomen and Adeleke, 2012). There are both public and private firm actors in the highly regulated sector. The main public actors would include the Nigerian National Petroleum Corporation (NNPC) and its subsidiary agencies like the Department of Petroleum Resources (DPR), Petroleum Products Pricing and Regulatory Agency (PPPRA) and the Petroleum Equalisation Fund (PEF) management board. These public agencies combine to provide marketing, regulatory and monitoring oversight for operations within the industry. Private firms cut across multinational subsidiaries, large major marketing and distribution firms, medium firms and very small businesses.

The PPPRA, (2010) suggests that there are over 750 private firms participating in the distribution of petroleum products to over 7954 retail outlets across 6 geopolitical zones (Ehinomen and Adeleke, 2012). These firms are commonly classified as either major marketers (MOMAN) or independent marketers (IPMAN) and together they account for the distribution of an estimated 150 million litres of products daily, using over 2000 trailer-trucks (Olagunku, 2011; NNPC, 2014). They are called marketing and distributing firms because most of these firms are expected to have retail outlets as part of their distribution licenses, however, some of these firms have only transport and distribution operations.

MOMAN companies are classified as large firms comprising both “foreign and “local” multinationals. The eight companies in this category are estimated to account for over 60% of the total product marketing and distribution in Nigeria (Ehinomen and Adeleke, 2012) although a more accurate estimate in today’s terms would see that figure range around 51-52% due to the increases in market share for medium firms like Capital Oil plc, Zenon Oil plc and Sahara Oil plc, all of whom have recently forward integrated beyond importation into distributive logistics.

The IPMAN group firms are all locally owned small and medium enterprises (SMEs) with a variety of ownership and operational structures. More known for their group identity, these firms are influential in the distribution of petroleum products, increasing their collective market share from an estimated 1% in 1981 to over 40% in 2010 (Ehinomen and Adeleke, 2012; NNPC 2010). The rise in volume and the accompanying expansion of independent firms in the sector are reflective of synonymous economic growth and development in Nigeria, signifying increased middle classes with higher disposable income, foreign direct investment (FDI) growth and infrastructure demand (World Bank, 2014).

Previous inquiries into downstream activities have highlighted significant problems relating to product scarcity, diversion, unionism and transportation inefficiencies (Obasanjo, 2013; Ehinomen and Adeleke, 2012; Ubogu et al., 2011). There are a range of freight transport modal options that have been and are currently being employed in the distribution of petroleum products, including road, pipelines and water, with road and pipelines being the most commonly used modes (Obasanjo and Nwankwo, 2014; Ehinomen and Adeleke, 2012). Emphasising the ideal of pipelines as the preferred transport system, Onuoha (2010) states that Nigeria’s overall pipeline network spans over 5000 kilometres. With 4315 kilometres of the 5000 dedicated to multi-product movements. Additionally, a 7-metre width allowance either side of the pipelines is claimed by the federal government and this has led to land conflicts with opportunistic vandalism of the pipelines for economic gain or sabotage (Onuoha, 2010). Due to these factors, many marketers and indeed the central regulatory agencies have adopted road freight transport as the preferred means of petroleum product movement, thus road freight accounts for the largest share of product freight in Nigeria (Obasanjo and Nwankwo, 2014). Owing to its flexibility and adaptability, road transport is the most common freight movement system used by firms in the industry although some other authors would cite problems associated with pipeline damages and vandalization as a main driver of road freight preference in the industry (Ehinomen and Adeleke, 2012; Onuoha, 2010).

Externality wise, there are a plethora of road freight related challenges in the industry, including but not limited to poor lead times, poor road infrastructure, high cost of maintenance, air and environmental pollution, diversion, hoarding, subversion and fatalities (Obinna and Nwankwo, 2014; Schneider et al., 2013; Ehinomen and Adeleke, 2012; Anomoharan, 2010). Records also indicate that between 2010 and 2015, there have been over ten major incidents involving petroleum product freight via road, with a combined human casualty figure of over 200 lives (see Table 2.1 below). Even more disturbing are the earlier findings of a 2010 road safety report, which indicates over 4,076 deaths and 12,994 injuries from petroleum product road freight incidents between 2007 and 2010 (Federal Road Safety Corps, 2010).

Table . - Reported downstream-related freight incidents with associated casualties

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Incident | Location/ Date | Casualty | Data Source and Link | Dimensional Impact |
| Fuel truck crash | Onitsha /  1-06-15 | 60 | BBC News  http://www.bbc.co.uk/news/world-africa-32959825 | Loss of life, economic loss, air pollution, |
| Multi-vehicle accident | Okobie/  13-07-12 | 100 | Daily Mail  http://www.dailymail.co.uk/news/article-2173014/More-100-killed-Nigeria-tanker-villagers-tried-scoop-spilled-fuel-blast.html | Loss of life, economic loss, land and air pollution |
| Fuel truck crash | Onitsha/  25-12-15 | 100 | International Business Times  http://www.ibtimes.com/nigeria-gas-tanker-explosion-claims-lives-over-100-people-ahead-christmas-2239864 | Loss of life, economic loss, air pollution, disruption of community life |
| Fuel Truck crash | Lagos/  6-6-15 |  | Premium Times http://www.premiumtimesng.com/news/more-news/184436-fuel-tanker-explodes-in-lagos-destroys-houses-shops.html | Economic loss, personal injuries, air and environmental pollution |

The table above stresses the importance of sustainable road freight transport solutions that can help mitigate these societal ills. Although the data above does not reflect actual economic and environmental costs, it infers some common externalities from road freight operations, including CO2 emissions, noise pollution and other health related challenges (ICCT, 2015). The consequences have both local and international implications, such that emissions in Nigeria do not necessarily affect the Nigerian environment only but also they also the capacity to affect lives across the globe. For example, road freight deaths in Nigeria can involve foreign citizens working and living in Nigeria, economic losses from road freight inefficiencies can affect Italian and British shareholders in Agip Nigeria plc, as such many freight externalities are without spatial boundaries. A study that explores and contributes towards sustainable road freight transportation in the Nigerian downstream industry will therefore have global and localised consequences.

## 2.4 Aim and Objectives

Following through from the academic and industrial rationales, the purpose of this research is to explore the use of ICT for sustainable road freight transport in an emerging economy context, contributing further insight on ICT strategies and managerial perceptions from the Nigerian petroleum downstream context.

To achieve this goal, consideration is given to the scope of ICT deployment within the industry sector, management perceptions of sustainability and primary theoretical underpinnings that best explain these ICT strategies for sustainability within the Nigerian downstream sector. To this end, the following objectives have been set to guide the research enquiry

### 2.4.1 Objectives

1. RO1. Identify and conceptualise road freight transport operations in the Nigerian downstream industry.
2. RO2. Evaluate ICT deployment and associated strategies, relative to narrative managerial perceptions of sustainability.
3. RO3. Devise an assessment and framework tool for ICT based sustainability performance in road freight transport operations within the Nigerian downstream industry.

## 2.5 Research Questions

To achieve the above objectives, the following research questions have been set to guide the design, implementation and evaluation phases of this thesis.

1. RQ1: How are ICT mechanisms being used to support 3BL sustainability performance in road transport operations, with emphasis on social sustainability?

This research question contributes to the design phase of this thesis by enabling the deduction of management strategy initiatives from the existing literature. Prior contributions within the literature often provide good vantage points for synthesizing progress and highlighting gaps to be addressed (Bryman and Bell, 2011). The literature identifies ICT as one of the key mechanisms used to aid sustainability in road freight transport operations; however empirical evidence to support this concept is very limited within the literature. Addressing this research question will help bridge this gap.

1. RQ2: What are the predominant managerial perceptions of sustainability in road freight transport and how does this affect their ICT strategies?
2. RQ3: Which theoretical rationale(s) best explain the 3BL performance priorities in sustainable road freight transport?

Linking all three phases of this study, research questions 2 and 3 address the relationship between managerial perception, environment and strategy within the literature, strengthening theory contributions in this area.

1. RQ4. How can 3BL sustainability practices in the industry’s road freight transportation operations be further improved through ICT use?

Linked to the objective of devising an assessment framework tool for supporting ICT use for sustainable road freight transportation, tackling this research question provides the base for positive research impact. This will help strengthen the relationship between academic research and practice around ICT use for road freight transport.

## 2.6 Key terminologies

In recognition of research diversity and academic credence, it is imperative to clarify the intended meanings and applications of key terminologies used in the body of this work. This is aimed at recognising the diversity of credible academic opinion and importantly providing the paradigmatic scope for evaluation of this work.

### 2.6.1 Freight Transport

Freight transport refers to all transport of goods and products other than people (HMRC, 2011). It is used as a generic term, encompassing all forms of haulage, i.e. the movement of tangible products between two different locations as part of a business fulfilment process. It is also used to capture transport movements that are made to enable the subsequent movement of goods between locations as well as reverse logistics movements (Cullen et al., 2013; Davies et al., 2007).

### 2.6.2 Road Freight Transport

Road Freight Transport is used to refer to the transportation or movement of goods using a road transport medium to fulfil this purpose. Its use within this thesis excludes movements via grounded pipelines or non-commercial purpose vehicles.

### 2.6.3 Sustainability

It is a multi-faceted idea, with several conceptualisations in the road freight transport literature (Behrends et al., 2008). In this study, the term is used to capture the tri-dimensional concept of sustainable development (Elkington, 1998; WECD, 1987). It is used to represent activities, practices and impacts for creating positive society and business outcomes from road freight transport operations. Primarily, economic efficiencies, positive social impacts and environmental protection are guiding examples of sustainability use in this thesis.

### 2.6.4 Information and Communications Technology (ICT)

The phrase and associated acronyms are used to capture any combination or configuration of hard and soft connectivity tools that enable a variety of relationships, and connectivity, with emphasis on information acquisition, processing, exchange, and remote access, for the definitive goals of monitoring and controlling performance to match stakeholder expectations. ICT references thus include specific or combined information, software and hardware mechanisms (Wang et al., 2015; Giannopoulos, 2004).

### 2.6.5 Downstream industry

The term downstream industry refers to all post-refinement or import processes and activities relating to petroleum products. This extends to the storage of imported products for distribution, bulk product transportation, marketing and distribution activities.

### 2.6.6 Marketing and distribution companies

“Marketing and distribution companies” is an original term used to describe firms that procure and/ or distribute petroleum products in the Nigerian downstream industry. These companies carry out the freighting and retailing of petroleum products to corporate and individual end-users within Nigeria (NNPC, 2014).

### 2.6.7 Managerial Perceptions

Managerial perceptions have been the focus of previous business and management research enquiry (Ozleblebici and Cetin, 2015; Sutcliffe, 1994; Anderson and Paine, 1975; Young 1956). In this work, managerial perception references are limited to the acuity of opinion and interpretation communicated by managers regarding particular issues. The use of the phrase is not intended to have any psychological connotation to it and it is used in relation to the strategic management literature (Sutcliffe, 1994, Anderson and Paine, 1975).

## 2.7 Boundaries

An important consideration of any research is the feasibility of the study and this study has boundaries that apply to its application and relevance. The use of the term downstream is restricted to the distribution process within the downstream industry. It excludes sourcing and retailing processes and the study’s outcomes are not intended to apply to sourcing or retailing functions as they are outside the purview of this study.

## 2.8 Chapter Summary

This chapter has provided further insights on the purpose and motivation for this study. Addressing specifics on academic and industry rationales, the research objectives and guiding questions have been discussed alongside an outline of the key terminologies.

The next chapter will present and critically discuss the literature relating to road freight transport sustainability, starting from a broader introduction of the logistics and supply chain management discipline through to a conceptual framework on ICT interventions in road freight transport. Knowledge and practice gaps are highlighted where appropriate and the review makes a case for the combination of theories to enable credible explanations on why managers use ICT mechanisms to aid sustainability in their road freight transport.

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3. Literature Review

## 3.1 Introduction

Literature reviews are normative for evaluating academic discourse, diverse topical issues and research propositions that advance knowledge cohesion within academia (Tranfield et al., 2003). This chapter presents a critical review of literature on sustainability in road freight transport, combining both traditional and systematic review techniques to reflect and critically assess the literature on sustainability in road freight transport. Primarily, it explores road freight transport as a subset of freight operations and identifies some critical externalities that create challenges for road freight operators. Recognising several mechanisms to address sustainability challenges, the review evaluates their fit and establishes ICT interventions and the most suitable to the Nigerian downstream operations both for the empirical inquiry and for practice purposes. Knowledge gaps and potential benefits of addressing the gaps are also highlighted. The chapter concludes with a conceptual framework summary that captures the assumptions for empirical investigation.

## 3.2 Freight Transport: Academic foundations in logistics and supply chain management

### 3.2.1 Key Terms and Academic Disciplines

### 3.2.1.1 Supply Chain Management

Christopher (2011) advances supply chain management to indicate more than just the planning orientation and framework for the flow of products and information through a business. Recognising the role of multi-actors in the fulfilment of business objectives, he explains supply chain management as the “*management of upstream and downstream relationships with suppliers and customers in order to deliver superior customer value at less cost to the supply chain as a whole*” (Christopher, 2011; pg. 3). These process relationships have significance to actors within the value delivery chain and key benefits like value enhancement, competitive advantage and process efficiencies are recognized in the literature (Porter, 1985). A supply chain is not a chain of businesses with one-to-one, business-to-business relationships, but a network of multiple businesses and relationships. Supply chain management (SCM) offers the opportunity to capture the synergy of intra- and intercompany integration and management. SCM deals with business process excellence and represents a new way of managing the business and relationships with other members of the supply chain (Lambert and Cooper, 2000).

In the literature, there is emphasis on integrative strategies, theories, benefits and barriers, practices and opportunities for sustainability in supply chain management (Palsson and Kovacs, 2014; Marchet et al., 2014; Evangelista, 2014; Ageron et al., 2013; Gimenez et al., 2012; McKinnon and Ge, 2006; Gunasekaran and Ngai, 2004; Lambert and Cooper, 2000). Characteristically, SCM processes stress functional components that combine to create value delivery, with different components assuming strategic importance in diverse chains. SCM components include information, logistics transportation, facilities, inventory, personnel and technology (Christopher, 2011). In practice, SCM processes like procurement, order fulfilment, returns (reverse logistics), manufacturing flow management, all create interdependence between different parts of the chain and these processes are effectively logistics and transport dependent (Lambert and Cooper, 2000). In this study, freight transport is determined as a component of the logistics activities that support commercial value delivery in supply chains. This thesis’ outcomes will contribute to the broader supply chain management literature and the specifics of road freight transport sustainability.

### 3.2.1.2 Logistics Management

Logistics is often associated with military function of deployment and support, i.e. the science of planning and carrying out the movement and maintenance of military forces including but not limited to the design and development, acquisition, storage, mobility and recovery management of military assets; physical and otherwise. Gourdin (2006) ties logistics management to two conceptual streams: physical distribution and materials management. The application of both streams is underscored by a customer-driven strategy that seeks to determine strategy formulation and implementation. In a broader sense, these goal-oriented characterizations highlight both conceptual and functional aspects of logistics management by delineating management and operational level applications of the concept. The Council of Logistics Management (CLM) outlines logistics as being that “part of the supply chain process which plans, implements and controls the effective flow and storage of goods, services and related information from the point of origin to the point of consumption in order to meet customer requirements” (CLM, 1997). There are still conceptual parallels regarding the fit between logistics and SCM with some authors positing logistics as a sub-function of SCM, whilst other definitions tend to emphasize logistics as a founding concept for SCM (Christopher, 2011; Simchi-Levi et al., 2010; Chen and Paulraj, 2004; Larson and Halldorsson, 2004). The practical viewpoint in this debate is to integrate conceptual and functional understanding in order to create a synergistic view of logistics, where both conceptual elements of right benefits, right customer, right quantity and right time and right conditions with materials management within the firm.

Although authors like Gourdin (2006) and Simchi-Levi et al., (2010) have deemed logistics to be equivalent to supply chain management, logistics lacks the inter-firm network integration element of supply chains. Perhaps the better understanding of the interrelationship between SCM and logistics can be pulled from the conceptual framework of Larson and Halldorsson (2004) who delineate perspectives along the unionist, inter-sectionist, re-labelling and traditionalist groups. The unionist perspective adopts a silo approach that emphasises the predominant functional areas of operations management, logistics, information systems, marketing and sales as key silos of supply chains whilst the re-labelling proponents see SCM as a new terminology for logistics, like the traditionalists who also characterize SCM as a facet of broader logistics advancement, i.e. a subset of the logistics function (Larson and Halldorsson, 2004). Although the unionist and traditionalist perspectives align with the early chronological accounts of logistics as a master subject, the inter-sectionists view SCM as a superstructure that encompasses a range of business processes with strategic input and implications for the multiple firms. This thesis aligns with the inter-sectionist school, according SCM as a broader strategic integration of business functions and processes, one of which is logistics.

### 3.2.1.3 Physical Distribution

Physical distribution is pivotal to functional logistics and SCM operations. As such, its complexities and configuration optimisation strategies have been of interest to researchers (Hesse and Rodrigue, 2004; Bienstock et al., 1997). For example, advancement in sustainable supply chain studies identifies physical distribution and transport as important components that can undermine or enable good performance (Gourdin, 2006; Bienstock et al., 1997; Crainic and Laporte, 1997). Additionally, physical distribution dynamics have been established as critical to firm profits, assuming strategic significance in the way that firms compete (Gourdin, 2006).

A good example of this strategic role may be inferred from just-in-time (JIT) strategies where physical distribution processes like inventory, transport and information management are central to customer satisfaction. Physical distribution deals with the essentials of the post-production process of value delivery or what Porter, (1990) classed as ‘outbound logistics’ in his value chain model and this is in line with the scope of industry or supply chain management that this thesis partly focuses on. It also considers the inbound distribution mechanisms that enable the sourcing and transfer of pre-production or consumption materials for creating customer value. The next section addresses the topical subject of freight transport as a generic method for the movement of goods between locations in a supply chain.

## 3.3 Freight Transport

Output transportation is an important part of the value delivery chain and considered a source of competitive advantage (Gourdin, 2006). Such mobility can impact all basic five operational objectives: flexibility, reliability, quality, speed and cost. For example, transport quality has been shown to be an important consideration for purchasing decisions with implications for firm profitability (Bienstock et al., 1997). Similarly, studies have found relationships between freight transport and cost management, highlighting strategic implications from modality (Gourdin, 2006), carrier selection (Nielsen et al., 2003) and outsourcing decisions (Crainic and Laporte, 1997). In recent times the literature has focused more on efficiency and sustainability (Wang et al., 2015; Nuzzolo and Comi, 2014; Sternberg et al., 2013; Ageron et al., 2013; Davies et al., 2007).

### 3.3.1 Freight transport and efficiency

Efficiency issues in freight transport relate to value delivery with minimal or no time, cost, energy or material waste. Ackerman and Pulkki (2003) find cost efficiency penalties for businesses in the South African pulpwood industry to be in the range on $4.32 million US dollars per annum, citing the provision for secondary intermediate transport as a key driver of high cost inefficiencies.

Other authors have also investigated cost efficiencies of freight routing in relation to stochastic demand fluctuations (Polimeni and Vitetta, 2012; Haughton, 2002; Campbell, 1990). In this regard, it has been important to account for infrastructure constraints that affect performance efficiencies. The literature has explored time efficiencies in freight transport, highlighting optimisation time related savings vis-à-vis uncertainty reductions and delays of up to 46.2% (Ando and Taniguchi, 2006; see also Polimeni and Vitetta, 2012). A key contribution of studies in this area borders on congestion and links to perceptions about optimal routes, aiding a better understanding of how travel time and utility links influence routing decision of drivers (Vreeswijk et al., 2014; Polimeni and Vitetta, 2012; Zhu and Levinson, 2012; Ando and Taniguchi, 2006).

Energy consumption and efficiency themes are emphasized in the freight transport literature. Within Europe, several policy directives have affirmed this and freight related logistics continues to occupy a priority position in the European Union (EU) 7th Framework Programme for Research (EU, 2006) and the provisions of Regulation (EC) No 1072/2009 capture this concern in terms of haulage energy consumptions, particularly the challenge of empty-running (EU, 2014). Consequently, some inquiries have evaluated energy related efficiencies and found significant improvements through technology, planning and modality interventions. For example, it has been demonstrated that a major constraint of airfreight modality relates to high-energy consumption compared to water and rail, with simple modal choices improving overall efficiency and reducing energy consumptions (Department for Energy and Climate Change, 2015; Winebrake et al., 2008). Notably, it is believed that significant energy efficiencies across a variety of modes can be achieved through effective route planning, with both rail and shipping shown to provide lower energy consumption depending on factors like density, frequency and technology (Demir et al., 2014; Winebrake et al., 2008; Hesse, 2002; Forkenbrock, 2001). Adverse efficiencies pose significant problems across all types of freight modes, however due to its connectivity and predominant usage; the problems are of greater concern in road freight transportation and this further underscores the relevance and timeliness of the modal choice for this study (EU, 2014).

### 3.3.2 Freight transport and sustainability

Sustainability or sustainable development is a topical issue within freight transport and logistics in general. Due to freight transport’s double-edged implications, i.e. critical to economic activity on the one hand and associated negative externalities on the other hand, freight transport is a complex topic. Freight transport is a major source of Greenhouse Gases (GHG) emissions, deaths, accidents, profits (or loss) and land dispute with several studies emphasizing the need for investigation across economic, social and environmental platforms (Wang et al., 2015; Sternberg et al., 2014; Pan et al., 2013; Leonardi and Baumgartner, 2004).

In 2014, transport accounted for 54.6 Mtoe (million tonnes of oil equivalent) representing 38% of the UK’s overall energy consumption with freight transport accounting for a significant proportion of that figure (DECC, 2015). Interestingly, there have been earlier estimates of combined food freight socio-economic and environmental costs of £9 billion annually within the UK (DEFRA, 2005) and suggestions are that these figures could be significantly higher when consumption-based adjustments are made, particularly if life-cycle models were used to model the costs of UK agro-freight (Helm et al., 2007; DEFRA, 2005; Garnett, 2010).

Beyond the emissions quandary, freight transport is an important enabler of business performance and in many instances; it has been identified as a source of competitive advantage at regional, national and firm levels (EU, 2012; Banister, 2007; Ando and Taniguchi, 2006). This competitive element is underpinned by economic efficiencies relating to cost, design, energy consumption and technology yet it is remains a difficult area for firms; margins are often very small and this impacts firm profitability, highlighting the pressure on society to balance efficiency priorities within contracting margins (EU, 2014, Davies et al., 2007; Hesse, 2002).

Social impacts of freight transport highlight useful perspectives on the performance outcomes of freight transport. The literature, albeit lean, has explored some of the social impacts of freight transport identifying congestion, accidents, noise pollution and health related concerns as some outcomes of the freight related movement (Demir et al., 2015; Lera-Lopez et al., 2014; Richardson, 2005). However, there are some positive social impacts like mobility empowerment (Ciliberti et al., 2008) and food quality enhancements (Dorosh et al., 2012). These multi-faceted outcomes of freight transport highlight the complexity of the freight related inquiries, where freight transportation enables positives within society but also causes concerns about the environment, wellbeing and efficiencies in the short and long term.

There are strengths in measuring sustainability in isolated dimensions of freight impact yet the preceding paragraphs extend credence to the notion that sustainability is best pursued as a comprehensive objective that caters for all the 3BL dimensions (Yusuf et al., 2013; Abbasi and Nilsson, 2012; Boschmann and Kwan, 2008). A cohesive and transcendental approach to freight transport sustainability has the potential to effectively drive policy, practice and theory within the scope of sustainable development as it comprehensively addresses the different nuances of freight transport externalities. For example, the freight transport industry may have gender inequality issues, education polarities and social consequence challenges that contribute to overall unsustainability indices yet research on these issues is extremely rare (Boschmann and Kwan, 2008). The neglect of these important social matters due to the emphasis on costs and ecologically related matters limits sustainable development. 3BL synergistic approaches can yield better insight for meeting the sustainability challenges and aid wholesome progress in this area. This comprehensive multi-dimensional approach to sustainability underpins this thesis, adopting a tripartite framework to explore sustainability in road freight transport within an emerging market context.

### 3.3.3 Freight transport modes

Freight transport is deliverable via a range of modes; air, water, land and pipelines, with land often delineated across rail and road mechanisms. According to Dekker et al., (2012), each mode of transport has different characteristics and enablers in terms of costs, time, transit, social capital and environmental performance. These mode aggregates are examined below as generic options for commercial freight mobility.

#### 3.3.3.1 Air freight

Air freight is an important part of the freight transport operation strategy and it contributes significantly to value delivery measures within the freight industry (Bowen and Leinbach, 2006). Growth indicators show that airfreight demand outpaced global GDP growth between 1970 and 2013; driven mostly by firm competition, outsourcing and resource leverages (IATA, 2016; Bowen and Leinbach, 2006). Despite its growth contributions, the climatic impact of airfreight transport is significantly higher per tonne carried compared to any other mode of transport (DEFRA, 2005). Concerns have also been raised regarding noise pollution, airport congestion, abuse and social inclusion or access costs related to airfreight (Rutherford, 2011; Airport Watch, 2009, Transport Committee, 2003). Trade-offs usually guide airfreight freight transport evaluations, where externalities are compared against perceived benefits like employment, road decongestion and speed. In comparison to other modes of freight mobility, airfreight like rail and sea can only function alongside hub strategies, which although holding strategic value, do not complete physical distribution loops, i.e. airfreight, must be combined with other modes of transportation, particularly road freight transport for the nodal or final links. In terms of its appropriation as a research focus, Fisher (1998) establishes that product types are critical to SC design and this is instructive for the focus of freight related studies. Specifically, in this industry, airfreight does not feature as an enabler of petroleum cargo mobility compared to rail, water and road.

#### 3.3.3.2 Water freight

Bontekoning and Priemus (2004) advocate paradigmatic modal shifts as necessary for freight transport, identifying waterways as one of the main viable alternatives to road freight. Water provides an immediate alternative to airfreight in terms of intercontinental shipping where limitations apply to land and pipeline means. Water freight is the largest contributor to upstream SC freight mobility when adjudged by the volume of goods by sector and modal share per ton-km (Nealer et al., 2011). As the most eco-efficient mode of freight movement, it underpins major industrial connections and there are increasing efforts to improve its reliability, speed and flexibility within international and local boundaries (Wang and Tamagawa, 2011; Winebrake et al., 2008). The use of water freight in the petroleum industry is mostly common to upstream activities although reports have found increased patronage for petroleum and food sector transfers, using barges and other special purpose carriers (Nealer et al., 2011).

With its designation alongside rail as the least energy and emissions intense modes, water freight provides a pivotal option for exploring the sustainable freight transport solutions. Despite its importance, there are some key limiting characteristics to water freight, the most obvious being accessibility. Many parts of the world are completely landlocked with no access via waterways, necessitating complementary nodal or destination modes; often road, rail or pipeline to complete final delivery. A second limitation to water relates to flexibility and there are valid concerns that increasing atomisation of freight flows will lead to structural logistics changes that will negatively affect inland waterway freight (Hesse, 2002). Bahrami, (2001) lends credence to this concern, questioning the competitiveness of water freight following e-commerce advancements and time instrumentation in freight performance.

The literature raises some concern about data on water freight and within Africa and its subcontinents; waterways play important roles in freight transport. Infrastructure problems identified by Teravaninthorn and Raballand (2009) translate to exclusion for some areas within Africa, with water being the only accessible means for goods transportation. For example, traders who move products between Port-Harcourt city and Bonny town in Southern Nigeria must rely exclusively on waterways for the movement of their products. Gwilliams (2011) underscores the importance of waterway transport to freight mobility within Africa and implies that its use is in decline, with social and economic consequences for the regions that would have ordinarily have benefited from higher patronage of this mode. Advancements in this area are currently facing pronounced security challenges with the increase in the activities of sea pirates and terrorist activities around the international and internal coastal areas (Gwilliams, 2011; The Economist, 2014). Figure 3.1 below illustrates the frequency and spread of these attacks across the West African subcontinent.



Figure : - Water Freight Attacks around Africa's Coasts (2010-2014).

(Source: The Economist, 29th November, 2014)

Alarming, as the information in Figure 3.1 may seem, it is noteworthy that the attacks identified above relate only to international water coastal attacks and does not account for hinterland attacks, which could be significantly higher. The implications of these are sure to affect business costs for security and make water freight less attractive to many managers.

As such, although water freight is important for social, economic and environmental considerations, many limiting factors restrict its viability as a modal alternative across global, regional and local spheres. Concurrent and future research continues to explore modal efficiencies that can be further harnessed to improve water and multi-modal freight sustainability.

#### 3.3.3.3 Pipeline freight

The use of pipelines for freight transport is common and early records of use date back to the 1800s (Egbunike and Porter, 2011). Considered an economical and environmentally friendly mode of freight mobility, it’s been noted as a viable alternative to other transport modes for pneumatic, slurry and capsuled products (Egbunike and Porter, 2011). Despite its potential contribution to freight transport sustainability, pipelines have been largely overlooked compared to the other modal options. A Parliamentary evidence report in 2008 highlights social, economic and environmental benefits of pipeline freight, citing lower risks of accidents, congestion and delays as some key social benefits that could reduce the 486 fatalities associated with heavy goods vehicles (HGVs) in the preceding years (Select Committee on Transport/FT45/ 2008). Further interesting prospects were related to potential savings of £2.5 billion in reduced travel and congestion as well as operational leverages around supply chain complexities, transport, packaging and manufacturing costs. These potential benefits are enormous, particularly for managing urban freight where pipelines already provide unrivalled services for the transportation of oil, water (industrial and household), gas, sewage and other industrial fluids yet contemporary management research in this area is limited (Egbunike and Porter, 2011; Howgego and Roe, 1998; Coyle et al, 1982). Perhaps three reasons may be advanced for the limited attention that pipeline freight has received in the literature: visibility, specificity and perceptions.

1. Visibility: Pipelines are often buried underground or deep in the sea, with very little portions visible to the public. This may effectively affect the awareness about the existence of the mode of freight transport and its usefulness as an alternative (Coyle et al, 1982).
2. Specificity: Unlike land and sea modes, the types of goods that can be transported via pipelines are of limited specifications and this is a major yet practical constraint to its use.
3. Perceptions: One of the arguments of the Select Committee on Transport’s (2008) evidence report was that pipeline freight development is a business issue and not necessarily an academic exercise. This perceptive limitation may have captured the noted apathy and literature dearth on this topic. A more inclusive approach that does not limit academic contribution to conceptualisation may help advance literature, practice and benefit from this mode.

Contextually, like the UK, Nigeria also has an extensive pipeline network predominantly dedicated to the transportation of petroleum products between regions (see Figure 3.2 below).

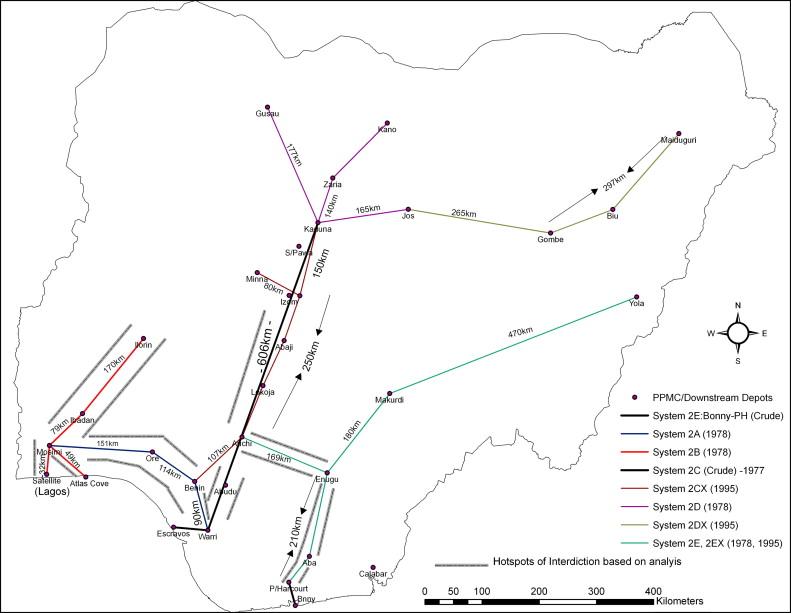


Figure : - Map illustrating Nigeria's downstream pipeline systems and length in kilometres according to year of development.

(Source: Anifowose et al., 2011)

It has been suggested that problems associated with interdiction (deliberate damage or sabotage) and corrosion undermined the capacity of the pipeline freight system in Nigeria (Anifowose et al., 2011). Pipeline freight networks are often the most flexible mode of freight transport yet as the map above reveals, its use and its coverage within Nigeria is quite limited. Whilst there is merit in the potential for efficient and sustainable freight transport through increased use of pipelines, concerted collaboration between public and private agencies is required to advance this option any further; this is only possible where two or more main actors share efforts to reach common freight transport objectives (Gonzalez-Feliu and Salanova, 2012).

#### 3.3.3.4 Land freight

The most relatable and visible mode of freight transport is land. Proximate, accessible and flexible, land freight systems operate across rail and road networks. Discussions on modality commonly distinguishes between the two classing them as separate modes yet besides the infrastructure characteristics, the elemental basis for both road and rail is land. DEFRA’s (2005) Food Miles report examines both types closely and aggregates their combined social costs (noise) to be at £283 million per year but as previously indicated, the common practice is to discuss both as individual modal types. For the purposes of this study, both are classified as land freight mechanisms but distinguished based on infrastructure peculiarities.

##### 3.3.3.4.1 Rail freight

Rail is considered one of the under-utilised modes of freight transport today and this deprives society of important benefits by way of low-energy consumption, low-emissions and congestion risks (Crainic, 2012; Janic and Vleugel, 2012; Motraghi and Marinov, 2012). In terms of emissions, Kim and Van Wee (2009) establish that the use of electric powered trains does not always result in lower CO2 emissions but rather regional power generation factors may result in higher emission output for rail freight compared to truck. Similarly, congestion risks claims remain debatable when adjudged from a causal viewpoint since rail crossings have been known to cause severe vehicular congestion. Suited to industrial uses where speed isn’t a critical success factor (CSF), rail freight is often adopted for bulk movement of large freight in addition to being cost effective as per volume/km measured (Hesse, 2002).

Bowen and Leinbach (2006) assert that rail freight suffers from operations and supply chain strategies around modularity where smaller, batch shipments with increasing time constraints combine to make rail freight less attractive. Within Europe and the US, rail represents one of the key mechanisms being adopted for improving freight transport sustainability at both planning, policy and implementation levels (McCartney and Stittle, 2013). It is thought that the UK’s rail freight industry has failed to effectively position itself as a leading option for internal freight movement since it was privatised in the 1990s and there are concerns that its contribution to sustainable transportation is less factual than claimed (McCartney and Stittle, 2013; Glaister, 2004). Rail network access and costs were listed as the main barriers to rail freight increase and whilst distance coverage is on the increase, the volumes lifted has remained relatively stagnant or declined in the last 15 years (Office of Rail Regulation, 2011).

Within Africa, Gwilliam (2011) infers that the haphazard approaches of colonial administrations and subsequent political corruption have combined to create infrastructure and utility problems for rail freight. On one hand, the implications of this infrastructure dearth relate to the concentration of freight transport on roads affecting the option of intermodal freight transport; the literature does not cite any instance of dedicated rail freight service within Africa. Perhaps a further complicating effect of the African infrastructure challenge is the common simultaneity of passenger and freight transport in many parts of Africa. The combined movement of large freight and human passengers in the same vehicle, complicates the operation of freight transport, increases the complexity of evaluating freight transport and adds to the increased hazards that emanate from freight transport (Porter, 2014).

By way of contrast, rail and water are the principal modes of freight movement in China, with penetration of rail freight networks subject to the level of industrialisation of the regions (Wang and Tamagawa, 2011). There are several important considerations that may be driving rail freight penetration in the Chinese economy including pollution worries from road transport, volume and type of the goods being transferred, accessibility of and distance between different regions, where road travel may require days of travel and have adverse effect on fuel consumption, drivers’ health and safety. Perhaps the disposition of China as a predominantly export community may be responsible for this trend of reliance on rail and water freight modes and this may highlight research prospects on intermodal development strategies for sustainability in emerging and underdeveloped nations. It is plausible that increased exports-driven industrialisation may help improve intermodal infrastructure and accessibilities in these types of contexts (Kveiborg and Fosgerau, 2007; McKinnon 2007).

##### 3.3.3.4.2 Road freight

Road is the dominant mode of freight transportation in terms of frequency and accessibility; contributing to economic development and will remain the most important mode of freight transport (ERTRAC, 2011). Owing to the enormity of its volume, flexibility and visibility, it will require a paradigm shift in alternative modal growth for road freight transport to be displaced (ERTRAC, 2011, EC, 2011). Within the EU, road freight accounts for over 70% of the inland freight transport with rail and inland waterways accounting for 16% and 6% respectively (EU, 2011). Businesses, governments and customers all rely on road freight as it enables both upstream and downstream movement of trade within society, influencing supply network configuration decisions (Pan et al., 2013; Hageback et al., 2004). The scientific literature has also linked economic growth to road freight transport, although data inconsistencies have created reliability concerns regarding this link (Alises et al., 2014; Bennathan et al., 1992).

In a pragmatic sense, Dey et al., (2011) suggest that with the concerns about emissions, safety and costs, it is imperative that logistics managers make good decisions about the mode of transportation they employ. This sets the foundation for internal and external costs that by way of common agreement represent the bad side of freight transport. It is commonly acknowledged that road freight efficiencies must be improved if cost and ecological targets are to be met (Li et al., 2013; EU, 2012). Despite its dynamism and flexibility strengths, road freight has higher environmental, financial and social costs compared to all the other modes of transport (Demir et al., 2014; Islam et al., 2013).

Contextually, the African continent is predominantly associated with underdevelopment as well as the lack of access to many basic infrastructures. The effects of Africa’s externalities are not limited to Africa alone as the impact of some activities adversely affects Europe and other continents despite their best efforts. For example, one such localised activity with global impact is road freight transport, where developing countries are estimated to contribute over 80% of GHG emissions from transport growth (Department of Transport, South African, 2011).

Road freight transport is an extremely important part of African economies like Nigeria, South Africa and Kenya, all of which are dependent of relatively undervalued goods to world markets (Gwilliam, 2011). Studies have highlighted disproportionate road freight prices in Africa compared to other regions (Rizet and Giwet, 1998), correlations between road freight transport and social wellbeing (Porter, 2014) as well as the links to global supply chain costs for agricultural products (Dorosh et al., 2012). Road freight is the predominant mode of freight movement in Africa and it has been recognised as a principal source of air pollution, GHG emissions, with calls for action to address road freight efficiencies, however, the literature on African road freight operations is still significantly lacking despite the implications for global contexts (Thambiran and Diab, 2011). Furthermore, with its vast challenges, economic and social contexts common to Africa can provide stimulating environments for research with localised and global benefits, advancing extant literature postulations and influencing policy development for sustainable development.

The extant literature identifies the strategic importance of freight transport to sustainable performance vis-à-vis economic growth, social cohesion, value delivery and environmental emissions outcomes. In terms of modality, four principal modes of freight movement; air, water, pipeline and land have been identified with varying degrees of utilisation, particularly in terms of rail and road who together account for over 80% of inland freight movement within some countries like the UK. Viability discussions have centred on the dynamism of modes in relation to flexibility and accessibility of the different modes, with road freight demand distinguished because of its network completing function and flexibility. These factors underline business’ concentration on road freight transport despite its increasing contributions to global externalities.

The next section of this review will focus on road transport as the dominant mode of freight transport globally, capturing sustainability challenges associated with freight transport and a systematic literature review discussion on mechanisms or approaches for addressing the externalities of road freight transportation. The systematic literature review validates the rationale for information and communications technology as the most suitable research variable for addressing road freight sustainability within global and contextual settings, specifically making a management case for ICT instrumentation in road freight transport research.

## 3.4 Road Freight Transport

Goods transportation is increasingly an important part of the value delivery chain and considered a source of competitive advantage (Gourdin, 2006). Road transport is the dominant mode of freight transport and essential for socio-economic development. Its importance to value delivery and profitability possibly influenced early scholarship in this area, focusing on cost management and efficiencies (Harrison, 1986; Joy, 1986; Sloss 1970; Chisholm; 1959; Cadbury, 1935). Initial scientific inquiries were interested in the roles of State regulations, organisation size and infrastructure on costs and profitability. For example, Chisholm (1959) investigated economies of scale in the UK (English and Welsh) milk industry, sampling 384 contractors handling milk transport from farms. His study established that besides the prospects of return logistics, there were no extra profits accruing to firms because of size. Furthermore, the study inferred restrictions from road infrastructure as significantly influencing road freight performance in the industry, affecting factors like speed, fleet size and build design. Contention around these claims led to a synthetization of Chisholm’s (1959), Cadbury’s (1935) and Smykay’s (1958) arguments by Harrison (1986) who argues that expansive growth is indicative of economics of scale subject to certain factors and conditions. State regulations also influenced the development of road haulage post World War 1, with extensive consequences resulting from the Road and Rail Traffic Act of 1933, which imposed licensing conditions based on size and novelty (Bayliss, 1998).

Following through from the focus on economic and operational efficiencies that emphasised optimisation as vital to road freight performance, scientific focus began to highlight environmental performance in road freight (McKinnon, 2007; Vanek and Campbell, 1999; McKinnon, 1996; 93). Within the UK, the importance of road freight transport energy efficiencies was demonstrated by report that between 1985-1995 transport energy usage was growing at a faster rate (31%) than any other sector average (7%). The implication of such was that the UK’s objective of being the least environmentally impacting industrialised nation was under threat (Vanek and Campbell, 1999). Managing road freight energy use and emissions is still of great concern within the UK and other industrialised nations but little is known about this in developing or emerging country contexts (Basu et al., 2016; Robles, 2016; Cullinane, 2014; Marchet et al., 2014; Oberhofer and Dieplinger, 2014; Evangelista, 2014; Cristea et al., 2013; Piecyk and McKinnon, 2010; Piecyk and McKinnon, 2007; Woodcock et al., 2007).

Road freight activities are intricately tied to other economic activities and the growth from other industries has implied growth tendencies for road freight. Whilst growth by itself is not a bad phenomenon, in road freight growth comes with externalities in form of CO2 emissions, land use deterioration, accidents, health and energy resource imbalances (Demir et al., 2014; Schreyer et al., 2004). These dual consequences have prompted and sustained research inquiries in this area, employing a wide variety of methodology, theories and perspectives. The literature identifies many generic externalities associated with road freight and some of these are examined in detail, highlighting contextual implications where applicable.

### 3.4.1 Road Freight and Sustainability

Sustainability is extensively discussed in the literature (Robles, 2016; Marchet et al., 2014; Oberhofer and Dieplinger, 2014; Dey et al., 2011; Himanen et al., 2005). Influenced by the natural and economic sciences, the term is used interchangeably with sustainable development, with many mutable interpretations that contribute to its broad appeal in today’s literature (Behrends et al., 2008; Dietz and Neumayer, 2006; Marshall and Toffel, 2005).

The Bruntland report (WCED, 1987) and Elkington’s (1997) people, planet and profit theory provide the most widely accepted notions on sustainability and give rise to the common referenced 3BL framework; particularly within the social sciences and management disciplines (Bedinger et al., 2015; Yusuf et al., 2013; Gimenez et al., 2012; Porter and Kramer, 2006: Kleindorfer et al., 2005). Despite their appeal, the operationalisation of these definitions has been questioned by several authors, with some inferences of them being mere political rhetoric (Gimenez et al., 2012, Marshall and Toffel, 2005; Jacobs, 1999). For example, social sustainability objectives have been reported to have negative impact on the economic performance of firms, highlighting one of many operational difficulties for managers (Gimenez et al., 2012; see also Ong et al., 2016).

Theoretical and pragmatic compromises have been discussed in the literature. For example, Jacob (1999) breaks the Bruntland position into two main perspectives: the technocratic and the political, advancing a complex dynamic theocratic structure that focuses on actual empirics rather than political dictates. Other authors have resorted to the “weak” and “strong” sustainability discourse, where the operational objectives for weak sustainability (WS) follows the economic constant of profitability as the priority measure, while strong sustainability (SS) emphasizes the prominence of environmental issues over profits (Hediger, 1999).

Researchers recognise this dichotomy and call for an intensification of studies that investigate 3BL sustainability in the operations management literature (Ageron et al., 2013; Gimenez et al., 2012). Consequently, the combination of contextual and operations nuances demonstrate the importance of meanings in sustainability studies. Empirical studies can provide insights and useful contributions to addressing the questions on sustainability applications (Marshall and Toffel, 2005).

The application of the 3BL framework to research on road freight transport is common within the literature, however, the upturn is trended towards the environmental and economic dimensions compared to the social (Wang et al., 2015; Oberhofer and Dieplinger, 2014; Palsson and Kovacs, 2014; Furst and Oberhofer, 2012). Although authors have identified the neglect of social issues, the fundamental questions of how and why social sustainability is deprioritized remain untouched. The next section will explore the notion of road freight transport externalities as antecedents for interventions.

### 3.4.2 Road Freight Externalities

The term “externalities” has been used by the Organisation for Economic Cooperation and Development to capture the costs or benefits imposed on unconnected parties from business activities (Helbling 2012; OECD, 2002). With roots in economic theories, externalities can be positive (beneficial) or negative (costly) to the non-participatory parties and theoretical explanations have bothered from coercive to bargaining incentives between the State and affected parties (Coase, 1960; see also “The Economics of Welfare” by Arthur Pigou, 1920).

The EU Handbook on External Costs of Transport (EC DG MOVE, 2014) uses the term “side effects” (pg.1) to refer to transport externalities, citing resource costs and productivity losses as some of the principal negatives from transport. Externalities thus represent a range of costs or benefits that arise from market transactions, which become imposed on populations other than those who give rise to them. Unsurprisingly, the literature focuses on negative or cost related externalities, exploring, simulating and modelling approaches for eliminating, mitigating and managing these negative “side effects”. Road traffic accidents, noise pollutions, health costs, land appropriation, climate abatement costs, GHG emissions, traffic congestion, energy consumption are some of the externality themes occurring within the literature. When internalised, these negatives can be considered as part of broader sustainability challenges that have implications for business practice and resource management (Lera-Lopez et al., 2014; Dablanc et al., 2013; Janic, 2007; Piecyk and McKinnon, 2007; Pellegram, 2001). Five main groups of externalities are examined next.

#### 3.4.1.1 Accidents

Freight related road accidents accounted for a significant number of fatalities across the UK, EU and the US (EC CARE, 2015; Watkiss et al., 2005; Lyman and Raver, 2003). Some key sustainability impacts from road freight related accidents include minor consequences like short delays from traffic congestions, driver fatigue as well as fatal consequences like death, pollution and the loss of property (Calthrop and Proost, 1998).

Within OECD countries, road accidents are measured in terms of the number of persons injured and deaths due to road accidents, whether immediate or within 30 days of the accident, and excluding suicides involving the use of road motor vehicles and the UK road freight industry, which employs over 285,000 HGV drivers in various capacities is under pressure to drive down accident occurrences. The industry’s turnover is estimated to be in the region of £22.9 billion in 2013 and a recent publication by the Department for Transport indicated that in 2013, just over 6000 accident incidents involving HGVs were reported in the UK. Of these, 8448 casualties were recorded and 258 were fatal (DfT, 2015). In an earlier, report dating back to 2002, social costs from accidents in the UK were pegged at £2 billion, food freight alone accounting for just lower than 48% of that total (DEFRA, 2005). The MERCURIO project data also showed that the social cost of road accidents in Italy has been around € 11 billion during the period between 2009 and 2011, France about € 8 billion, Austria € 2 billion and just below €1 billion for the Czech Republic (MERCURIO, 2012). Most these freight related accidents occurred within urban freight circles and highlighted food freight accidents as a being of national significance.

The appropriation of costs to accidents may not always capture the psychological, community and extended losses that accidents and associated consequences may be yielding yet the reported figures impose a relatable perspective of challenges posed by accidents related external costs. Extended consequences may become transferrable to businesses or customers in terms of price adjustments to accommodate increasing insurance costs, monitoring and mitigation measures as well as compensatory measures however the literature does not report this.

Within the wider EU and US contexts, there are similar safety concerns about the road freight transport accidents. All of the UK, EU and US have recorded converse relationships between freight growth and related accident fatalities which validates collaborative initiatives to address accident related costs, however the statistics also show a worrisome trend that may be overlooked, i.e. the majority of road freight related accidents involve passenger vehicles. For example, whilst large trucks were involved in 88% of the total freight related accidents in the US, the fatalities to the truck occupants were 691 compared to 3,273 for non-truck occupants in 2013 (US, Department of Transport, 2015). In the last quarter of 2013, there were calls for the ban of freight trucks in central London due to 6 cycling fatalities from truck related accidents in the city and the UK agencies have had to commit to improving safety for vulnerable road users (Freight Transport Association, 2014). The EC demonstrated initiative in this area through the European Truck Accidents Causation (ETAC) project in 2006 that developed a benchmarked methodology to investigate and address truck accidents. The project determined that 85.2% of truck accidents were due to human errors, with a quarter of that figure being linked directly to the truck drivers (EC, 2007).

One of the complications of road freight accidents relates to the impossibility of isolating freight movement from other road users. The quantification of road freight accident costs has been described from two different approaches: top-down and bottom-up (Swarts et al., 2012; Maibach et al., 2008). The top-down method focuses on material damages, administrative costs, medical and other conventional costs whilst the bottom up method assumes correlations between traffic levels, risk value assumptions and accidents (Maibach et al., 2008). The effect of this extends to the need for accident solutions to account for the actions of other road users in addition to managing their own road freight operations. This also applies to accounting for the associated costs, the boundaries remaining relatively undefined. For example, the EU/ MERCURIO project identified road accidents as the most important category of transport related external costs within Europe, considering both direct (health, police, fire-fighting, material damage) and indirect (loss of production, social expenditure; insurance and pensions) costs as part of its measurement metrics (MERCURIO, 2015). Effectively, there is common acceptance of road accidents as a major external cost of road freight transport. The indeterminate nature of these costs makes it difficult to place satisfactory financial figures on these incidents owing to causal links.

Contextually, road freight accidents in Africa have traditionally been blamed on infrastructure and Nigeria in particular has been ranked as having the highest rates in the world (Ubogu et al., 2011; FRSC, 2008). However, this infrastructure narrative has been moderated by suggestions that there are other complicating factors like corruption cartels, equipment age and transport monopolies that affect performance in the truck transport industry in Africa (Teravaninthorn and Raballand, 2009). Although the database on African freight related accidents is developing, the continent still lacks a cohesive cooperative front for road freight management and as such, the data on freight accidents is disaggregated and distorted across the continent.

In terms of cost comparisons, road freight is eleven times more likely to incur external costs than rail freight, with road freight related accidents accounting for $0.492 per tonne in South Africa (Swarts et al., 2012). A common feature of freight related accidents in Africa is akin to that of the EU and US where a greater proportion of the dead are persons other than the freight vehicle occupants. Perhaps a more worrying trend for Africa is the fatalities that affect pedestrians and bystanders compared to other groups of road users. Design deficiencies including the absence of guardrails, pedestrian walkways, road signs and enforcement have been cited as contributing factors to the trend in Africa (US Department of Transport, 2000). In some cases, literacy and poverty factors have led to fatalities where bystanders and members of the public have attempted to exploit accidents for economic or personal profit with dire consequences. One of such unique cases is related to the movement of flammable goods, specifically petroleum products in Nigeria, where over 500 lives have been lost in the last decade due to explosions occurring whilst persons attempted to scoop or siphon petroleum products from fallen tankers (see Table 2.1 above). Such desperate behavioural tendencies tend to be localised to the Nigerian environment but sadly reflects a growing challenge to road freight transport planning.

Road freight accidents continue to pose a major challenge to Africa with projections that related incidents will double by 2030 unless significant steps are taken to address the driving factors. From a global perspective, the UK, EC region, US continue to demonstrate leadership in addressing the external costs of road freight albeit there are many complicating factors that need addressing. Africa still lacks leadership in this area and there is an urgent need to address this class of externality that accounts for between 10-16 % of global incidents although it has less than 4% of the world’s road freight. Besides, the limited number of studies focused on South Africa, there is limited empirical evidence to substantiate these claims from the perspective of emerging nations in Africa.

#### 3.4.1.2 Noise Pollution

Noise pollution is a principal source of irritation and harm from freight transport (Macharis et al., 2011). Noise nuisance from road freight can lead to speech interference, annoyance, sleep disturbance, mental disorders and cardiovascular effects; however, the official policy perspective of the UK is one that questions the verifiability of its effects on health and quantification of its corresponding impacts (EC, 2014; DEFRA, 2005). In terms of major impacts, annoyance and health impacts are considered the main impacts from noise and the EC practice suggests that these two effects are independent, i.e. the potential long term health risk is not considered in people's perceived noise annoyance or nuisance.

Noise reduction has been a priority although this often involves trade-offs between noise levels and air quality in some instances (International Energy Agency, 2004). As freight transport demand grows, exposure to noise emanating from road freight operations has also increased. Noise problems tend to be more of an urban concern, where urban area freight creates nuisance to the detriment of the inhabitants of that urban area. Local authorities have been identified as principal players who fail to demonstrate proper awareness about the associated urban freight problems (Ballantyne et al., 2013; Allen et al., 2000).

An important question in the quest towards sustainable freight is the acceptability or prevalence of certain factors as key indicators in certain geographical or cultural contexts. In this sense, the question of what is alien to, detrimental or harmful to society has to be put in the context of the society for whom the question is being posed.

At local levels, externalities like accidents are very much tangible and the negative impacts like deaths, injuries and delays are immediate and relatable in all cultural contexts. On the other hand, noise may not always be construed as a negative externality in some contexts although Ballantyne et al., (2013) make bold claims regarding the prevalence of road freight perceptions, stating that perceptions at local levels are quite similar and the problems are similar based on the evidence from their study but this may somewhat extensive. Reasons pertaining to infrastructure, local culture and economic sector growth all affect the experience and challenges associated with road freight transport. For example, a city like London with significant growth will face more freight transport challenges compared to a quiet rural local authority like Loughborough.

At national levels, these factors exert even bigger influences on the local authority and populations perceptions of freight transport. Black and Geenhuizen’s (2006) inference that some parts of the world like Europe recognise noise and vibration damage as significant concerns affirms this position of relative variance in perceptions about noise as an externality. Within the literature, reviews did not yield many specific empirical findings of noise as an issue of significant concern within African societies when freight related externalities were evaluated. Perhaps Swarts et al.’s (2012) paper provides the most focus investigation based on the assumption of noise as an externality of concern. Aiming to estimate noise costs for South Africa using comparable GDP per capita, they acknowledge that factors like population density can skew the data estimates, thereby applying some caution to the yield of their cost model for freight transport externalities. Despite the relative absence of empirical data, one cannot discount noise nuisance as an external cost to society and it is plausible to infer that noise pollution does constitute nuisance in developing economy contexts as much as they do within industrialised economy contexts, the key difference being the varying levels of awareness in these different contexts.

#### 3.4.1.3 Congestion

The problem of congestion is closely associated with journey delays and disruptions to supply chains and broader operations value delivery activities (Sanchez-Rodrigues et al., 2010; McKinnon, 2007). Classed as unplanned, congestion often implies the over-utilisation of road infrastructure causing severe delays, disruption, losses and in some case health issues for the parties. Further sub-classification has been applied to the problem of congestion, with ‘planned’ and ‘unplanned’ being used to categorise the problem based on predictability (Sanchez –Rodrigues et al., 2010). In any event, the concern about congestions relates to the requirement for adjustment that it confers on the parties involved; for example, a firm who uses the M25 between 9am-11am weekdays may be able to predict traffic congestion but the options for alternative routing or postponing require some adjustment to their performance schedules otherwise they must embrace delay. The association of freight with congestion is closely aligned with demand and general economic growth and this has implications for economic planning, urbanisation and land use. In principle for every extra freight vehicle that is deployed, there is an increased demand for the same road capacity. Congestion from road freight transport creates uncertainty, reduces productivity and creates costs challenges to society. However, authors like Beuthe et al., (2002) have questioned the suitability of congestion as an externality, since its cost is often accounted for by carriers (Dablanc et al., 2013; Davies et al., 2007). This consideration is premised on the adjustments for congestion charges that are applicable to certain road networks within the UK and some other countries. The difficulty with such assumptions is twofold;

1. Congestion charges apply to other users besides freight providers
2. Internalisation of costs does not necessarily contribute to compensate other road users who may have no benefit from the specific freight activity but still suffer from the impact of freight related congestion.

The above reasons support the depiction of congestion as an externality, since there are costs borne by society that are not wholly accounted for.

Within Africa, the problem of road congestion extends beyond capacity and utilisation to planning, communication and corruption. Planning issues extend to poor assessment of freight routes, insufficient hubs and inadequate parking spaces; in many instances, these are non-existent. Corruption does play a big role with daily occurrence of law enforcement officers evidenced to feign ignorance of road regulation breaches in exchange for monetary rewards (The Guardian Nigeria, 2015; Ubogu et al., 2011).

Contextually, Teravaninthorn and Raballand (2009) report correlations between freighting costs and congestion in Africa while Ubogu et al., (2011) go further to stress that congestion related issues make it easier to move freight from Europe to Nigeria, than it is to move the same freight within Nigeria’s borders. In recent years, the impacts of congestion in Nigeria have been known to include theft, loss of property and life and street begging. The main risks being the likelihood of criminals taking advantage of congestion to rob victims of their personal items and people have been killed whilst stationary or held up in congestion traffic (US Overseas Security Advisory Council, 2015; Foreign and Commonwealth Office, 2015).

In summary, the weightier arguments highlight congestion as a significant problem in road freight transport, affecting connected and otherwise stakeholders. The literature shows that beyond its financial costs, congestion can also affect social wellbeing and in some cases, lead to loss of life and property. Congestion perhaps captures the direct implications of the economic growth and freight demand outcome, where increased economic activities create higher freight demand at rates faster than the infrastructure growth rates. Sustainable road freight transport practices must therefore account for congestion as an external cost that needs addressing.

#### 3.4.1.4 Land Appropriation

Litman and Burwell (2006) argue that reduction in automobile dependency is a key principle of sustainable transport since it helps to reduce the demand for road infrastructure. This applies to freight movements since one of the closely correlated impacts of freight transport use is the pressure on existing land infrastructure. Relating to some of the issues aforementioned, the problem of land appropriation extends to the allocation of land for road traffic purposes, often perceived as causing shortages in land use for other purposes like housing, pedestrian walkway, historical preservation and recreation. In some urban contexts, local authorities and planners are using regulations to control freight movement as a measure of addressing the land use challenge (Lindholm, 2012, Behrends et al., 2008). The difficulty with land use and the freight transport sustainability debates relates to the rationale of fundamentals in terms of whether freight transport is a necessity, such that it justifies the dedication of existing or new infrastructure to freight movement. Land appropriation concerns go beyond the freight conundrum and represent a very big debate in society (Stanley, 2014). The compromise guide for land appropriation is to ensure land for transport use optimises transit, completes communities, provides jobs and diversity, encourages affordability and increases intermodality (Stanley, 2014).

Within Africa, freight land appropriation is an area of intense worry. For example, there are areas like Apapa, Ikorodu, Onne etc., that are known for extended congestion, hardship and high transport costs occasioned by freight trucks parked illegally or otherwise along main roads or at best without recourse to other road users’ safety. The literature captures this as a relic of colonial infrastructure systems that have failed to develop significantly due to policy lapses, poor coordination and competing interests from powerful stakeholders (Gwilliams, 2011). Storeygard, (2013) dictates that the road network of countries can change endogenously, with both extensive and intensive implications. In the majority of cases, expansion of existing road networks is cheaper to implement but local social practices can create problems for land appropriation management. In Rivers state area of Southern Nigeria, there is a close association between hawking, unlicensed (ad hoc) business activities and road constructions. In fact, major roads are considered prime location for citing informal market developments and this often leads to infrastructure expansion challenges for policy makers and construction firms.

For the purpose of this study, the literature on land appropriation is recognised as an active area of research inquiry on road freight externality. The position here is to afford recognition without undermining the need for infrastructure development.

#### 3.4.1.5 GHG Emissions

A greenhouse gas (GHG) emission is the most common topic within the literature on road freight transport. Considered a growing field of research interest, emissions from road transport are amplified by the extended impact on local, national and global scales (Li et al., 2013; McKinnon and Piecyk, 2009; Zanni and Bristow, 2009). GHG emissions create extensive consequences for the planet and can hamper the future ‘liveability’ of our planet. Accordingly, the Kyoto Protocol (1997) aimed to drive national and global efforts to contain emissions levels with transport identified as one of the emission intensive sectors for prioritisation (Li et al, 2013; Chapman, 2007; Steenhof et al., 2006). The use of the term GHG emissions is used to capture an array of environmentally related issues such as air pollution (M’raihi et al, 2015, McKinnon, 2007), chemical poisoning or contamination (World Health Organisation – International Agency for Research on Cancer, 2012), energy consumption (Sorell et al., 2009; Kamakate and Schipper, 2009).

CO2 emission is the most common form of GHG researched in the literature accounting for over 56% of the total emission related literature review, ahead of sulphur dioxide (SO2) Nitrous Oxide (NOx), and perfluorocarbons (PFCs). These other gases are reportedly converted to CO2 equivalency for analysis and these gases react with other chemical forms to deplete the ozone, reduce oxygen levels and gradually endanger parts of the earth (Ozen and Tuydes-Yaman, 2013).

Road freight transport plays a significant part in CO2 production in the UK, second only to the wider energy industry in total carbon emissions although the CO2 rates have been in decline over the last decade (McKinnon, 2009; McKinnon and Piecyk, 2009). One of the critical elements of GHG emissions as an externality is that of measurement, i.e. what is the most accurate and reliable method for capturing, recording, analysing and reporting on road freight emissions. Authors have addressed the important issue of GHG measurements and highlight the challenges of data decomposition and accuracy, with transport intensity, fuel consumption, speed and tonne per kilometre as common metrics. Perhaps a most useful read in this area is the work of McKinnon and Piecyk (2009) who take time to discuss the complexities of road freight type, geographical limitations, data reliability and analytical methods in terms of the measurement metrics approaches. However, there seems to be a common acceptance of the decomposition approach as a suitable method of measurement and analysis for freight GHG emissions (M’raihi et al., 2015; Demir et al., 2014; Cristea et al., 2013; Li et al., 2013; Motraghi and Marinov, 2012; Wang et al., 2012; Sorell et al., 2009; Steenhof et al., 2006; Leonardi and Baumgartner, 2004). A very useful analysis of road freight transportation research techniques is provided by Demir et al., (2014) who review over 58 papers on emissions from road freight, identifying over 15 microscopic and macroscopic techniques employed to investigate emissions in road freight transport. Although their review does not investigate the database composition of the papers, it focuses on fuel composition as a base measure of CO2 emission in road freight transport. Piecyk and McKinnon (2007) examine internalisation of externalities and estimate emissions costs of CO2 to be 15% (£1.05 billion) for HGV activity within the UK in 2007. Like accidents, current policy practices in many States extend to internalisation costs for firms who reflect emission charges on business rates or pricing. This measure as a policy response to address the challenge of emissions is discussed further in section 3.5 below.

Gwilliams (2011) reports that although emission problems are becoming increasingly acute in sub-Saharan Africa only Accra and Dakar cities have initiated formal policies for quantifying the impact. The gravity of the situation in Africa is further heightened by database inadequacies, poor maintenance of freight vehicles and inadequate inspection standards. The combined effect of these may lead to serious local and global impacts in future, if action is not initiated to address these issues. In their study on South Africa, Havenga et al., (2011) employ tonne per km to calculate and cost carbon emissions in rail and road freight and find major cost saving opportunities for firms through collaborative stakeholder approach to addressing emissions, primarily from reduced intensity.

Similarly, M’raihi et al., (2015) affirm the coupling between economic growth and emissions in Tunisia, identifying intensity as an influencing factor rather than the main driver of emissions that causes air pollution. Interestingly none of the reviewed studies on Africa focuses on the problem of energy consumption as an environmental issue unlike authors from other regions who tend to emphasize the atmospheric and usage consequences of emissions (Galos et al., 2015; Hao et al., 2015; Liimatainen et al., 2012; Eom et al., 2012; McKinnon and Piecyk, 2009). The literature on road freight emissions in Africa is still very thin, underlining the need for more qualitative and quantitative research to focus on a region that is susceptible to atmospheric, health and social harm from emissions.

There are many other externalities that may be connected to or associated with road freight activity but the most direct and common issues have been discussed in this section. An examination of the issues highlights the complexities involved in road freight sustainability yet there is also a clear indication of the spread of externalities across economic, environmental and social dimensions of sustainability. The categorisation of these issues may reveal overlaps between different sustainability dimensions; for example, although emissions are often discussed from an environmental perspective, the impacts extend to social and economic consequences. These shared consequences between society and business highlight the collective responsibility to act by multiple stakeholders in both competitive and collaborative ways in order to arrest the challenges poised. The literature shows that emissions, accidents and congestions are the most commonly addressed externalities, with increasing attention being paid to noise pollution and land use appropriation. The outcomes for Africa are even more worrying since the data suggests that although externalities are heightened within the continent, so far, very few studies have investigated these problems in the literature. Furthermore, it would appear that sub-Saharan Africa is failing to pay appropriate attention to the effects of emissions, accidents and noise pollution from road freight transport. The problem is amplified for countries with comparably high economic growth indices, where established correlations between road freight demand and economic growth suggests that these externalities will increase rather than abate.

The next section will present a solutions perspective to the problem of road freight externalities, identifying the main approaches being used to mitigate externalities from road freight transport. This is executed by way of a systematic review that explores scientific literature on sustainable road freight. Among its key contributions to this thesis is the identification of information and communication technology (ICT) as the optimal approach for managing road freight externalities within a 3BL framework in emerging countries.

## 3.5 Systematic Review of the Literature

The use of systematic reviews in the social science research has been the focus of many debates (see Evans and Benefield, 2001; Hammersley, 2001). Initial criticism centred on its ontological impositions from the positivist tradition of the medical sciences where it holds its origin; for example, Hammersley (2001) cites the ‘superiority’ postures of value and explicitness as evidence of its disconnect and non-suitability for social science research (pg. 544-545). Similarly, the propensity to ignore value judgement of the researcher in conducting systematic reviews has been questioned by Morell (2008) who adopts a narrative theory perspective to discount the polemic justifications for systematic reviews. The use of systematic reviews in the social sciences and specifically management research has significantly developed in the last decade with increasing acceptance across ontological and epistemological divides (Denyer and Tranfield, 2009). As knowledge converges and develops towards complementary methods in the social sciences, the pillars of reliability and apposition are critical for evaluating research credibility, especially in complex studies (Bryman and Bell, 2011).

Tranfield et al., (2003) had suggested that systematic reviews help to map relevant intellectual territories that identify how and where the literature base can benefit from further studies. This is particularly important for doctoral studies where the commitment of resources to examining a research problem is second only to the *potential* contribution of the eventual research process output within a limited period.

Perhaps a more important consideration is the pragmatism of Morell (2008) who advocates for reviews to account for cultural and political arenas that are imbued into management research. The importance of these issues is addressed by Denyer and Tranfield (2009) who advocate the use of systematic reviews to enable transparency, inclusivity, heuristics and explanation in the review process. These qualities are not only useful for systematic reviews but also provide very good bases for strengthening the outcome of qualitative studies. Additionally, the recent literature identifies the prospects of employing systematic reviews to advance conceptual and theoretical frameworks through the analysis and/or synthesis of themes and arguments of existing studies (Thome et al., 2016). These propositions were significantly influential in the decision to conduct a systematic review as part of this thesis. Having explored the extant literature using the narrative review method to examine the problem phenomena, the use of a systematic review was considered advantageous for exploring intervening mechanisms (themes) and theory perspectives that have been applied in studies on road freight transport sustainability. In summary, the conduct of a systematic review for this research was driven by:

1. The need to identify the range of studies on the subject of interest; road freight transport
2. The identification of the major themes covered by studies on road freight transport sustainability from operational and policy perspectives
3. The identification of pertinent gaps within the extant literature through a synthesis of the existing studies and,
4. The need to support the research case using verifiable scientific tools to develop a theory based conceptual framework for empirical research.

To meet these objectives, the following preliminary research questions were set as precursors to the empirical work.

1. What are the main intervention mechanism themes of peer-reviewed studies on road freight transport sustainability?
2. Which theme(s) is potentially the intervention mechanism for addressing the problem of sustainability within the Nigerian downstream industry?

By addressing these research questions, the systematic review results helped, not only to promote rigour in the research process through inclusivity and justification of mechanisms but it also allowed for an objective discourse of the pertinent generative mechanisms that accommodated contextual nuances that are critical to qualitative studies (Denyer and Tranfield, 2009; Morell, 2008).

### 3.5.1 Conducting the systematic review

Denyer and Tranfield (2009) emphasise the importance of a review protocol prior to the conduct of the systematic review of the literature, citing its usefulness for mitigating bias in the review process. To this end, a protocol[[1]](#footnote-1) was developed and shared with the supervisory team. The protocol was not a rigid guide and remained subject to modification as the actual review process progressed. The focus was on identifying contemporary and updated intervention mechanisms and the cut off timeline for the review was set between the years 2001-2016. The decision reached with the understanding of the need to provide search scope that was updated yet dating back to a reasonable cut-off time; in this case, the turn of the new century.

Following the development of research questions for the review, the search criteria for the studies to be included in the review were set. Both simple operator and Boolean search methods were combined to execute the search using different phrases and terms to implement the search. In the first instance, the review process was designed to follow a funnelling procedure, moving from broad references to smaller and restrictive ones as the review progressed. Using the established protocol, 5 principal databases: Science Direct®, Emerald®, Taylor and Francis®, Sage® and Google Scholar®, were identified as suitable for conducting the literature search. This was driven by a combination of previous literature experience and scope. The decision to use multiple databases rather than a single source like the Web of Science was based on preliminary tests of content and suitability was also informed by the greater opportunity for exhaustive latitude in terms of the range of accessible literature. Search strings and keys works like “sustainable freight”, “green freight”, “road freight”, “sustainable freight\*”, “green freight\*” and “road freight\*” were used to search these databases with a combined yield of 2265 hits. After a review of titles and over 300 abstracts from the first searches, a number of adjustments were made to the protocol; a) the use of the “road freight” string was removed due to its extremely large sample. Some of the search hits did not address any sustainability issue and often included other transport and freight literature. This led to a decline of about 1158 papers that were excluded from the search. b) The use of Google scholar to implement the search was reviewed and a decision was made to exclude the database because of reasons bothering on duplicity and credibility. Most the documents (see Figure 3.3 below) that were returned from the other databases were also included in the Google Scholar yields but importantly, the quality of some of the abstracts in the sample did not command the confidence of being peer reviewed and thus suitable for academic research. Furthermore, a comparison of the total hits for the ‘sustainable freight string’ highlighted concerns about validity where the return from the Google Scholar base was almost 8 times the yield of all the other databases combined (965:115), with the majority of the initial 200 materials that were scanned indicating duplication within and across Google scholar and other databases as well as the inclusion of generic materials outside the scope of the review. The database structure for the systematic review was revised in the light of the initial results and a decision was made to exclude Google Scholar based on considerations regarding the quality and duplication of the results. Whilst it is plausible to suggest that the exclusion of the database may raise questions about the scope of the evidence incorporated in the review, it is also equally important that review meets the key objectives and that proactive action is taken to mitigate quality issues within the evidence cited. This is particularly important when the “peer review” criterion is taken into consideration.

Figure 3:3 - Chart illustrating database ‘hits’ for “Sustainable Freight” search string

Following the revision, the search terms were replicated across the remaining databases with additional strings used to streamline the searches. As captured by the protocol, the focus was on peer-reviewed material in published sources and a total of 323 hits were returned across 8 re-organized searches. After screening for duplicates and relevance, a total of 135 materials were accepted for further review. A 3rd stage review of the abstracts, introduction and publication type saw an elimination of a further 51 materials which were books, conference proceedings or did not materially discuss the related subject of sustainability in road freight transport. A total of 84 journal articles from 38 different journal publications were finally accepted for inclusion in the review report (See figure 3.4 and Appendix 7 overleaf).

Figure 3:4 - Journal titles of 84 selected review articles for the period 2001-2016

Content wise, theoretical gaps still exist in the literature. Of the 84 papers reviewed, only 11 papers explicitly or implicitly identified with any management theory (Table 3.1). This supports the need for more theoretical content in logistics research and also underscores some of the challenges with theory appropriation in the field (Defee et al., 2010; Mentzer et al., 2004).

Table 3.1 - Review articles with theory content

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Authors | Year | Paper | Theory |
| 1 | Haughton, Michael A | 2002 | Route re-optimization's impact on delivery efficiency | Probability |
| 2 | Kim, Nam Seok;  Van Wee, Bert | 2009 | Assessment of CO2 emissions for truck-only and rail-based intermodal freight systems in Europe | Location theory |
| 3 | Wiegmans, Bart W | 2010 | The Freight Transport Portfolio: A New Way to Analyse Intermodal Freight Transport as Compared to Single-Mode Road Transport | Equity Portfolio Management |
| 4 | Rich, J.; Kveiborg, O.; Hansen, C. O. | 2011 | On structural inelasticity of modal substitution in freight transport | Aggregation |
| 5 | Furst, Elmar; Oberhofer, Peter | 2012 | Greening road freight transport: Evidence from an empirical project in Austria | Environmental Management/ Theory of Planned Behaviour |
| 6 | Sternberg, Henrik; Germann, Tim; Klaas-Wissing, Thorsten | 2013 | Who controls the fleet? Initial insights into road freight transport planning and control from an industrial network perspective | Network |
| 7 | Ballantyne, Erica F; Lindholm, Maria; Whiteing, Anthony | 2013 | A comparative study of urban freight transport planning: Addressing stakeholder needs | Stakeholder |
| 8 | Palsson, Henrik; Kovács, Gyöngyi | 2014 | Reducing transport emissions: A reaction to stakeholder pressure or a strategy to increase competitive advantage | RBV/ Stakeholder |
| 9 | Lammgård, Catrin; Andersson, Dan | 2014 | Environmental considerations and trade-offs in purchasing of transportation services | Process |
| 10 | Newnam, Sharon; Goode, Natassia | 2015 | Do not blame the driver: A systems analysis of the causes of road freight crashes | Systems theory |
| 11 | Li, Le; Negenborn, Rudy R.; De Schutter, Bart | 2015 | Intermodal freight transport planning – A receding horizon control approach | Systems and Control theory |

Using Denyer and Tranfield’s (2009) context, intervention, mechanisms and outcome (CIMO) framework, each article was carefully evaluated to identify the areas of analysis and synthesis in line with the review objectives.

In terms of addressing the first objective, the topics covered ranged from performance design to policy issues, highlighting a significantly diverse literature spectrum. For example, Islam et al., (2013) examined the literature to develop an online benchmarking tool for freight transport operations in the EU, Switzerland and Norway, whilst authors like Wang et al., (2015) and Sternberg et al., (2014) investigated the use of ICT in road freight operations, highlighting CO2 emissions reductions and efficiency gains from the use of ICT in road freight operations. Other topical issues bordering on land use and freight (Alho and Silva 2014; Piecyk and McKinnon, 2007), policy frameworks (Mraihi et al., 2014; Zanni and Bristow, 2013; McKinnon, 2007), urban freight planning (Ballantyne et al., 2013) and HGV breaking design modelling (Midgley et al., 2013) are also covered by the range of articles reviewed.

NVivo11TM was used to query and review the selected papers, exploring each paper in detail, exploring the principal focus of each paper, key arguments, theoretical underpinnings, methodological design and key findings. Using the coding function on NVivo11, themes were created and aggregated with some papers discussing multiple themes. Since the focus of the review was on identifying topical intervening mechanisms for addressing road freight challenges, the topics were aggregated into themes that captured the predominant discussion of the papers based on frequency of use, authors’ depiction as keyword in context, analogies and sorting. The process was also influenced by previous knowledge about the literature on road freight transport and this contributed significantly to enabling the designation of expert themes. In total, six main themes were identified in the process; Policy, operations (design and process), modality (uni-modality, co-modality and inter-modality), decoupling, ICT and ‘others’ (land use, reporting and measurement systems). Figure 3.5 shows the distribution of the articles according to the intervening mechanisms that they addressed. Operations, policy and modality commanded higher scholastic attention within the literature reviewed, accounting for 61 of the 84 papers reviewed. Incidentally, ICT was commonly identified as a viable mechanism for road freight interventions.

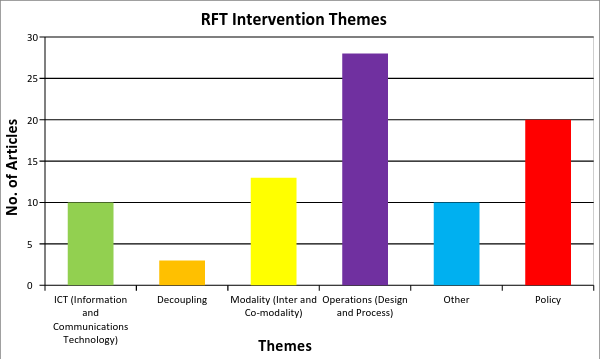


Figure 3:5 - Road Freight Transport Sustainability Intervention Mechanisms

### 3.5.2 Review Themes

#### 3.5.2.1 Operations:

The operations theme reflects interventions that focused on optimising road freight performance through a combination of equipment and process design initiatives. Articles in this category explored intervention mechanisms across strategic, tactical and operational levels. Topics relating to fleet management strategies (Velaquez-Martinez et al., 2016; Allen et al., 2012; Ubogu et al., 2011; McKinnon and Yongli, 2006), routing (Ehmke et al., 2016; Fleischmann et al., 2004; Haughton, 2002), vehicular design and load utility (Midgley and Cebon, 2015; Olsson and Woxenius, 2014), fuel trade-offs (Li et al., 2015; Gilpin et al., 2014; Demir et al., 2011) and costs (Lammgard and Anderson, 2014), fell within this purview. Some of the main contributions in this area include the importance of assigning the ‘right’ vehicle to the ‘right’ areas, advocating fleet management models that account for environmental distinctions as a means for addressing CO2 emissions (Velaquez-Martinez et al., 2016). Midgley and Cebon (2015) identified significant Elv gains of 9-17% from modelling hydraulic controls with some caution[[2]](#footnote-2), highlighting the potential gains of HGV design as a critical intervention mechanism in sustainability research.

In terms of fuel choices and implications, the work of Li et al., (2015) provides useful insight into the potentials of alternative fuels in road freight operations. They adopt model consumption and demand using a cost-optimisation approach to forecast consumption with their results indicating that diesel and gasoline will still be responsible for over 70% of freight fuel by 2030 citing resource constraints as principal limitations to bigger decline on gasoline and diesel dependence. Routing efficiencies are of key concern to scholars with recommendations for a ‘mixed fleet’ strategy being adduced by Ehmke et al., (2016), who also note the potential for significant emission reductions over load management strategies on routes. Importantly, one very common feature of many operations papers is the deference to information technology or systems as vital mechanisms for enabling sustainability gains from an independent perspective or from a combined operations viewpoint (Sternberg et al., 2013; Perez-Martinez, 2009; Fleischmann et al., 2004).

#### 3.5.2.2 Policy

Policy refers to government or state driven mechanisms for addressing problems associated with road freight. Policy interventions spanned local, regional and national levels, although the strict national level or supranational strategies are discussed under the ‘decoupling’ theme. Most policy mechanisms focused on the urban freight problem (Stelling, 2014; Ballantyne et al., 2013; Liimatainen et al., 2012; Dablanc, 2007). Four papers adopted review methods to provide an overview of the approaches within the topical area and went further to make policy recommendations for addressing road freight transport externalities (Stelling, 2014; Massara, 2012; Winebrake et al., 2012; McKinnon, 2009). Some key topical issues under this theme explored robustness of policy mechanisms, for example Ballantyne et al., (2013) advocated a ‘new stakeholder’ approach for addressing the urban freight problem at local council levels. This was to cater for conflicting objectives that often pitch businesses and councils at opposing divides. Steenhof et al., (2006) explore the Canadian environment and identify links between trade and emissions, citing intermodal rail-truck options as a viable strategy for addressing the increase in emissions from road freight. In similar vein, Winebrake et al.’s (2012) review of the USA environment highlighted some crucial policy misconstructions regarding the efficiencies from road freight management citing that “*policymakers should be careful when using existing freight elasticity estimates in the literature to estimate the HGV rebound effect. Aside from general caveats associated with these indirect measures of the rebound effect, freight elasticity estimates are inﬂuenced by a number of ‘‘factors of variability’’ categorized by the speciﬁc nature of the shipping activity, the macroeconomic inﬂuences involved, and the measurement tools used to assess elasticities. Ignoring these factors may lead to biased results when applying the literature to a speciﬁc policy analysis case*”- pg. 258.

The rebound effect refers to increased resource consumption because of relative price deflation arising from efficiencies in performance, i.e. the difference between projected and actual energy savings as a direct correlate of increased efficiencies (Winebrake et al., 2012; Matos and Silva, 2011). The arguments put forward suggests that policy makers need to go beyond energy efficiency savings to actual energy demand reduction. In particular, it is advocated that measurement adjustments be made to policy projections for energy efficiencies in the road freight sector, where rebound effects can be as high as 24%. Similarly, a modelling of data across 11 international energy agency (IEA) countries indicated that inter-modal policy interventions towards rail may be more effective than decoupling strategies in terms of emission reductions (Eom et al., 2012).

In terms of geographical references, M’raihi et al., (2014) model the emissions problem in Tunisia, where they proffer a combination of incentivising arrangements and fiscal strategies as critical to the addressing the carbon emission problems of road freight transport. Also noteworthy is their refutation of the proposals for decoupling as an effective strategy for addressing the environmental issues in road freight transport and they adduce the difficult economic and political realities as deterrents to decoupling, where the government would have to constrict manufacturing growth investments to drive service-oriented growth in a flailing economy. This point is particularly instructive in the evaluation of strategic options for different countries, with developing economies less likely to effectively pursue policy strategies that de-emphasize their main revenue and growth processes.

#### 3.5.2.3 Modality

Modality addresses the means and mode of transport that is used to move freight from one point to another. Under this theme, the main topics focus on the complementation of road freight transport with other modes of transport rather than the elimination of road freight transport. The attraction of road freight transport in terms of flexibility, speed and time is acknowledged by authors in this field, (Khorheh et al., 2016; Winebrake et al., 2012; Kim and Van Wee, 2009; Arnold et al., 2004; Bontekoning and Priemus, 2004) and this means that in certain instances, last mile deliveries are inherently dependent on road modes for the foreseeable future. Despite these limitations to eliminating road freight, the literature presents modal combinations as means for addressing congestion, emissions and cost concerns that are associated with road freight transport, which is considered unimodal, i.e. using a single mode (Li et al., 2015; Macharis et al., 2011; Kim and Van Wee, 2004). The terms ‘co-modality’ and ‘multimodality’ ‘intermodality’ are used within the reviewed literature. Co-modality is defined as the efficient use of different modes (Harris et al., 2015), whilst Ruiz-Garcia et al., (2007) differentiate between inter and multimodality, where the latter is using different transport means and the former refers to the integration of administrative and transfer processes for freight shipment across different transport modes. Bontekoning et al., (2004) and Macharis et al., (2011) focus on the issue of packaging, addressing intermodality as a combination of at least two transport modes in a single transport chain, without a change of the container for the goods (see also Arnold et al., 2004).

Intermodality seems to be the focus of the literature with all the 13 papers reviewed addressing different approaches. Intermodality is considered a vital intervention mechanism for curbing emissions and reducing congestion problems. For example, one study links intermodal practices to 30% reductions in emissions and congestion within urban spaces (Sanchez-Rodrigues et al., 2015). Rail and water modes are considered as best alternatives for complementing road freight transport although Bontekoning and Priemus, (2004) acknowledge that for many shipments from international sources, water freight transport is an inalienable part of the chain being the main means of export and import shipment between countries. Intermodality leverages on data that suggests rail and water as emitting the least amount of GHG emissions, with surplus cargo capacities (Sanchez-Rodriguez et al., 2015). By nature, intermodality is a complex operation model and current limitations to its use include infrastructure (Arnold et al., 2016; M’raihi et al., 2014; Stelling, 2014; Caris et al., 2008), decision making and decision support systems (Macharis et al., 2011; Caris et al., 2008); interoperability and planning (Marchet et al., 2012; Ruiz-Garcia et al., 2007; Button et al., 2001) and transition (Bontekoning, 2004). From the literature, a common requirement for the use of intermodality as an intervention mechanism is preceded by the availability of adequate modal infrastructure like functional railways, shipping terminals and useable roads. The absence of these base requirements will restrict the capacity to deploy interventions along this method, although the value of studies in this area extends to education and policy influence.

#### 3.5.2.4 Decoupling:

Akin to policy initiatives, decoupling focuses on national and supranational levels only, e.g. UK, European Union (Liimatainen et al., 2013). It does not apply to local or municipal levels and thus commands a different theme category in the review. Decoupling as an intervening mechanism focuses on transport policymaking that is aimed at separating economic growth from freight as a measure of curbing externalities from freight (McKinnon, 2007). Traditionally, decoupling measures have focused on freight intensity (tonne-km), using modal split, vehicle utilisation and emissions as metric units for GDP comparisons (Alises et al., 2014; McKinnon, 2007, Steenhof et al., 2006). The literature concedes that there are still data concerns about the decoupling measures, where the metric units vary across different agencies and countries (McKinnon, 2007). Furthermore, questions have been raised about whether decoupling simply implies ‘passing off’ emissions to other environments, with further concerns about the practicality in terms of developing countries developing capacities to deemphasise non-service oriented industries in terms of addressing freight transport intensity (Alises et al., 2014; M’raihi et al., 2014).

Perhaps a major contribution of studies in this area is the development of decomposition analysis frameworks for exploring the relationship between GDP growth and road freight transport, where sectoral analysis enables the identification of specific industries that tend to account for higher road freight emissions (Alises et al., 2014; Liimatainen et al., 2013; McKinnon, 2007). Decoupling strategies can focus on promoting other intervention mechanisms in these specific industries in order to reduce their emission quotas without necessarily discounting growth within these industries. Studies in this area have been encouraged to take factors like economic structure, haulage distances and modal splits into consideration when examining and recommending decoupling strategies; this is in addition to traditional GDP aggregate used for measurements.

#### 3.5.2.5 Information and Communications Technology

ICT accounted for 12% (10) of the articles reviewed although a few other themed articles identified to ICT as a key mechanism for addressing road freight transport sustainability. ICT encompasses both information systems (IS) and information technology (IT) and refers to a combination of hard and soft connectivity tools that allow for communication exchanges, remote monitoring and performance controls within freight transport operations (Wang et al., 2015, Sternberg et al., 2014; Marchet et al., 2009). This broad-based approach to defining ICT in road freight transport is common within the literature although authors like Marchet et al., (2009) have developed classification taxonomies for evaluating ICT from a firm perspective. They draw on Giannopoulos’s (2004) framework to classify transport ICT into the following categories:

1. **Transport management applications** – “*Decision support tools for planning, optimising and executing transport strategies and functions*” (pg.788).
2. **Supply chain execution applications** – “*Product flow automation and management tools for processing, tracking and integrating transport functions within the supply chain*” (pg. 789).
3. **Field force automation applications** – “*Remote capability technologies that aid operational integration and efficiencies*” (pg. 789)
4. **Fleet and freight management applications** – “*Reporting tools for monitoring, controlling and measuring freight operations*” (pg. 790).

This useful taxonomy highlights some of the complex yet overlapping nature of ICT use in road freight operations, yet Giannopoulos’ framework fails to explicitly distinguish between software and hardware components (Wang et al., 2015). The classification proposed by Wang et al., (2015) gives a more comprehensive overview of ICT use (please see Table 3.2 overleaf).

Table 3.2 - Categorisation of ICT mechanisms in transport and logistics operations

|  |  |  |
| --- | --- | --- |
| Levels for the use of ICT | Key references | Key applications and systems |
| 1 | **Baumgartner et al. (2008)** | **On-vehicle or in-cab ICT systems managing individual vehicles or loads** |
| Stefansson and Lumsden (2008) | Digital tachograph, which works by digitally storing data on the driver and vehicle in its memory and on a credit card-sized plastic card known as the “driver smart card”. It is an electronic system for recording driving and rest times for drivers and co-drivers of trucks that are driven under EC driver’ hours rules |
| Baumgartner et al. (2008), Zeimpekis and Giaglis (2006) | Telematics, which is made up of three components: an on-board computer, a satellite receiver/GPS, and a communications device. These are commonly combined into a single piece of equipment within the vehicle, supported by office-based equipment and software. It is the wireless backbone of vehicle and load management and helps to monitor the movement of vehicles, fuel consumption and communicate with drivers |
| 2 | **Botta-Genoulaz et al., (2005), Gupta and Kohli (2006)** | **Enterprise systems deployed to manage specific business processes** |
| Baumgartner et al. (2008), Helo and Szekely (2005), Marchet et al. (2009) | Best of breed functional systems: a typical application is transportation management system (TMS) which usually offers the following functions  Planning and scheduling: daily route and resource planning and strategic what-if scenarios analysis for long term business plan.  Execution and monitoring: driver communication, real time or retrospective tracking, management reporting and financial settlement |
| Gupta and Kohli (2006), Yusuf et al. (2004) | Fully integrated systems: a typical application is Enterprise Resource Planning (ERP) system which integrates all of a company’s major business processes (from order processing to product distribution) within a single family of software modules |
| 3 | **Brown et al. (2009)** | **Inter-organisational systems managing mainly the dyadic business activities between two organisations.** |
| Evangelista et al. (2010) | Customer relationship management (CRM) system, allowing business to carry out b2b sales on the web, provide support for marketing and customer service |
| Evangelista et al. (2010), Buxmann et al. (2004) | Supplier relationship management (SRM) or Supply chain management (SCM) system, designed to deal with the procurement of product or service components and the movement and distribution of components and finished products throughout the supply chain |
| 4 | **Auramo et al. (2002)** | **Network systems usually involve multiple participants and communications are simultaneously conducted between two or more companies** |
| Davies et al. (2007), Wang et al. (2009), Wang et al. (2011) | Open electronic logistics marketplaces, mainly for sport trading of transport services between shippers and carriers. Such systems can be used for identifying backhaul opportunities.  Closed electronic logistics marketplaces, for long-term logistics provision and execution. Such systems integrate shippers (consignors), carriers and customers (consignees) and can be used for horizontal transport collaboration between shippers or between carriers. |

(Adapted from Wang et al., 2015, pg. 8-9)

In this sense, ICT is conceptualised as consisting of 3 main components, the software components (applications, operating systems etc.; (Gupta and Kohli, 2006; Giannopoulos, 2004), the hardware components (Wang et al., 2015; Marchet et al., 2011, Perego et al., 2009) and the information component (Harris et al., 2015; Evangelista et al., 2010). Addressing issues around connectivity, network relationship management, enterprise processes and asset management, the above table captures the multifaceted perspectives on ICT use within the generic literature. It details the scope of ICT as it applies to road freight transportation and perhaps it is plausible to suggest that at each level, there are aggregated software, hardware and information components that make up ICT infrastructure within road freight operations. This position is supported by Sternberg et al., (2014), Ando and Taniguchi (2006) and Cranic et al., (2009); all of who adopt different perspectives of ICT to investigate fleet management, scheduling and intelligence in road freight operations using ICT. As such, ICT is commonly presented as positively impacting road freight transport through operational efficiencies in road freight (Wang et al., 2015; Davies et al., 2007; Button et al., 2001), providing social benefits (Button et al., 2001), cost reduction and effectiveness (Marchet et al., 2012), driver working time and administration time reductions by 8.3% and 15.4% respectively (Sternberg et al., 2014).

Despite the plethora of contributions highlighted, only Sternberg et al., (2014) explicitly addresses the social aspects of ICT’s potential in terms of road freight transport sustainability. In their study, Wang et al., (2015) as well as Walker and Manson (2014) investigate sustainability but focus on the environmental/ emissions aspect of sustainability, whilst all of Marchet et al., (2012; 09), Davies et al., (2007), Ando and Taniguchi (2006), Button et al., (2002) focus on efficiencies from what is often the economic perspective. In addition, whereas Sternberg et al.’s (2014) article provides some useful insights into social issues in road freight transport, its scope is quite narrow and effectively omits critical social externalities like congestion, accidents, community welfare and noise from its purview.

Predictably, the topical matter of adoption drivers and barriers has been previously investigated within the reviewed literature. Marchet et al., (2009) explore this issue, using the Italian freight transport system as a case study and they highlight size, integration and interoperability, awareness and industry structure as the most influential factors for of ICT adoption within road freight operations. Additionally, Harris et al., (2015) suggest that strategic orientations and management capabilities influence adoption of ICT in road freight operations; e.g., commercial success data, return on investment ratios and duration can all create negative dispositions towards ICT adoption by freight managers. Walker and Manson (2014) establish that topologies are critical in the decision to adopt ICT and go on to caution that ICT by itself is not sufficient to address all the externalities of road freight transport. The emergent position is that there are several factors that drive adoption for a wide variation of objectives.

#### 3.5.2.6 Others

This generic category encompasses studies that focus on, performance and reporting tools (Kinnear et al., 2015; Islam et al., 2011), land use and infrastructure (Alho and Silva 2014; Carballo-Penela et al., 2012) and reviews (Khorheh et al., 2015; Demir et al., 2014; Marchet et al., 2014). The concept of ‘green corridors’ as a Pan-European intervention mechanism for road freight transport sustainability is presented in the work of Carbello-Panela et al., (2012). Green corridors require dedicated infrastructure for freight mobility, each of which would incorporate inland waterways, road, rail and shipping. As a strategy, ‘green corridors’ encompasses policy, ICT, intermodal and operations mechanisms that create dedicated freight infrastructure frameworks that are ecologically and environmentally friendly. Additionally, Alho and Silva (2014) consider the infrastructure challenge from a more social perspective, exploring the illegal use of parking bays and the implications for policy makers and managers, where illegal demand is fuelling unauthorised parking with disruptive outcomes.

In terms of reviews, whilst Demir et al., (2014) focus on emissions and operational framework tools for addressing the challenege of emissions from road freight transport, Khorheh et al., (2015) introduce an interesting perspective to the externality problem, highlighting direct and indirect impacts of road freight transport emissions. They also highlight taxation and incentive planning as some socio-economic intervention mechanisms, in addition to information technology and cultural instrumentations.

### 3.5.3 Review Discussion

In addressing the second research question, the background information in Section 2.2–2.3, highlighted infrastructural, behavioural and regulatory challenges within the industry. As critical factors, it is important to consider how these challenges may affect the various intervention mechanisms prior discussed, in terms of accessibility and effectiveness to address the research problem within the Nigerian downstream industry.

From the literature synthesis, infrastructure is critical to intermodal strategies and M’raihi et al., (2014), Ubogu et al., (2011) capture the limitations of intermodal arguments in terms of interventions within Africa; the infrastructure does not exist and the governments over the years have demonstrated little commitment to improving the transport infrastructure in most of Africa (Ubogu, 2011; Gwilliams, 2011). Companies do not have the responsibility for developing infrastructure and do not have the policy influence to drive such. This makes intermodal strategies less probable from a firm perspective.

The limitation to policy and decoupling strategies are similar to those of intermodality. Like many other developing nations, Nigeria still struggles with policy development and appropriation, particularly in terms of sustainable development (Ehinomen and Adeleke, 2012, Ubogu et al., 2011). Concerning decoupling strategies, the downstream industry is part of the larger petroleum industry that is the highest earning sector for the country and is significant to national GDP growth (Iwayemi et al., 2009). Decoupling strategies will require a move from petroleum to other industries that are less freight intensive, requiring a paradigmatic shift in economic policies and practice, a proposition that may be extremely difficult to implement in a country that has struggled to diversify its economy base for over two decades. Policy initiatives can offer some limited yield, in terms of standards and regulating behaviour, however the problems of compliance and corruption cast realistic doubts over the effectiveness of policy instruments as a tool. For example, Ubogu et al., (2011) cite instances where police officers at checkpoints ‘charge’ bribes from truck drivers, sometimes using firearms as coercive weapons. This raising some worrying concerns about the prospects of policy as an intervening mechanism in a context where enforcement is still chaotic.

Similarly, the operations literature does provide very useful mechanisms for improving sustainability performance in the industry. Operations mechanisms like traditional routing, fleet type, vehicle design and fuel type offer useful mechanisms for addressing emissions, congestion and performance problems (Velaquez-Martinez et al., 2016; Midgley and Cebon, 2015; Gilpin et al., 2014; Sanchez-Rodrigues et al., 2013; Sternberg, 2013; Crainic et al., 2004), yet it is difficult for firms to implement these strategies simultaneously. Furthermore, the review suggests that a lot of the operations strategies require ICT platforms for effectiveness (Sternberg, 2013; Ando and Taniguchi, 2006; Crainic et al., 2004). This dependency on ICT for effectiveness suggests a stronger parallel between operations and ICT, where mutual dependencies exist between both although it would seem that the reviewed operations literature identifies developments with ICT as more integral to road freight transport sustainability than traditional operations approach (Sternberg et al., 2014; Perez-Martinez, 2009; Bontekoning and Priemus, 2004).

ICT offers a robust scope for exploring the multifaceted challenges associated with road freight transport in terms of both existing technology and the range of problems addressed. Whilst requiring significant cost investment to implement (Marchet et al., 2009), ICT offers benefits in terms of performance control and monitoring. Control in the sense that management have the complete command over its deployment and usage within their operations, with extended benefit for society. As stated earlier, this study adopts a firm focus to influence road freight transport sustainability, exploring wholesome mechanisms for interventions; the emphasis being on management action rather than government actions as catalysts for addressing the problem. In spite of the costs, it provides a more attractive option for addressing performance and sustainability issues within road freight operations.

In conclusion, there are several intervening mechanisms that have been employed to address road freight externalities. Following the evaluation of the various mechanisms themes identified in the systematic review of the literature, it would seem that operations and ICT mechanisms are the most feasible options for intervention within the Nigerian petroleum downstream sector. From the review, 3 papers by M’raihi et al., (2014, 15) and Ubogu et al., (2011) were the only ones focused within the African context despite its increasing economic growth. Both papers question the feasibility of policy, decoupling and intermodal strategies as intervening mechanisms, inferring operations and ICT as a more effective options for addressing the externality problems within the context. Following a comparative evaluation, it would seem that from a firm perspective, ICT is a more effective option of strategic management intervention within the downstream industry context (Wang et al., 2015, Sternberg et al., 2014). In spite of this potential, the literature revealed no empirical work on ICT intervention within contexts like the Nigerian context, considering the enormous importance of sustainability in the context. This stresses the need to explore the use of ICT in freight operations in the Nigerian downstream industry. Specifically, the scope of interest extends to ICT use and influencing factors (theoretical rationale) and practical implications for practitioner and academic learning in similar contexts.

## 3.6 Theoretical Rationale/ Framework

One of the emergent results from the systematic review of the literature relates to the dearth of theory that links intervening mechanisms with managerial actions; 11 of 84 papers (see Table 3.1 above). Theoretical validations are vital to the development and adoption of logistics research and scientific learning (Olavarrieta and Ellinger, 1997). Beyond the discovery of learning, systemic structure is required to explain and predict phenomena, yet the evidence from the literature review suggests that use of theory in the examination of sustainability in road freight transport operations is thin, with none of the ICT papers having any theory input (Defee et al., 2010; Mentzer et al., 2004; Olavarrieta and Ellinger, 1997).

A precursor to theory is an understanding of the links between firm activities, decision-making and environmental inputs (Sutcliffe, 1994). For example, in attempting to address the question of why firms incorporate environmental considerations in their transport operations, Palsson and Kovacs (2014) establish two decision motives pressure and competitive advantage as precursors for theorising. Nilsson (2006) also advances complexity within logistics as a basis for theorising on novelty and sensitivity logistics management; however, to the best of my knowledge the issue of sustainability in road freight transport has not been largely advanced in any ICT and road freight research, particularly from a triple bottom line perspective of sustainability. In this study, the business context environment and perceptions of managers are considered fundamental precursors for theorising on ICT and sustainability within road freight transport operations. As such, they are considered critical to understanding the parameters of the second research question which seeks to ascertain managerial perceptions of sustainability and correlations between ICT uses in their operations.

Fundamentally, studies have explored links between managerial perceptions and strategic decision-making (Beyer et al., 1997; Sutcliffe, 1994; Anderson and Paine, 1975). For example, Anderson and Paine (1975) linked managerial perceptions to strategic decisions, establishing links between business environments and managerial actions. The influence of perceptual factors on intervention mechanisms as part of strategic actions cannot be overstated since these perceptions drive action and preference (Sutcliffe, 1994). Business environment uncertainties present the biggest perceptual challenges for managers, where uncertainty is “the difference between the amount of information required to perform a task and the amount of information already possessed by the organisation” (Galbraith, 1973, p.5). Beyer et al., (1997) and Walsh (1988) both address the concept of selective perception in relation to managerial and established links between functional experience and perceptions with albeit diverse significance.

In the more recent literature, Massis et al., (2013) suggest links between ‘executive cognition’ and strategic management processes, further establishing links between emotional dispositions and executive perceptions in family businesses. Furthermore, we know that there are subtle variations between managerial perceptions in different industries, for example, Ozleblebici et al.’s (2015) study identified differences in military and business managerial perceptions, business managers influenced by risk and experience, whilst military managers being more perceptive to careful, collaborative and long term issues. The downstream industry provides a unique context for further exploring these perceptions, relative to managerial decision-making and actions.

Correspondingly, the position of this study is that managerial perceptions of their environment influence their interpretation and strategy on specific issues like sustainability. This reiterates the paradigmatic underpinning of this research, where shared community realities are critical to sense making (see chapter 4). Essentially, the working proposition is that managerial perceptions about sustainability influence the strategic actions (intervention mechanisms) that they exploit to address challenges in their operations. This proposition provides a useful guide for exploring the use (or potential) of ICT within the road freight transport operations in the petroleum downstream industry but equally for providing theoretical explanation for the strategic action within the industry. The theoretical significance of this research stems from the need to understand (a) why managers ‘may’ conceive of sustainability in particular ways, and (b) link their conceptions to the use of resources for sustainability performance.

Theories are essential to understanding and explaining these prospects and theories offer useful insight for future research work and the extant literature has looked at sustainability from both a generic SCM perspective (ElTayeb et al., 2010; Wolf and Seuring, 2010; Carter and Rogers, 2008) and a freight transport perspective (Palsson and Kovacs, 2014). As previously established, the literature evidences sustainability as a positive outcome for firms, distinguishing between internal and external reasons for sustainability choices in road freight transport. For example, Eng-Larsson and Kohn (2012) investigate transport intermodality from a shipper’s perspective working with the assumption that modal shifts will improve transport quality and positively affect performance. Identifying internal and external influences, their study confirmed their positive effect assumptions regarding the cost efficiencies of intermodal freight transport, highlighting varying degrees of strategic importance.

As previously referenced, Palsson and Kovacs (2014) distinguish between internal and external drivers as a basis for investigating ‘why’ firms elect to reduce emissions within their transport operations. Their study confirmed previous assumptions that firms conceive of environmental sustainability as positively affecting performance, with both external and internal factors driving this combining RBV and stakeholder perspectives, yet it is one of a few papers that explore or validate management theories in road freight transport studies (see also Newnam and Goode, 2015; Lammgard and Anderson, 2014; Ballantyne et al., 2013; Sternberg et al., 2013). It is noteworthy that besides Palsson and Kovacs et al., (2013), Sternberg et al., (2013) and Ballantyne et al., (2013) none of the other papers explicitly discuss and justify theory appropriation in road freight transport research.

As earlier stated, Defee et al., (2010) reviewed management theories in supply chain and logistics literature, conducting a content analysis of 683 papers. They identified 181 unique theory propositions in the 364 articles reviewed with the resource based view and transaction cost economics theories as accounting for 19% of the theoretical incidents within the articles reviewed. Although they did not specifically discuss theory appropriation in road freight transport, the concentration of theories underline gaps in the area of theory application in the road freight literature. To the best of my knowledge, the literature does not reveal any specific instance of theoretical appropriation to research on ICT use in road freight transport. It is important that as practice embraces ICT as a potent mechanism for addressing road freight transport sustainability, academic contributions show leadership by advancing useful theory explanations that promote understanding, replication and strategy improvements. This next section of this chapter, discusses some relevant theoretical lenses that are considered as suitable theory frameworks for this study.

### 3.6.1 Theories

#### 3.6.1.1 Resource Based View: (RBV)

From a viewpoint of firms as competitive entities, RBV prospects firm strategies as geared towards resource accumulation and coordination for sustainable competitive advantage (Liu et al., 2010; Grant, 1991; Prahalad and Hamel, 1990; Wernerfelt, 1984). Focusing on resources and capabilities for competing, RBV assumes firms to be bundles of heterogeneous resources around which specific value-creating strategies can be developed to gain sustainable competitive advantages (Eisenhardt and Martin, 2000; Barney, 1991, Penrose, 1959). Barney’s (1991) criteria is perhaps the most common construct of the resource based view where value, rare, inimitable and non-substitutability (VRIN) characteristics are advanced as qualifying criteria for firm resources that can aid competitive advantage. In this sense, ‘value’ denotes the extent to which the combinations of a firm’s resources match the external environment and enables it to exploit the business environment advantageously (Hoskisson et al., 1999; Barney, 1991). ‘Rare’ captures the perceived inaccessibility of a firm’s resources in the market it competes in, ‘inimitability’ represents the difficulty of imitation without higher cost disadvantage and ‘substitutability’ addresses the availability of similar resources which are available to other firms.

Grant (1991) adopts a slightly more integrative framework with emphasis on the capabilities that emerge from the routine coordination of the company’s resources and processes as critical to competitive advantage. Essentially, he theorises about what firms *have and can do* better than their rivals in order to compete advantageously within their different markets; in this case the explicit combination of resources all assets, capabilities, organizational processes, attributes and information all controlled by a firm in specific ways that distinguishes the firm and its output within the market (Carter and Rogers, 2008; Barney et al., 2011). As clearly illustrated by Hoskisson et al., (1999), RBV represents internally focused theories on strategic management that seeks to explain how management establish competitive advantage irrespective of their environment (Grant, 1991).

Pertinent considerations apply to the evaluation of road freight operations from a resource based view perspective. First, the determination of tangible and intangible resources is vital, secondly establishing what routines give rise to capabilities and the competency configurations that enable firms gain competitive advantage is important and all these require empirical input and perspectives for validation. In terms of the application to road freight studies, Liu et al.’s (2010) study focused on logistics from a generic perspective rather than road freight transportation specifically. The only explicit example of RBV’s application in road freight transport sustainability literature is the paper by Palsson and Kovacs (2014). In their study, they found that although policy and image factors *may* drive companies to reduce their transport emissions, it is only the internalisation of environmental factors for competitive advantage that drives firms beyond what they term as the ‘normal threshold’. The internalisation process requires the conceptualisation of sustainability as possessing the VRIN criteria or the very least, providing a platform where the routines can be combined to give competitive advantage. For example, studies have associated brand image with competitive advantage (Leonardi et al., 2014) and it is thus plausible to suggest that sustainability performance can improve a company’s brand image perceptions and give them a competitive advantage (Palsson and Kovacs, 2014; Hoskisson et al., 1999; Grant, 1991; Wernerfelt, 1984).

In relation to this study, the adoption of ICT as an intervention mechanism is of prime importance in helping to establish whether adopting firms see ICT as a resource that can be configured to gain competitive advantage or as a threshold resource that offers little opportunities for distinctive competencies that can give competitive advantage to the firms (Liu et al., 2010; Wernerfelt, 1984). In this regard, RBV offers the most suitable theoretical lens for evaluating ICT use for sustainability from a competitive and short term point of view, yet the application of RBV to evaluate strategy in contexts where local market conditions like price regulations and low variation exert significant influence on market competitiveness (such that it limits the extent to which firms are able to distinguish their products and compete advantageously within a given market) is largely unverified (Eisenhardt and Martin, 2000).

In highly regulated market environments, where market prices are fixed, quota allocations are fixed and products are largely undifferentiated, the challenge of configuring heterogeneous resources for non-competitive purposes is contrary to the fundamentals of RBV and this may limit the adequacy of applying a competitive theory to explain potentially non-competitive actions by firms for the longer term sustainability reasons. This is critical because sustainability goes beyond just competitiveness to account for resource efficiencies across social, economic and environmental dimensions (Yusuf et al., 2013). Previous inquiries into road freight using RBV lens have not explored contexts with relatively high levels of price regulation and product quota allocations (Palsson and Kovac, 2014; Liu et al., 2010). Factors like regulation, stakeholder pressure and customer requirements have all been recognised as motivating sustainability performance in road freight transport, however RBV may not provide theoretical insights on how these non-competitive factors influence the use of resources like ICT for sustainability performance and this perhaps explains the alternative theory views adopted in some of the other literature on road freight transport sustainability (Ballantyne et al., 2013; Sternberg et al, 2013; Eng-Larsson and Kohn, 2012; Carter and Jennings, 2002).

This limitation to RBV has been linked to its internal focus and it has been argued that the recognition of this as a theoretical weakness led to the development of the dynamic capability theories that attempt to adapt RBV theories to accommodate external market conditions (Eisenhardt and Martin, 2000; Teece et al., 1997). In this regard, Teece et al., (1997) introduce the reconfiguration construct to RBV’s competency framework, arguing for sustained competitive advantage through the integration, development and periodic reconfiguration of competencies. Inadvertently, dynamic capabilities establish the limitations of RBV as a single comprehensive theoretical lens in the sense that although it attempts to make a case for functional, adaptive characterisation of competencies, dynamic capability adaptations of RBV has not been applied in highly-controlled contexts like the Nigerian petroleum downstream industry where regulatory effects pose significant limitations on competitiveness. It is therefore expedient to acknowledge this theoretical weakness of RBV and mitigate this by integrating a non-competitive base theory into the theoretical framework. This will increase the robustness of the theoretical framework for the research phenomena of interest.

#### 3.6.1.2 Corporate Social Responsibility (CSR)

Corporate social responsibility theories have been rarely applied in road freight transport studies. CSR refers to a firm’s consideration of, and responsiveness to environmental issues beyond its economic, technical and regulatory requirements (Davis, 1973; McGuire, 1963). Dithering along the evasive measures of ethics, Carroll (1979) introduces the concept of discretionary expectation at the apex of social sustainability and in so doing extends the concept beyond the responsiveness model of Ackerman and Bauer (1976). Woods and Logsdon, (2002) also describe CSR as the role of a firm to solve social issues and this perhaps provides a much more recent construct of CSR in the new century. Increasingly, firm strategy evaluation from CSR perspectives focus on both its responsibilities as well as its discretionary action to be involved in and contribute to the solving of social issues despite Friedman’s objections to its subversion of business objectives (Friedman, 1962). Freeman and Liedtka (1991) also raised some limitations to CSR emphasizing its lack of dynamism and inclination to limit the relationship between the firm and society as one of social responsibility, however incremental developments have addressed this question and validated CSR as an effective explanatory framework for firm actions (Seechi, 2007).

More recently, Garriga and Mele (2004) reviewed and classified CSR theories into four categories: instrumental, ethical, integrative and political, albeit with latent classifications. According to them, the instrumental theorists follow the traditional philosophy of the firm as an instrument of wealth creation and no more, the ethical theorists are at the other extreme with normative stakeholder principles, universal rights empowerment and sustainable development at the core of their constructs. The political and integrative theorists are compromises that fall between the extremes, acknowledging social responsibilities that confer management with social power (political theories). They also acknowledge the requirement of firms to respond to social issues within their environment; integrative theories on corporate social performance (Carroll, 1979), public responsibility (Preston and Post, 1981) and stakeholder management (Emshoff and Freeman, 1984). Seechi (2007) condenses this framework into a more contemporary framework with three categories; the utilitarian, managerial and relational.

The utilitarian category re-echoes the instrumental classification, emphasizing the role of the firm as an economic tool with no explicit social responsibility besides those that are functional or cost imposing on the firm (Coase, 1988; Friedman, 1970). The managerial theorists represent the compromise school where although avoiding the extremes of Friedman’s postulation, they justify organisational philanthropy only if they will yield some economic benefit, tangible or intangible (Drucker, 1973). Effectively, this set of integrators began to drive studies around competitive advantage as a basis for CSR practices and this perhaps may be credited with the biggest acceptance of CSR theories within strategic management research at the time (Vogel, 2006). Finally, the relational school of thought conceptualises CSR as emanating from the ‘citizenship’ construct with implicative benefits and responsibilities. It ties the corporations to the social contract theory where the operative cost-benefit scenario applies to the relationships with taxation being just one of many costs to the firm (Seechi, 2007; Woods and Logsdon, 2002).

Consistent with the objectives of this study and the purpose of theory, CSR theories have been applied in road freight related studies and it would seem that ‘perceptive responsibilities’ may be driving firm practices to tackle externalities from road freight transportation (Porter and Kramer, 2002; Waddock and Smith, 2000; Drucker, 1973; Friedman, 1962; Clark 1957). For example, Ciliberti et al., (2008) adopted CSR theory to develop their logistics social responsibility (LSR) framework, extending the work of Carter and Jennings (2002) where they establish social pro-activeness and responsibility as common strategic objectives of management action in road freight operations, however, these studies have been critiqued for focusing (like most papers) on the environmental aspects of sustainability without any input on the social aspects (Nikolaou et al., 2013). Consequently, whereas CSR may be adequate for explaining the social performance of firms, it may not be suitable for explaining the use of ICT for competitive performance.

Notably, Ballantyne et al., (2013) adopted the stakeholder theory to investigate urban freight and local council management, establishing that wider stakeholder participation is required to address urban freight problems. Despite their findings, application of the stakeholder theory as opposed to CSR will require knowledge of key stakeholders and their functions within the industry, indicating its suitability for post-exploratory studies rather than initial inquiries. Additionally, Ballantyne et al.’s work focuses on policy mechanisms in relatively free market conditions as opposed to firm operations in market environs that are relatively chaotic like the Nigerian downstream industry context (Hitt et al., 2007). As such, the relational corporate social responsibility (RCSR) theory, which focuses on the non-competitive responsibilities of firm performance and accommodates managerial actions as society specific, provides a better lens for exploring road freight transport sustainability within the context. RCSR propositions define corporate citizenship from the perspective of implied social contracts, and thus complements the competitive focus of RBV. In this regard, the integration of the two theories provides a better theory framework for explaining the use of ICT for road freight transport sustainability, accommodating both competitive and non-competitive rationales for its use.

In combining theories, this research follows well-established practices within the literature. For example, Palsson and Kovacs’ (2014) unidimensional study successfully combined RBV and stakeholder theories to explore environmental sustainability in road freight transport, validating the combination of both theories. Importantly, Mayer and Sparrowe’s (2013) paper in the Academy of Management Journal, accentuates the relevance of theory combination to management research, establishing four scenarios that justify the integration of theories in research:

1. Single Phenomenon - two theoretical perspectives: common dependant variable that allows for investigation from two vantage points. E.g. RBV and TCE on subcontracting.
2. One Phenomenon – Seemingly two disparate theoretical perspectives – Identifying and employing seemingly conflicting theories to complement understanding of phenomena.
3. Adaptation – Applying one theory to the domain of another theory – E.g. Social theory and TCE to explore social relationships outside the firm or government behaviour.
4. Combining multiple streams of research sharing similar explanatory accounts – More than two different theory explanations are fused in dialogical contexts to integrate their explanations under one broad umbrella.

The preceding discussion on RBV and RSCR theories demonstrates that combination of both theoretical perspectives in one conceptual framework will provide a better understanding of ICT use for road freight transport sustainability in the Nigerian petroleum downstream sector. RBV emphasises the use of resources like ICT for competitive advantage from an internally focused strategy whilst the RCSR can explain the resource allocation for non-competitive purposes from an external perspective. The nuances of the local context and the literature suggests that a robust theoretical framework that accommodates resource uses for both competitive and non-competitive elements of sustainability is a better approach for this study (Palsson and Kovacs, 2014; Yusuf et al., 2013; Mayer and Sparrowe, 2013). The fusion of both theories into an integrated framework will provide a better scope for making sense of the data and offer more stimulating insights on this phenomenon. Importantly, the research objectives and instrumentation (see Chapter 4) support this position as a viable option. In the next section, the conceptual framework and key assumptions for the framework are discussed.

## 3.7 Conceptual Framework

A common premise of this study is the assumption that firms seek to be economically, socially and environmentally sustainable (Wang et al., 2015; Palsson and Kovacs, 2014; Sternberg et al., 2014; ElTayeb et al., 2010). The acceptance of this premise as plausible within road freight transport operations is moderated by the adoption of ICT as an intervening mechanism for aiding the sustainability performance across this multi-dimensional concept of sustainability. The conceptual framework for this research is influenced by the literature reviewed, the industry data and the theoretical framework that has been discussed (Figure 3.6).

**Sustainable Road Freight Transport**

**Social**

* Reduced Congestion
* Zero Accidents
* Training and welfare
* Improved road safety
* Improved Communication

RBV

**Economic**

* Good Profits
* Increase Shareholder Wealth
* Improved Efficiencies
* Improved visibility and
* Loss prevention and Inventory mgmt.

**Environmental**

* Low GHG emissions
* No Spillages
* Low Land Requirement
* Low Energy Consumption

RCSR

**Hardware**

* Computers
* Mobiles
* On-Board Computers
* Network accessories

**Software**

* Applications
* Programs
* Operating Systems

**ICT**

**Information**

Data

Database

Downstream Managerial Perceptions



Figure : - Conceptual Framework

Figure 3.6 above captures the conceptual structure for this research and provides the scope for the analysis, in line with the stated objectives and research questions.

As a primary factor, it is believed that managerial perceptions drive decision making and strategies (Anderson and Paine, 1975). These perceptions and decision making influence the adoption, range and use of information and communications technology use in their firms. For example, the decision to invest in on-board computers in addition to desktops and office software is driven by managerial decisions that are derived from perceptions about their requirements to operate or compete in their business environments. In terms of ICT use for sustainability, it is assumed that manner of adoption and latitude of use are best explained by the combination of the resource based view and relational corporate social responsibility theories, where the weak connectors reflect the literature on the relationship between theory and specific dimensions of sustainability.

Accordingly, the figure (3.6) above represents the assumptions of this study relative to the downstream industry’s freight transport operations. Although the literature discusses ICT use for sustainable transport (e.g. Wang et al., 2015) it fails to discuss this from a 3BL perspective and as such, the discourse here is based on the premise that specific managerial perceptions will influence managements’ use of ICT mechanisms for 3BL performance. The conceptual framework thus provides a good overview for the research purpose and objectives by way of a diagrammatic representation of the assumptions that guide the research process.

## 3.8 Summary

This chapter has reviewed and discussed the extant literature on road freight, progressing from a generic review to a more streamlined focus on road freight externalities in the discourse on sustainable road freight. The first part of the review served to highlight the nature of freight transport and the problems that have been associated with road freight transport; congestion, efficiency, GHG emissions and energy consumption, land use, noise and pollution. The second part incorporated a systematic review technique to synthesize the literature and help identify intervention mechanism themes for road freight transport sustainability. *ICT*, *Operations, Modality, Policy* and *Decoupling* emerged as the main intervention themes and ICT was identified as the most contextually appropriate theme for exploring sustainability within the Nigerian downstream sector, linking the adhoc research questions to the main research objectives in section 2.6.

Following the identification of ICT’s suitability, the chapter also discussed the theoretical framework for this study, drawing on Mayer and Sparrowe’s (2013) integration guide to justify the combination of two theories to underpin the research. The chapter concludes with a review of some key assumptions and a concise summary of the interrelationships between the assumptions, themes and constructs that emerged from the review and background sections, advancing a conceptual framework. The conceptual framework outlined in simple terms, the abstraction that guides this research inquiry, representing the interrelationship between assumptions and the prospective outcomes prior to empirical data collection.

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4. Methodology (Design)

## 4.1 Introduction

In the preceding chapter, the literature review explored the extant literature, employing an exploratory review to highlight key externalities as well as a systematic review to highlight knowledge gaps within the literature. Further discussions on the nature of theoretical perspectives as underpinnings for this study were also pointed out, setting the stage for the implementation of the study from a design perspective. Chapter 4 extends the discussion in chapter 3 by addressing the research design and planning stages of the study. It articulates the author’s philosophical position and ties into the specifics on the research objectives, data requirements, data planning and execution strategy Figure 4.1 gives a diagrammatic overview.

Ontology - RELATIVISM

**MODERATE CONSTRUCTIONISM**

**Research Philosophy**

Epistemology

SUBJECTIVISM

Methodology

DIALECTISM

**Research Paradigm**

Qualitative strategies

Abduction rationale

Multiple Case Studies

Semi-structured interviews

Non-participant observations

Archival documents

Thematic and Content Analysis

**Research Data collection design and Instrumentation**

**Research Analysis**

**Research Methods**

**Research Rationale**

Figure 4:1 - Research Paradigm and Methods Structure

## 4.2 Practice and Perspectives: Research paradigms

Knowledge does not exist in isolation, with research practice being closely embedded within specific frameworks that guide assumptions, evaluation and postulations (Jankowicz, 2005). This creates a fine line between research design and implementation strategies, effectively delineating the positions of reality that any author seeks to establish. The undergirdings of these notions are conventionally captured within paradigmatic representation of beliefs that are considered most informed and sophisticated for justifying methods (Guba and Lincoln, 1994). A common form of classifying research design and implementation methods is the qualitative and quantitative dichotomy that delineates between the quasi-perceptions, assumptions and foci of the various components of the research enquiry. However, these approaches are underpinned by paradigms that guide the perceptions of knowledge and the types of inquiries that follow through and I will discuss these before going through to the discussion of the research approach adopted for this research.

Approaches are embedded within existential assumptions that establish the nature of knowing and this is captured succinctly by Morgan and Smircich (1980) who argue “*that the case for research methods… cannot be considered or presented in the abstract, because the choice and adequacy of a method embodies a variety of assumptions regarding the nature of knowledge and the methods through which knowledge can be obtained, as well as a set of root assumptions about the nature of the phenomena to be investigated*” (pg. 491). De-prioritising the arguments on symmetries between approaches or otherwise, the implications of these guiding assumptions dictate the basis for the review and evaluation of scientific research (Lincoln and Guba, 2002).

These fundamental assumptions concerning the process of knowing, the nature of reality and perceptions of realities, constitute what is often referred to as paradigms, i.e. the constructs of ontological, epistemological and methodological beliefs in the development of knowledge for scientific consumption (Naslund, 2002; Denzin and Lincoln, 1994). In relation to this thesis, these elements provide vital philosophical insights into the perception and conceptualisation of the phenomena of interest, the research design strategy and the corresponding knowledge contributions. It is imperative that an explicit discourse of these matters be conducted to aid understanding and evaluation of the knowledge claims made in this study.

## 4.3 Research Philosophy

The research philosophy is a fundamental and critical aspect of the research process. It depicts the nature of epistemological, ontological and methodological configurations that support the research inquiry. Persuasion and utility are critical components of the research philosophy with suitability rather than proof being the effective means of evaluation (Guba and Lincoln, 1994). This rejection of ‘absolutes’ is assumed and occupies a central role in the philosophy of this study, where the design and analysis focuses on extra-territorial and contextual data to make meaning of sustainability in road freight transport (Naslund, 2002).

### 4.3.1 Research Ontology

Ontologies are critical to understanding as they depict the researcher’s idea of reality, i.e. the notion of *what reality is* (Jarvensivu and Tornroos, 2010; Guba and Lincoln, 1994). These conceptualisations may be individualistic or grouped; however, the literature aggregates them along a fixed or constructive continuum, with the expectation that each investigator or investigation is ontologically suited along the imaginary horizontal line that depicts the two extreme ontological values (Figure 4.2).

Fixed

Relative

**REALITY CONTINUUM**

Figure : - Diagram illustrating the concept of ontological continuum

In contemporary scientific management literature, some beliefs have been distinguished as representing major ontological ideologies based on extensive arguments, persuasiveness and utility in research. These are positivism, post-positivism, critical realism and constructionism/ relativism/ idealism (Guba and Lincoln, 1994; Lincoln and Guba, 2000; Easton, 2002). Positivism determines reality as only based on empirical truth, driven by immutable natural laws and mechanisms, i.e. to say, *how things are* (Guba and Lincoln, 1994; Hart, 1958). The purpose of positivist research is to converge, confirm and add to the ‘body of knowledge’ that increases as human inquiry extends beyond existing boundaries. In this regard, the most critical feature of positivism is the notion of generalisability, where the pursuance of reductionist tendencies necessitates ‘controlling’ of localised variables to promote the replicability of knowledge or truth as it were.

Despite early philosophical treatise on the legal and moral substance of positivism (with some philosophers questioning the nature of ‘what is’ and ‘what ought to be’, for example see Hart, 1958), it is still the predominant ontological position of many management research; particularly logistics research in the Americas (Naslund, 2002). In many ways, the development and proof of hypothesis about experienced phenomena has led to criticisms of fashioned reality propositions by critics of positivism. They argue that this position of singular reality fails to accommodate the idiosyncratic nuances of different contexts, cultures and most importantly, knowledge limitations (Slevitch, 2011; Guba and Lincoln, 1994). In the case of freight transport research, the appropriation of single reality constructs to different contexts in controlled examinations may lead to a distortion of reality; where climatic, cultural, infrastructural and utility characteristics that influence perceptions are ignored as part of the control mechanism in positivist research. Furthermore, as argued by Guba and Lincoln (1994) monolithic reality affiliations create credibility problems for the social science researcher in terms of relevance and theoretical propriety.

At the other extreme of the ontological debate is *relativism* or constructionism (Jarvensivu and Tornroos; 2010; Easton, 2002) *idealism* (Slevitch, 2011; Guba and Lincoln; 1994; Smith 1983), or *interpretivism* (Blumberg et al., 2005). Its proponents conceive of reality as illustrated by immediate individual or community knowledge only (Slevitch, 2011). The notions of reality are determined by the experience, narratives and interpretation of each individual or specific community (Jarvensivu and Tornroos, 2010). In this instance, the occasioning of multiple, apprehensible social realities is accommodated and reality is a non-constant outcome of social construction (Lincoln and Guba, 2000; Guba and Lincoln, 1994).

Generally, Bryman and Bell (2011) contend that constructionism is the main ontological position of qualitative research strategies (See also Davies et al., (2007), Thomas and Linstead, (2002) for examples of application in freight related studies). Nevertheless, critics have cited concerns about replicability, validity and appropriation as some disabling flaws of the relativist position (See Bryman and Bell, 2015 & Guba and Lincoln, 1994). For example, if reality is completely transient, then a logical implication is that knowledge about phenomenon becomes “inoperable” over time or in different constructions by differing individuals. By logic, if we consider the purpose of management research as intended to allow the aggregation of knowledge that promotes organizational performance across boundaries, then a purely constructionist approach is at variance with this objective. This is so because its transient underpinnings prevent shared reality notions and undermine any notion of objectivity. It is therefore unsurprising to note that post-positivism and other critical or moderate paradigms hold different positions; arguing for augmented realism or moderated relativism that recognises imperfections of our ability *to know an objective reality or interpreted reality* but rather to accept reality as stemming from communal acceptance and critical evaluation respectively (See Jarvensivu and Tornroos 2010; Lincoln and Guba, 2000).

In this case, reality is conceived of as a shared construction that is subject to empirical verification; for example, the literature documents differences in definitions, meanings and scope of sustainability, with each definition having strong affiliation and adoption amongst different academic and practitioner communities (Marshall and Toffel, 2006). Shared experiences or constructions not only help to reinforce acceptance of realities but they also act as gatekeeping mechanisms for excluding incredulous machinations as reality constructs. In essence, the notion of *‘what is’* becomes relative to the community that experiences and accepts “*the*” phenomenon; this being subject to specific, purposeful empirical enquiry and critical evaluation of the arguments made in its favour. This thesis is premised on the logic of moderate constructionism and this is expounded on in the succeeding sections of this chapter.

### 4.3.2 Research Epistemology:

The concept of epistemology relates to the idea of how we come to know, i.e. what counts as factual knowledge about specific realities (Hugh, 1990). The term is said to have come from the Greek lexicon where the word ‘episteme’, is the term for knowledge (Krauss, 2005). In this sense, the main postulates have bothered on the *subjectivity* versus *objectivity* discourse with the objectivists considered as aligned to positivism (absolutists) and the subjectivists to relativism (Kuhn et al., 2000).

Hughes (1990) asserts that epistemological standpoints provide lenses through which specific investigators make sense of their perceptions on reality and further asserts that these lenses must be in logical consonance with reality assumptions to allow for knowledge claims. The objective position of knowledge being accessible *facts* that are correct in their representation of reality without expressly accounting for other environmental factors (that may influence the knowing process) is inconsistent with the premise of this study. For instance, the literature reviews exemplify varied extensions of road freight transport practices, policies, goals and operationalisation moderated by geographical, technological and socio-cultural factors. All these factors exert significant influence on the *familiarities* of the communities that experience road freight transport realities. To this end, it is reasonable to argue that the preferred epistemological view is one where the aggregation of comparable judgements based on prevailing arguments is best for augmenting our understanding or creating knowledge realities (Kuhn et al., 2000).

Subjectivism accommodates these nuances and meanings within the specifics of a research context, providing opportunities for explanations beyond the ‘*received view*’ (Blumberg et al., 2005; Easton, 2002; Guba and Lincoln 1994). In this regard, the intentions of this study require the incorporation of local environmental factors to establish meanings of sustainability, as well as contextual applications for addressing sustainability challenges in road freight transport. The idea of knowledge realities will be subject to credibility and trustworthiness, i.e. based on shared community narrative(s) about the use of information and communications technology for sustainability performance. This suggests the need for the aggregation of multiple views on the same subject matter in order to develop credible knowledge about the phenomena and this requirement is reflected in the discussion on methods and instrumentation.

According to Krauss (2005), epistemologies are closely aligned with ontologies and methodologies in the choice of paradigms; where ontology involves the philosophy of reality, epistemology addresses how we derive that reality and methodology identifies the particular practices used to attain knowledge of reality. This is consistent with the convictions of reality as well as its application to this research and I discuss my position on methodology next.

### 4.3.3 Research Methodology

Methodologies may be sometimes confused with methods due to common usage yet methodologies extend beyond the boundaries of tools employed for the conducting the study (Slevitch, 2011). Methodology refers to the principles that guide the research process, dictating the theoretical affiliations, variables, procedures for data collection, analysis and strategy for implementation (Slevitch, 2011; Guba and Lincoln, 1994).

From a critical perspective on methodologies, Jarvensivu and Tornroos, (2010) compared different paradigms and distinguished methods based on the emphasis on empirical observation. Their matrix presented the positivist or realist paradigm as being completely focused on empirical observation, whilst depicting relativists as less emphatic about direct observational data. This position is somewhat misleading as it demonstrates a bias regarding the idea of knowledge from an epistemological perspective. Notably, Lincoln et al., (2011) advance stronger arguments for methodology considerations addressing the aphoristic and pluralistic foundations of the different paradigms. At one extreme, positivism is considered as aligned to generic truth methodologies that test hypothetical notions of knowledge and at the other extreme relativism or constructionism embraces the superiority of dialectic exchanges to establish knowledge (Lincoln et al., 2011). This is perhaps a better way to depict methodology assumptions and in fairness to Jarvensivu and Tornroos (2010) their caveat on the ‘generic’ nature of these distinctions point to their recognition of limitations to their discourse on methodology affiliations.

Accordingly, this study adopts a dialectic methodology, which goes beyond dialogic evidence to accommodate the subtle materialities of the research context and community in the knowledge creation process (Cromby and Nightingale, 1999). This position is based on the acceptance of research contexts as dynamic settings that provide rich situational data that aid the construction of reality as accepted within that community. Thus, a dialectic methodology requires multiple data collection instrumentation and accords significance to all the discernible elements within the research context.

## 4.4 Research Design Paradigm (Aggregation)

The question of paradigms and assumptions is one that has attracted significant inquiry over centuries; however, the increasing consensus centres on the ability of the researcher to clearly outline the strongest arguments in favour of their selected paradigm (Guba and Lincoln, 1994). Paradigms like *social constructivism* (Burr, 2015; Cromby and Nightingale, 1999, Gergen, 1985), *moderate constructivism* (Jarvensivu and Tornroos, 2012) *critical theory* (Kincheloe and McLaren, 2002), *post-modernism* (Blaikie, 1996; Rosenau, 1992), *critical realism* (Easton, 2002; Parker, 1992; Anderson, 1986) and *post-positivism* (Clark, 2002; Kuhn, 1970) are some common paradigms in the social sciences. Nevertheless, the preceding arguments would suggest that a paradigmatic position within the critical realism and social constructivism segment of the paradigm continuum provides the most suitable undergirding for this study.

### 4.4.1 Social constructivism (SC)

SC posits that knowledge and knowing are outcomes of social processes with society holding primordial place in the acquisition of experience and language being *the most critical* and sometimes *only medium of knowing* (Cromby and Nightingale, 1999). Some stated flaws of social constructionism include its reliance on language as the only dialogical method of knowing, i.e. it fails to acknowledge the evidence from other instruments like observations which contribute to constructions of reality. The construct of language as the basis of reality has been previously queried and linked to the difficulties of attaining theoretical closure (Elder-Vass, 2012). Cromby and Nightingale (1999) possibly captured this criticism, stating that “w*e must strategically deploy the analytical and critical methods we have developed in an attempt to forge a coherent and grounded social constructionism that explains the world, in all its intransigence and mess, since only in this way might we contribute to its progressive transformation”* (pg.10). Considering that one of the objectives of this study is to advance theory, it is difficult to achieve this objective within a social constructionist paradigm.

### 4.4.2 Critical Realism (CR)

CR provides an alternative view and Easton’s (2002) work on *critical realism* highlights some flaws of both relativism and realism extremes, using the rationale of prediction logic and absolutes respectively to point out weaknesses in both paradigms. The thesis argued that purpose is foremost to methodology where consistencies of approach alongside predetermined objectives become the measure of paradigmatic propriety (Easton 2002). Making a case for critical realism, the literature acknowledges its provision for platforms that accepts the existence of *a* multifaceted reality that may be independent of our limited knowledge. It also accepts the fallibility of our knowing and that knowledge is accumulated from a combination of communal or social practices (Jarvensivu and Tornroos, 2010; Easton, 2002).

A number of key alignments are required for the creation of knowledge for the critical realist; the acceptance of an independent external reality, the fallibility of methodology, the role of social structures in the creation process and the subjection of knowledge to critique as part of the creation process. However, its position on an objective reality creates limitations on its suitability for this study where the probability of different manifestations of materiality and community experiences are expected.

### 4.4.3 Moderate Constructionism (MR)

MC is an emergent paradigm although questions may be raised about its difference from social constructionism or critical realism paradigms. A good case is presented for *moderate constructionism* (also called moderate social constructionism) where elements of materiality, social influence, critical uptake and dialogical methodology are advanced (Elder-Vass, 2012; Jarvensivu and Tornroos, 2010; Dubois and Gibbert, 2010). Elder-Vass (2012) distinguishes moderate constructionism from social or traditional constructionism based on the materiality element of reality that is unaccounted for by the language focus of social constructionism. Moderate constructionism adherents accommodate the materiality and discursive elements of ‘being’, which are critical to the development or proof of theory and this helps to overcome the scepticism flaws of constructionism vis-à-vis materiality (external realities), linguistic limitations and questions of multiple sources of data as realistic representation of phenomena (see also, Kasperova and Kitching, 2014; Cromby and Nightingale, 1999). Essentially, moderate constructionism like its social equivalent, aligns with the relativist propositions although it recognises the multiple sources of knowledge beyond the language infatuation of the social constructionists (Elder-Vass, 2012). Jarvensivu and Tornroos (2010) also advance that the distinction between *critical realism* and *moderate constructionism* is based on the disposition of moderate constructionism towards multiple knowledge bases as opposed to critical realism that upholds the notion of one universal truth.

The important question for any researcher in selecting a position rests on the ability to narrow the purpose or objective of the research around the application of the knowledge advanced. Following critical thought at the design stage and continuous reflexivity, the idea of community-generated knowledge as condensed but not universal was embraced (Kuhn et al., 2000). Whereas knowledge from communities may apply to communities of similar characteristics, across spatial boundaries, the prospects of an unequivocal understanding or acceptance of *any knowledge* by all individuals and communities is highly improbable and thus moderation of knowledge claim is an essential part of the knowing process. This restricted replicability assumption is perhaps a better position compared to the claims that moderate constructionism allows for analytical generalisability (Hermes and Mainela, 2014). This assumption aligns favourably with the moderate constructionist paradigm that accepts the creation of knowledge *in situ,* subject to critical evaluation (Jarvensivu and Tornroos, 2010). The position of moderate constructionism is one that incorporates the social blocs of constructionism but emphasises community exchanges, critical evaluation and materiality over indeterminate individual postulations. Importantly, the issue of limitations by way of replicability and acceptance within the body of knowledge is one that needs addressing (Bryman and Bell, 2015; Yin, 2003).

In terms of replicability, moderate constructionism embraces the critical evaluation of knowledge within community boundaries and although subjective interpretations may vary over time, the impact is mitigated by increasing the level of community representation within the study (Jarvensivu and Tornroos, 2010; Jones, 2002). Steps were designed into place to achieve this in the methods strategy for this study. Also with regards to the questions of acceptance, the positivist influence on logistics based studies is acknowledged yet the impact of relativism on logistics and freight studies is considered timely (see Ambrosini and Routhier 2004; Naslund, 2002). These underscore the significant contributions of moderate paradigms to knowledge regarding logistics and freight operations. Perhaps consistency of approach and logic will provide the most credible basis for future paradigmatic evaluation and the methods and instrumentation have been designed to support these criteria.

In view of the preceding, the better and more defensible paradigm is moderate constructionism and the implications for this research extend to the following cornerstones:

* The methods must enable learning from a shared community perspective
* The interpretations must reflect both dialectic interactions and materiality in order to create credible knowledge and,
* The contributions, particularly theory claims must follow critical evaluation and be consistent with the constraints of the empirics, to the extent that specific understanding emerges from the community rather than other pre-evaluated communities.

The quote below sums up the philosophical position of this thesis:

“*Whereas a million white swans can never establish, with complete confidence, the proposition that all swans are white, one black swan can completely falsify it*”– Guba and Lincoln (1994, pg. 107).

## 4.5 Research Methods

Beyond the paradigmatic and philosophical assumptions, considerations on methods often reflect the way to which researcher strategies are commonly classed (Bryman and Bell, 2015; Krauss, 2005; Saunders et al., 2009). Often along qualitative and quantitative demarcations, methods capture the approaches adopted to implement research within specific paradigms.

Qualitative researchers are deemed as having paradigmatic alignments with constructionists/ interpretivists, emphasizing contextual validation and limitations to knowledge (Bryman and Bell, 2015). The rejection of singular realities is commonly used to distinguish between qualitative and quantitative research but it also serves as a criticism for qualitative studies where studies which account for multiple realities or individual realities (at the extreme) are considered incapable of reflecting ‘the’ truth about phenomena (Krauss, 2005; Trochim, 2000).

Quantitative research on the other hand reject the notion of subjective realities with emphasis on measurability as the right tactic for capturing realities and thus attracting a default subscription to the realist or positivist paradigm (Blumberg et al., 2005; Guba and Lincoln, 1994). However, the legitimacy of the qualitative, quantitative dichotomy has not been without its critics; for example, Wood and Welch (2010) highlight that increasing awareness of useful contributions by both method categories has given rise to the mixed methods approach that combines both quantitative and qualitative methods. They go further to conclude that the principal basis of the dichotomy between both methods: statistical vs non-statistical and hypothetical deduction vs induction; do not create mutually exclusive methods since there are some inductive studies that employ statistical inferences and deductive studies that combine qualitative elements to establish hypothesis for testing (See also Bryman and Bell, 2015; 2011).

Table 4.1 reflects conventional distinctions between qualitative and quantitative studies, where theory and paradigmatic elements are used to class research. Although these distinctions provide useful guides, a better practice is perhaps to recognise the rationale for the distinction from an evaluative perspective, i.e. both approaches being considered as useful for the design, planning and evaluation of research and driving their value propositions as credible knowledge sources.

Table 4.1 - Fundamental differences between quantitative and qualitative research strategies

|  |  |  |
| --- | --- | --- |
|  | **Quantitative** | **Qualitative** |
| **Principal Orientation to the role of theory in relation to research** | Deductive; testing of theory | Inductive; generation of theory |
| **Epistemological Orientation** | Natural science model, in particular positivism | Interpretivism/ Subjectivism |
| **Ontological orientation** | Objectivism | Constructionism |

(Adapted from Bryman and Bell, 2015, pg. 38)

Furthermore, when one considers that the prior advanced criticisms of the inductive and deductive divide, there is a stronger case for deemphasizing research as either qualitative or quantitative (Jarvensivu and Tornroos; 2010 Dubois and Gadde, 2002). In terms of richness although qualitative studies have been credited as allowing richer knowledge (Eisenhardt and Graebner, 2007; Lee et al., 2007), the contribution of quantitative studies cannot be discounted either. However, where generalisability and statistical representation is not a principal objective of the research, a qualitative method is perhaps a better way to understand the research phenomena within the specific context (Saunders et al., 2009).

Consistent with the preceding paragraph, a qualitative approach was adopted for this study, influencing the design tactics, implementation and evaluation, with emphasis on contextual community-based sense making as principal realities for evaluation. Making this case, Naslund, (2002) highlights logistics studies as predominantly quantitative prior to the early 2000s yet he also identifies complexity and theory development needs as justifications for increased use of qualitative methods in logistics research. Qualitative methods enable richer contextual descriptions and better constraint management capabilities, which are crucial to promoting knowledge and theory development in complex environments (Saunders et al., 2009; Lee et al., 2007).

Qualitative data has been criticised as menial and susceptible to bias but perhaps the most critical element relates to the self-defeating paradigmatic irony whereby the positive argument for theory development is counteracted by the occasioning of multiple realities that limit theory appropriations. This weakness although critical can be mitigated by the paradigmatic design and moderate constructionism adequately addresses this concern, whereas the combination of dialogical, material and critical evaluation elements help to address the problem of multiple realities as a limitation of qualitative methodology (Elder-Vass, 2012; Jarvensivu and Tornroos, 2010). In this way, the research keeps with the tradition of contextual reality but constrains reality as being based on community dialogue, acceptance of materiality and the subjection of the research findings to critical evaluation for validation. Additionally, the elements of materiality and community dialogue allow for some level of objectivity and aggregation respectively, helping to mitigate bias. This can be achieved through triangulation whereby data is collected using multiple instrumentations (Bryman and Bell, 2011; Saunders et al., 2009).

As mentioned earlier, in terms of appropriateness of qualitative methods as timely and relevant for freight transport related studies, Ambrosini and Routhier (2004) reviewed methods and results of studies carried out across nine industrialised nations and they highlight urgency in the need for more qualitative research within countries like Australia and the USA. The principal reason for this call was tied to “regrets” about the “lack of knowledge on the functioning of logistics systems and on the different role of actors” (pg. 72). Conversely, in the UK, Germany, France and Canada where priority is given to understanding actors and systems, qualitative methods are considered significant enablers of this understanding with more timely and relevant outputs. (See also Velaquez-Martinez et al., 2016).

To reiterate, the principal reasons for adopting qualitative methods for this study include:

1. Paradigmatic affiliations of moderate constructionism (Elder-Vass, 2012; Jarvensivu and Tornroos, 2010).
2. Timeliness and relevance for freight transport and logistics research (Ambrosini and Routhier, 2004; Naslund, 2002).
3. Research design consistencies in terms of the suitability for meeting the research objectives. Consistency influences extend to data collection tools, methods of analysis, reporting formats and presentation (Saunders et al., 2009).
4. Better suitability for explorative studies where the focus in on capturing real experiences within the research context (Blumberg et al., 2005).

With the above in mind, the next section discusses the theory rationale for this study before deliberating the method tools adopted for this research.

## 4.6 Research Theory Rationale

Theory rationale refers to the role that prior knowledge plays in the development of the research arguments, i.e. the reasoning approach of the researcher relative to the phenomenon of interest (Bryman and Bell, 2015). Three main relationships are identified in the literature; deductive, inductive and abductive (Jarvensivu and Tornroos, 2010; Saunders et al., 2007; Dubois and Gadde, 2002).

Inductive research adopts an exploratory perspective to research, ignoring knowledge assumptions whilst seeking to discover what is, in order to theorise about observations; the idea being to let the empirical evidence guide the knowing and knowledge outcome (Bryman and Bell, 2015). With induction, there is the presupposition of the research platform as “a clean slate” awaiting impression through empirical experience (Locke, 1689), however the proponents go beyond the knowing and knowledge creation claims to assert ‘rule’ or ‘principle’ logics about inductive knowledge (Glaser and Strauss, 1967). Inherently, this creates a weakness in the reasoning disposition as questions may be raised about the alignment between subjective knowledge and rule making with stronger criticisms on the connexion logic of ‘empty slates’ and research (Bryman and Bell, 2015).

In practice, formulating and designing empirical research presupposes some prior knowledge about the phenomenon of interest and this vitiates the claims of emptiness by inductive proponents who engage in designed research. It may well be that induction can only be truly justified by accidental discovery and as such an unsuitable approach for academically structured research (it is impossible to design for what one has no knowledge about).

Conversely, deductive research assumes a ‘test’ approach to research, acknowledging the input of prior assumptions as basis for testable knowledge (Saunders et al., 2007). According to Bryman and Bell (2015), positivism is often the paradigmatic forte of the deductive researcher who links factuality to verifiability, thus restricting the role of theory to proof. By accommodating assumptions or hypothesis, deductive reasoning allows for (and perhaps has greatly influenced management research) design for testing. A keystone of the deduction philosophy is to treat design as a rigid structure for the birthing of knowledge, inadvertently creating drawbacks to the approach, since the ‘test’ structures are not infallible mediums in the knowing and knowledge creation process. For example, the inability of a researcher to prove prevalent domestic abuse using structural modelling techniques does not necessarily translate to an absence of domestic abuse amongst the population understudied. More so, the practice of stating research limitations is in itself an indictment of the fallibility of the deductive process and its output. Despite their weaknesses, induction and deduction still constitute the principally stated reasoning approaches to management research and the contributions of knowledge outcomes from these reasoning strands have contributed immensely to the development of management knowledge and practice. Rationally, the better judgement is to think of these relationships between research and theory as representing tendencies rather than incontrovertible distinctions.

The interaction between prior knowledge and theory has been and continues to be the subject of extensive philosophical debate beyond the boundaries of this study, yet one of the more recent propositions has been the ‘abduction’ principle that seems to be a pragmatic compromise between the inductive and deductive schools of thought (Jarvensivu and Tornroos, 2010; Dubois and Gaddes, 2002; Coffey and Atkinson, 1993). Abduction acknowledges the role of prior knowledge in the design, evaluation and evolution of knowledge but it also accommodates the novelty of the empirical process, accepting the ‘surprise’ factor as a crucial element of the research process. This view is consistent with the perspective of this research vis-à-vis the design of the research based on assumptions driven by the extant literature yet accommodating the possibility of unique theory outcomes from actual empirical data within the context. Bryman and Bell (2015) suggests that abductive reasoning has been embraced in the social sciences community where logical and pre-existing inferences are used to build knowledge theories.

This study makes no primordial claims to the freight transport phenomena by way of sustainability challenges discussed in the literature review but rather aims to explore the phenomena within theoretical advancement on how managers make meaning of and work for 3BL sustainability in their road freight operations as one of its key objectives. Abductive reasoning thus aligns well with this study’s objectives and allows for a logic-based approach for identifying the best theory propositions premised on dialogue, documented evidence and observations (Mantere and Ketokivi, 2013).

## 4.7 Research Design and Instruments

In this section, I discuss the empirical work design for the study, identifying the design strategies, tools used for accessing and collecting data, analytical tools and ethical considerations made prior to and during the course of empirical work.

### 4.7.1 Case Studies

Case studies are conversant tactics used to examine phenomena in management research (Eisenhardt and Graebner, 2007; Yin, 2003). Case studies provide many opportunities to study complex phenomena in their natural state. They involve the identification of the research phenomena, suitable contexts and/ or specific case(s) for interacting with or observing it (Bryman and Bell, 2015). Essentially, case studies are research designs “*that involves investigating one or a small number of social entities or situations about which data are collected using multiple sources of data and developing a holistic description through an iterative research process*” (Dubois and Gibbert, 2010; pg. 130).

The term ‘case’ can refer to a variation of referenced units, e.g. a house, an organisation, location, person or even an event (Bryman and Bell, 2015). Cases represent appropriate units and although used in both quantitative and qualitative studies they are more commonly associated with qualitative rather than quantitative inquiries. Case studies have been identified as suitable for freight transport studies: for example, Evangelista (2014) applied the case study method to investigate environmental sustainability in the Italian transport and logistics industry and identified three distinct approaches to environmental sustainability (See also Davies et al 2007). Notably, the units or cases were fleet firms in contrast to the works of Figliozzi (2011) and Davies et al., (2007) who adopted city and country units as cases respectively (see also Liimatainen et al., 2014; Cullen et al., 2013; Anderson and Ogren, 2011).

Yin (2003) identifies three conditions for determining the appropriation of the case study strategy in research; (a) type of research question, (b) perspective of focus, i.e. contemporary or historic, and (c) nature and extent of control the researcher has over behavioural events (pg. 1). The strategy is preferred for “meaning seeking”, “clarification” and “explanatory” research questions, contemporary perspectives and situations where the researcher has little control over events. These criteria are expanded on below;

1. Research Questions: In the second chapter of this thesis, the following research questions were put forward;
2. How are ICT mechanisms being used to support sustainability in road transport operations, with emphasis on social sustainability?
3. What are the prevalent managerial perceptions of sustainability in road freight transport and how does this affect their ICT strategies?
4. Which theoretical rationale(s) best explain the performance between ICT and the different dimensions of the 3BL paradigm in sustainable road freight?
5. How can 3BL sustainability performance in road freight transport be better executed through ICT?

The above research questions focus on providing explanatory rather than predictive knowledge insights about sustainable road freight transport within the empirical context. The link between the research question and the strategy extends also to the principles that guide reasoning rationales, i.e. the abductive approaches to studying the phenomena of interest. Qualitative questions, when applied in abductive reasoning are suitable for creating knowledge and the research questions that guide this research inquiry match the explanatory disposition of the case study strategy as determined by Yin (2003). For example, research questions (a) and (c) capture this position succinctly where the combination of ‘which’ and ‘how’ interrogatives are used to establish the extant literature as well as knowledge gaps.

It is noteworthy that whereas Yin (2003) did not specifically make mention of interrogatives other than ‘how’ and ‘why’, Lee, Collier and Cullen (2007) critiqued the parochial restrictions placed on the suitability of particular interrogatives to case study strategies, especially where case studies have suitability for both qualitative and quantitative research (See also Bryman and Bell, 2015; Voss et al., 2012; Eisenhardt and Graebner, 2007).

1. Perspective: The focus of a study on contemporary or historical issues provides useful but limited reckoning for determining the suitability of the case study strategy to research inquiry. It is useful for underlining the contribution of the inquiry to practice and knowledge. Despite the idea that case studies are best suited to contemporary studies, it is important to establish that case study strategies can and have been applied to retrospective (backward looking) management research (See Pan and Scarborough, 2010; Eisenhardt and Graebner, 2007).in both cases, the authors established significant learning implications by investigating issues that had occurred in the past. This precedence gives justification to the appropriation of case studies for both researches that focus on both contemporary and historical issues. It would appear that the perspectives limitations for appropriating case study designs is linked to scenarios where strategies like surveys; cross-sectional and experimental designs may be deemed as offering better insights (Bryman and Bell, 2015). Accordingly, this study explores the use of ICT and it is determined that both historical and contemporary data will be relevant to the study, with the evidence allowing comparisons between the different data sources for credibility. Both data perspectives will be used as points of reference for engaging dialogical exchanges with the participants (Please refer to Appendix 2, Questions 18-20). Again this balance stems from the paradigmatic position that recognizes knowledge as an outcome of moderate construction between communities where past and present experiences form the basis of reality (Jarvensivu and Tornroos, 2010).
2. Control: Adoption of case study strategies using the control criteria provides a useful delineation for design at paradigmatic level where the principles of subjectivity and objectivity places some boundaries on the ability of the researcher to influence the research. It is an adequate measure for making research strategy justifications where experiments provide viable strategy alternative, such that the behavioural events are impossible to subject to the researcher’s influence. This may not always be a deciding factor as experiments may be embedded within cases. It is perhaps better to accept that whilst the scope of Yin’s (2003) control criteria may be useful for justifying the choice of case study strategies, it creates restrictions as a research strategy support mechanism.

For this study, the objectives and research questions span exploratory and explanatory insights, with more significance placed on the explanatory outcomes. Consequently, the case study strategy is viable for the purpose and objectives. The criterion below provides further justification for the use of the case study strategy in this study.

1. Setting – Where the natural setting is instrumental to understanding the phenomena and it is non-transferable (See Voss et al., 2002; Meredith, 1998)
2. Complexity – Where the purpose of the study entails dynamic and complex interactions within each setting (Bryman and Bell, 2015; Lee et al., 2007; Voss et al., 2002). This highlights the idea of richness that is often associated with the case study approach where capacity to draw from a range of sources, apply different instrumentations and provide multi-faceted coverage of the phenomena is critical to the purpose of the study
3. Particularization – Where it is intended that boundaries apply to the research submissions, i.e. extrapolations beyond the contexts are not the intention of the researchers (Lee et al., 2007).
4. Abductive theory building – Where the research is intended to enable the incremental development or refinement of existing theory from a combination of both the extant and fresh empirical data (Jarvensivu and Tornroos, 2010, Eisenhardt and Graebner, 2007; Voss et al., 2002). The work of Jarvensivu and Tornroos (2010) provides an excellent example of deploying case study where they report on a previous research that employed the case study strategy to establish conceptualisations of value-driven management in strategic networks and its practical applications. They employ an abductive approach to establish links between existing knowledge theories on value-driven management and the data from their single case study, allowing for an extension of theory. This position is somewhat corroborated by Eisenhardt and Graebner (2007) who explain that inductive case studies are natural complements to prior deductive research, whilst highlighting some challenges to justifying inductive case research, in terms of scope and permeability. By way of balance, it is pertinent to point out that despite the superiority antecedents of deductive proponents, case studies can also prelude deductive inquiries (Voss et al., 2002).

The research background (road freight transport) is made up of complex dynamics (Sternberg et al., 2013); the operations functions and processes are interconnected such that it is difficult to make good sense of one aspect in the absence of data about other functions. The case study strategy is a useful way to capture the complex hard and soft dynamics on sustainability sense making and practice within the downstream industry operations (Voss et al., 2002). Furthermore, road freight transport research can benefit from being conducted in natural settings and case studies provide the best frames for achieving this within management research, particularly using tools like observations, surveys and interviews (Yin, 2003).

Finally, the intention to proffer theory insights on the relationship between road freight transport and ICT use for sustainability strengthens the case for the adoption of a research design strategy that allows for theory development. This also influenced the decision to adopt a multiple case study strategy for this research (Eisenhardt and Graebner, 2007; Voss et al., 2002).

***4.7.1.1 Multiple Case Studies***

Eisenhardt and Graebner (2007) argue that the emergence of theory from case study data is based on the recognition of relationship patterns within and across cases, such that replication allows for recursive use of data to reinforce logical propositions (See Bryman and Bell, 2015). Case study strategies may be used across single case units or multiple cases however multiple case studies have become quite commonplace in management studies being associated with *rigour* (Marchet et al., 2009; Blumberg et al., 2005; Yin, 2003), *replication*, (Eisenhardt and Graebner, 2007) and *external validity* or *generalisation* (Voss et al., 2002). The literature review revealed particularly important factors that influenced the decision to adopt the multiple case study approach for this research. The first factor relates to the insufficiency of contextual data on sustainable road freight transport and this makes the case for a robust and rigorous approach to the study, in order to achieve theoretical appropriation (Wang et al., 2015; Yin 2003). As such, the use of a multiple cases provides rigour in the research process and supports the *replication* of the findings (Bryman and Bell, 2015, Blumberg et al., 2005)

Secondly, the objective of evolving a management tool for use within the industry necessitates some level of ‘comparability’ of patterns and relationships for relevance. The replication logic of multiple case studies promotes the theory advancement especially when implemented using a polar type (Jugdev and LaFramboise, 2010; Eisenhardt and Graebner, 2007; Voss et al., 2002). Yin (2003) outlines a number of advantages and disadvantages to the use of multiple case studies (see Table 4.2 below).

Table 4.2 - Advantages and Disadvantages of Multiple Case Studies

|  |  |
| --- | --- |
| Advantages | Disadvantages |
| Evidence is considered more compelling because it is considered as robust | Time and resource exertion. Demands are significantly greater than single case studies |
| Replication logic and therefore better theoretical appropriation | Case sufficiency is more difficult to establish |
| Higher study prospects, where difficulties with one of the cases does not vitiate the entire study. | Can be considered as less in-depth compared to single cases, raising questions of the justification of the method. |

Adapted from Yin (2003)

The first concern raised is indeed critical as it raises key questions about access, finances, time allocation and management, embeddedness within the cases and general feasibility. It was determined that early planning was vital to mitigating these issues and the research development process at the University of Sheffield aided this significantly.

***4.7.1.2 Theoretical and Selective Sampling***

A more critical issue relates to identifying the appropriate number of cases for the study (Yin, 2003; Voss et al., 2002). As a guide, a minimum of two cases is suggested as a starting point by Yin (2003) and Eisenhardt and Graebner (2007) underscore the importance of selecting the right cases, particularly in respect of the links between the cases and theory development, where case sufficiency is crucial to making theory claims.

While there are no specifically recommended numbers of cases, the onus is on each researcher to make the judgement call on what number is sufficient for their study’s purpose and an explicit explanatory reasoning is advised (Yin, 2003). Theoretical sampling is a useful way of improving the representation of the data and improves the quality perception of the research output. Whilst theoretical sampling involves the use of emergent theory to guide theory collection until the researcher reaches theoretical saturation, selective sampling is informed by the use of prior literature to identify settings and population types prior to data collection (Drauker et al., 2007; Coyne, 1997). Pure theoretical sampling research can become indeterminate, since the researcher has no control over the theory development and is more suited to grounded theory research (Coyne, 1997, Glaser 1978). In practice, selective sampling underpinned by theory propositions is more common, i.e. a combination of selective and theoretical sampling to determine saturation (Patton, 1990, Sandelowski, 1995).

In this study, the rationale for case inclusion was driven by selective criteria that reflects the literature and heuristic documentation of the industry’s composition (please refer to Table 4.3 overleaf). These were used to establish a ‘minimum’ number of cases, which ensured that all the different industry criteria characteristics were covered, combining criterion and snowballing techniques to establish case types (Yin, 2003).

Table 4.3 - Case Selection Criteria

|  |  |  |
| --- | --- | --- |
| **Criteria** | **Characteristics** | |
| **Nationality** | Nigerian (Local) | International (Multinational) |
| **Size** | Small and Medium | Large |
| **Management** | Board | Individual |
| **Ownership** | State | Non-State (Private/ Public) |

As mentioned previously, Table 4.3 above outlines the base criteria for case selection as applied in this study. At the design stage a minimum of 6 cases were intended for selection but the eventual number of cases in the field was slightly higher. This strategy helped to meet the requirements for a polar typology to the case nature and this was influenced by feedback from reviewers at an international conference where the pilot study was presented prior to the main fieldwork (EurOMA, 2015). Polar cases enable comparative cases and help to stimulate theory development allowing for a more robust insight on the phenomena of interest because different typologies have been examined as part of the study (Jugdev and LaFramboise, 2010; Eisenhardt and Graebner, 2007). Feasibility was also a very important consideration particularly in terms of access, costs and time, all of which can be crucial to the success or failure of a research (Bryman and Bell, 2015; Saunders et al., 2007).

#### 4.7.1.3 Criteria justification:

1. Nationality: Some companies within the petroleum downstream industry are wholly owned and registered as Nigerian companies, whilst others are registered in Nigeria as subsidiaries of foreign companies.
2. Size: Some of these companies had more than 100 employees whilst others had less. The companies with less than 100 employees were classed as SMEs (small and medium enterprises) whilst the companies with over 100 employees were classed as large. Concerns arose from the consideration of companies with 70-90+ employees and how stringent the classification criteria would be applied in this case and the resolve was to allow the dictates of the data determine. Moreso, the industry’s regulatory agency and the literature highlighted eight major companies.All other firms not in this group were treated as SMEs (NNPC, 2014, Ehinomen and Adeleke, 2012).
3. Ownership: Some of the companies were state owned by the Nigerian government and others were owned by non-state actors whether held through publicly listed shares or private equity.
4. Management Structure: This was a crucial consideration for this study due to the emphasis on managerial perception. It was determined that the majority of the companies would have board structures but previous industry knowledge also informed that there were individual or self-employed businesses that participated in the petroleum downstream road freight transport process and it was useful to make provision for data from such sources.

Employing the multiple case study strategy allowed for a very good fit between the research objectives and the overall field work strategy. The minimum number of cases provided a useful guide for field work implementation but also allowed for flexibility in the actual field work process; a necessary skill for case study work (Yin, 2003). Importantly, within the cases, senior level executives and managers were identified as the target participants for the research. It was estimated that access to any one organisation would range from as little as 1 to as many as 7 managers depending on the size and variation within the company. Eisenhardt and Graebner’s (2007) advice on limiting bias was taken into account and the supervisory team submitted that the managerial respondents be as diverse as possible from within the same organisation, in addition to their being highly knowledgeable about the topics of the research (See also Voss et al., 2002).

#### 4.7.1.4. Research Instrumentation

Instrumentation refers to the tools employed to collect data from the various sources. In consistency with my moderate constructionism affiliation, it was important to employ instrumentation tools that enabled dialogic and materiality concepts in the research process and so in this study, the principal source instruments used for the data collection were interviews and observations.

**4.7.1.4.1 Interviews:** These are dialogic exchanges between the researcher and participants where questions are mostly used to elicit responses from the participants being used in both qualitative and quantitative studies; however, flexibility and fluidity are desirable in the use of interviews for qualitative studies (Bryman and Bell, 2015). Interviews are considered a most important source of case study information and also the most widely used instrument for data collection in case study research (Blumberg et al., 2005; Yin, 2003). The literature identifies three main classes of interviews and their appropriation for case study research. The table below outlines the different features of each highlighting perceived strengths and weaknesses.

Table 4.4 - Types of interviews, their strengths and weaknesses

|  |  |  |
| --- | --- | --- |
| **Interview Type** | **Strengths** | **Weaknesses** |
| **Structured:**  Administered with the aim of each participant responding to the same set of questions in the same exact format, often with a fixed range of answers. | Focused  Allows for aggregation and comparability  Data is easier to transcribe and analyse | Monotonous  May exclude data richness due to missed follow-up opportunities  Difficult to justify use with in-depth studies. |
| **Semi-Structured:**  Administered with the aim of each participant responding to the same or similarly worded set of questions without any set ordering to the questions. The interviewer also has the opportunity to extend and ask follow up questions from the responses of the participants | Flexibility  Easy to transcribe compared to unstructured interviews  Allows for comparability  Effective control without stifling the data source  Richer data compared to the structured interview | Transcription may be difficult  Coding and analysis can be time consuming and more difficult  Requires higher skill set to deal with different participants uniquely |
| **Unstructured:**  Administered with the aim of each participant addressing different issues, with phrasing and ordering for each interview different from the others. | Reflexivity  Very rich data  Greater objectivity of the responses  More interesting for the interviewee or participant | Subjective  Time consuming or unpredictable  Greater risk of losing focus and control of the interview  Requires advanced interviewing skill sets for implementation |

Adapted from Bryman and Bell, (2015) and Yin (2003)

Using the table above (4.4), semi-structured interviews were identified as the most viable instrumentation for data collection. They matched the paradigmatic position and practical objectives of the research vis-à-vis moderate constructionism as accommodating of dialogical inquiries and materiality in order to make sense of reality within applicable contexts. In terms of practicality, because the objectives of the study necessitated rich contextual data, it was also important to ensure that feasibility in terms of time and other resource requirements for the research were not overlooked. Semi structured interviews provided the most feasible option that allowed for rich data without loss of control over the interview process (Voss et al., 2002). The literature, particularly, Yin’s book on case study research (3rd edition) addressed interviewing skills training in addition to workshops on qualitative methods. Similarly, concerns regarding transcription, coding and comparability were addressed through adherence to case study research protocol development and the use of pilot studies as precursors to the main study.

Blumberg et al., (2005), Bryman and Bell (2015) elucidate on communication methods using interviews, identifying personal (face to face) and phone communications as the most common forms of interview communication, also highlighting mail and computer assisted interviewing as viable alternatives.

Personal interviews entail the physical presence of both parties in the same location for dialogue to ensue. A major advantage of this method is the higher likelihood of cooperation from the participants, in addition to the opportunity to capture and reflect other idiosyncratic elements of the interview process, e.g. body posture, eye contact, demeanour, and ambience of the interview setting (Bryman and Bell, 2015). Concerns on personal interviews extend to practicality of the researcher being able to reach the physical location for the interviews, safety, costs of travel, higher skill requirements to manage self and interviewee and difficulties with following –up.

Phone interviews on the other hand are interviews conducting via telephone conduits that enable the dialogical exchange between the parties (Blumberg et al., 2005). It is a preferred method for reaching large numbers of participants and a useful means for overcoming the spatial restrictions and this makes it a lot more cost-effective compared to the associated costs for reaching a similar number of participants using the face-to-face method. Some authors have questioned if it can enable sustained dialogue for in-depth inquiries (Bryman and Bell, 2015) and this in addition to the limitations arising from lack of observation, phone availability and data inferiority restricts the use of phone interviews for qualitative data collection.

These pragmatic approaches consider spatial and geographical issues such as accessibility, time, trust, conversation clarity, visual observations and ethical constraints. These led to the decision to employ face-to-face interviews as the primary instrument for data collection. This method tallied with the key objectives of the research and importantly would help to overcome access and trust issues that were expected. Trust was a crucial consideration, as many of the potential respondents would tend to prefer face-to-face interactions as part of their way of assessing my true intentions for the research interviews. Personal interviews also afforded the opportunity to be flexible with interview scheduling and execution taking the demeanour of the participants into consideration, e.g. what questions were best to ask at particular times during the course of the interview and which questions were less appropriate for the particular time. Additionally, phone interviews would be used as alternative options where personal interviews were impossible to conduct. For example, certain parts of Nigeria are known for insurgency attacks and the risks associated with visiting those parts of the country to collect data were over the acceptable levels. In such instances, phone interviews were the better options, particularly where ethical approval excluded physical access to those areas. This pragmatic combination of both phone and personal interviews ensured that the use of interviews provided optimal data coverage for the study.

**4.7.1.4.1 Observations:** Voss et al., (2002) suggest that triangulation enhances the data collection in case study research. Eisenhardt and Graebner, (2007) as well as Bryman and Bell (2015) support this notion with the argument that different tools can help address retrospective and real time issues within case studies. Similarly, Barratt et al., (2011) suggest that triangulation helps to improve the reliability of the data and contributes to the richness.

From a practical point of view, observations are extremely useful for capturing in-situ data about any phenomena, particularly where there is the intention to mitigate bias. Non-participant observations were therefore selected as one of the research instruments, with the aim of capturing real time data about actual operational processes in the movement of petroleum products via road. An extremely flexible design was taken in this instance to ensure that both on-site and off-site processes were observed including but not limited to congestion incidents, driving behaviour, layout of premises, interaction between managers and employees, office layout, ICT infrastructure range, air quality and noise emanating from trucks (engines and horns). These would be used to compare the data from the responses and analysed to improve the rigour of the inferences made from the data.

A range of hardware tools like voice recorders, laptops, camera, plain paper and video cameras would support observations where possible. In all other instances, personal senses will aid data collection e.g. eyes to observe smoke from truck’s exhaust, ears and eyes for observing noise pollution from truck engine sounds and horns.

## 4.8 Research Analysis

Dialectic theory development requires rigorous analytical frameworks that help to promote critical and logical relationship between the data and the findings that theory claims are based on (Lee et al., 2007). An important distinction of qualitative data analysis is linked to the principle of iteration that views data collection and data analysis stage as simultaneous rather than sequential (Bryman and Bell, 2015). Whilst there are a number of approaches to qualitative data analysis: discourse, narrative, thematic, content and grounded theory approaches, thematic and content analysis are considered most appropriate for meeting the objectives of this study (Miles and Huberman, 1994).

Bryman and Bell (2015) discuss grounded theory and analytic induction, contending that the term ‘thematic’ has no identifiable heritage and is often conflated with coding, however their designation of grounded theory and analytic induction methods do not adequately capture the essence of thematic analysis as a tool in the hands of a qualitative researcher. For one, the principles of analytic induction are premised on the attainment of positivism, seeking objective and universal explanations of a phenomena through continuous data collection (Bryman and Bell, 2015), whilst grounded theory principles focus on ‘In Vivo’ data evaluation without a base in the existing literature (Miles et al., 2013; Glaser and Strauss, 1967). These classifications do not cater for research inquiries that incorporate existing literature but do not seek to establish universal truths, i.e. the development of theory within a moderate constructionism framework. This weakness makes it inappropriate to adopt any of these broad strategies as analytical methods for this study. Preference is given to the use of thematic and content analysis as a combined framework for identifying contextually unique data as well as comparison with the extant literature to make theory refinement.

Content analysis will aid the review and evaluation of the data to identify ‘In Vivo’ words, themes and evidence, whilst thematic analysis will facilitate coding for patterns, relationships and explanatory constructs (Miles et al., 2013). NVivo11 software for qualitative data analysis supports this process and its functions such as the word frequency query tool will be used to identify ‘In Vivo’ contents from the data. Similarly, the coding and analysis matrix tool will be used to create and explore visual relationship patterns for within case and cross case analysis of the data (Bazeley and Jackson, 2013).

## 4.9 Research Access

Access refers to the formal and informal permission, consent and terms agreed to by the research population or participants. Saunders et al., (2009) identified two principal methods of access; traditional and the Internet mediated methods. The former entails the use of physical contacts, mail posts and on site methods to contact and negotiate research permission and consent from the organisation and participants whilst the latter employs internet mediums to secure access to the target research participants (Saunders et al., 2009). Access is often an ongoing and incremental issue and the recommendations of Voss et al., (2002), adhered to by way of targeting senior level executives and using family, friends and professional contacts to initiate access to the different organisations (See also Bryman, and Bell, 2015).

Negotiations for access commenced early in 2014 with informal discussions with a number of petroleum downstream company executives. They were informed of the research topic, the potential participation benefits and requirements for participation. This process allowed for a measurement of the topics receptivity by the community and some network contacts were developed in this instance. Recourse was then made to family, friends and colleagues who worked mostly in the upstream sector of the petroleum industry, notifying them of the research topic and the key objectives. These were preparatory steps for formal access negotiations post-ethical approval and collegiate mandate for the research.

Following ethical approval[[3]](#footnote-3) for the research in October 2014, a research protocol[[4]](#footnote-4) was designed detailing the purpose of the study, informed consent requirements, scope of access required, timing schedule for fieldwork, supervisory and ethical guarantees, as well as the prospective interview questions (Yin, 2003). The protocol was reviewed by the supervisory team consisting of Prof. John Cullen and Dr. Niraj Kumar, who gave feedback on improving the details of the document. The protocol draft was used to design a pilot study and following family contacts, two pilot interviews were approved by the management of a major multinational and a major local company. Access permit communication letters were received alongside signed ‘informed consent’ statements by the participants indicating their understanding of the research purpose and their willingness to participate in the interview process. Web search information was also used to source contacts for some of the other companies and introductory emails were then sent to initiate research access negotiations.

Following the conduct and analysis of the pilot study, including subsequent presentation at conferences, feedback on the wording of the questions, clarity of reference, length of the interviews, scope of the inquiry and participant recommendations were infused to prepare a final protocol that was then sent via email and dropped off in person over the course of the fieldwork. The benefits of the protocol and associated documents prepared prior to field work included ease of transcription, easier coding for analysis and ease of dialogue during the interview process. Reflecting, although the design of the protocol expected negotiation to be a specific phase with specific time schedule in the research plan, the reality of the fieldwork showed that qualitative case studies required continuous access. This process was continuous and dynamic, requiring flexibility, creativity and ‘courage’ at certain times.

## 4.10 Research Ethics

Ethics are critical to research output and the Sheffield University Management School (SUMS) has targeted trainings and programmes on research ethics. Blumberg et al., (2005) maintain that whilst research ethics can be approached from deontological or teleological perspectives, management scholars have often preferred the teleological view because of its focus on consequences for all the research stakeholders; the important priority in management research is to eliminate or reduce consequential harm to the participants or population as a result of the research process (Bryman and Bell, 2015). In addition to the procedural requirements of the University of Sheffield, measures were put in place to ensure compliance with the provisions of the UK Data Protection Act (1998), which provided superseding statutory guidance for the sourcing, storage or use of data in the UK.

Anonymity was incorporated into the research protocol, data collection, analysis and reporting processes in order to improve access as well as protect the participants from the any harm. In addition, privacy and confidentiality of identify, data and reports were incorporated into the research design to minimise exposure from data. In some instances, the participants objected to the use of electronic devices during the course of the interview.

Similarly, considerations were made regarding the use of deceptive disguise in observations and this was rejected as the on-site observation intentions were communicated as part of the negotiation process. Where off premise observations were made, no disclosure would be made on persons and the principles of anonymity would still apply.

Additionally, Bryman and Bell (2015) highlight informed consent as critical to ethical research. Informed consent not only provides the participants with the opportunity to set the terms for the research participation, it also serves as part of the confidentiality agreement for the research. Berg (2007) explain informed consent as knowledge driven, based on the freedom of choice that is exercised by the participants without any element of fraud, inducement, deceit, or manipulation. The practicality of ensuring that consent was always informed raised questions about the nature of organisational access, the levels of access and the maintenance of access (Saunders et al., 2009). The interview protocol ensured that decisions to participate were informed by adequate knowledge of the research’s purpose, objectives and scope. Although the protocol packs were sent off prior to the interviews sessions, all the consent forms were signed prior to the start of the interview sessions, following a review of the contents. This ensured that participants understood the purpose; requirements, limitations and their rights to stop or disengage during the interview process (see Appendix 4 for anonymised specimen of signed consent forms).

Finally, part of the ethics framework required risk assessments prior to and during the course of the research. At the early stages of planning, Nigeria was tackling the outbreak of the deadly Ebola virus which required close monitoring of the situation. Updates from the World Health Organisation (WHO) were regularly reviewed for progress and permission for fieldwork was only granted when the supervisory team were satisfied that it was safe to do so in accordance with the reports of the WHO in October 2014. Other protocols on travel accommodation, insurance, medical access and financial resources were assessed as part of the wider risk evaluation process, prior to and during the fieldwork. The flexible approach to interviewing was to prove critical following an armed robbery incident during the fieldwork. This is discussed further in the next chapter.

**Research Paradigm**: Moderate constructionism

**Research Design**

Multiple Case Studies

**Analysis:**

NVivo Software

Content analysis

Thematic analysis

**Research Instrumentation**: Semi-structured interviews, Non-participant Observations

**Method**

Qualitative

Access and Ethical Considerations

Figure 4:3 - Methodology Design Framework

## 4.11 Chapter Summary

As represented by Figure 4.3 above, this chapter presented and discussed the key elements of the research design, addressing the paradigmatic, instrumentation and ethical elements of the research. Although written retrospectively, it captured the rationales behind the moderate constructionist position of the study, linking this paradigm to the questions, objectives and method of research. Importantly, the chapter also highlighted the importance of ‘fit’ between the methods, instrumentation and analysis aspects of the research, with rationales for the adoption and/ or rejection of specific alternatives where appropriate. It concluded with an overview of the ethical and access related considerations prior to field work, acting as a precursor to the next chapter which will see a detailed discussion of the implementation phase of the field work, addressing the pilot study, feedback, field work access, safety, challenges and management skills in the data collection and analysis of the data.

# 

5. Methodology (Implementation)

## 5.1 Introduction

The preceding chapter was focused on the preparatory and design aspects of this study and in this chapter; the implementation of fieldwork is discussed. In the following sections, the research protocol, pilot study and fieldwork developments outcomes are examined to allow an understanding into the post-design phase of the research. The purpose of this chapter is to enable the reader to gain some first-hand insight into the post-design phase of the research, underlining the challenges and rewards of the transition processes between research designs and actual empirical work (Please refer to Figure 5.1 below for a summary).

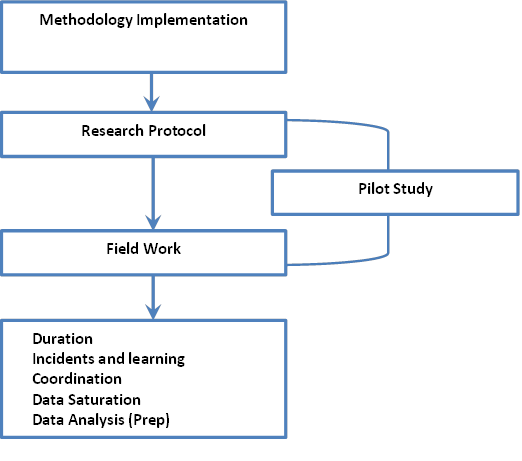


Figure 5:1 - Methodology implementation overview

## 5.2 Research Protocol

The research protocol is an inalienable quality tool for qualitative case study research (Yin, 2003). The research protocol for this study followed through from the internal evaluation process (confirmation review) at the Sheffield University Management School, where the case for the research was defended before a panel of examiners. Feedback from the review process was incorporated into the progressive research plan and the protocol was developed using a combination of literature and focus discussions with the supervisory team.

In the first instance, the recommendation of Checkland and Holwell (1998) was followed to develop a framework of ideas in advance to aid audit and critical scrutiny. The research objectives and questions were arranged into a diagrammatic representation that showed the relationship between the different objectives, questions and the literature. E.g., Objective 2 on ICT deployment and strategies was linked to research question 1. A number of potential dialogue questions were formulated to address the research objectives. In the first instance, 15 interview questions were developed and presented to the supervisory team for review. A principal concern was the assumption that the number of questions would engage the participants for the targeted average time of sixty minutes per interview. Secondly, it was observed that many implied assumptions were made about the participants and their ability to understand the questions and it was agreed that it was better to have more simplistic and unassuming questions than to have few complex questions that could prove difficult to implement. Presentation errors were also noted for revision and correction.

Following these initial procedures in January 2015, a second draft was presented in February 2015 with the feedback and question rationale clearly incorporated into the planning document. The importance of this process highlighted the value of ‘experience' in contributing to the research development process. A draft version of the protocol was approved in February 2015 and the next task was to implement a pilot study to improve the validity of the questions, ease of understanding and identify potential interview challenges before fieldwork.

## 5.3 Pilot study

In April 2015, two pilot studies were conducted with a lubricant manager and a distribution manager in a multinational and local firm respectively. Due to safety and security restrictions, the interviews were conducted over the telephone and each lasted an average of 58 minutes. The interviews covered 21 questions with the last question soliciting contributions from interviewees. Key feedback from the pilot study includes:

1. Language moderation – One of the respondents thought some of the terms were not easily relatable.
2. Skill requirement – The importance of dialogic engagement was highlighted. I had struggled to elicit rich, detailed responses from one of the interviewees; his answers were often short and curtailed.
3. Validity – The respondents could relate to the topic and the problem focus of the research, agreeing to participate in the main study.
4. Timing – Whilst the timing for each session were similar, there was also some sense that not all the interviewees were keen to talk for long periods. Although they both acknowledged the relevance of the questions, they thought some questions were too long and in some cases requiring answers which had already been provided.

These items were discussed with the supervisory teams following the interviews and the protocol was revisited. This led to a readjustment of the overall questions from 21 to 23, breaking down questions that were identified as complex or confusing into simpler forms. The language was adjusted and notes were made to ensure that the actual interview process allowed for an explanation of any terms that were not comprehensible by the interviewees. The data from the pilot study was presented as part of a conference paper at the European Operations Management Association (EurOMA) conference in Neuchatel on June 24, 2015.

## 5.4 Fieldwork

Following institutional clearance, I left for Nigeria on the 28th of July 2015 to commence fieldwork. Although several enquiries had been made using email and phone contacts to the major marketing companies, at the point of commencement, only one other appointment was planned asides the contacts from the pilot study.

### 5.4.1 Duration

Fieldwork lasted just over 2 months in Nigeria, although data collection continued via phone between October and December 2015. Over fifteen company sites belonging to 13 firms were visited in Lagos (South-Western Nigeria), Port-Harcourt (Niger Delta region) and Abuja (Capital city and Central Nigeria). In each area, interviews were complemented with observations on congestion, infrastructure, drivers' behaviour, office outlay, accessibility and parking habits (Figures 5.2 and 5.3).



Figure 5:2 - Image of parked petroleum freight trucks on Ikwerre road in Port-Harcourt (12-08-2015)



Figure 5:3 - Set of parked petroleum freight trucks in Apapa Nigeria (15-09-2015)

After exhausting the initial contacts and conducting the first set of interviews within 2 weeks, progress with access was extremely slow and panic set in. I had envisaged faster progress and the target was to conduct 40 interviews with middle and senior managers in the petroleum marketing and distribution companies. The 1st two weeks in Lagos had generated only three interviews with managers in some multinational firms in the industry (anonymised in subsequent discussion).

The next 10 days were spent in Port-Harcourt where visits and site observations were made to Orte plc, Vertex Limited and Forte Oil plc. 2 more interviews were conducted before returning to Lagos due to a security incident. 18 further interviews were conducted in Lagos over the course of the next three weeks with 2 more interviews conducted in Abuja afterwards. A total of 25 face-to-face interviews and over 23 (observation and access) site visits were made before returning to the UK. Additionally, off-site observations as illustrated above and a number of additional phone interviews were scheduled via telephone due to reasons of unavailability (out of the country), security (northern Nigeria) and time. An additional 7 interviews were conducted via telephone between October and December 2015.

### 5.4.2 Incidents and learning

Although risk assessments were carried out prior to the fieldwork, there were specific incidents that occurred and are considered worth reporting for learning purposes. On day 3 of fieldwork in Port-Harcourt, I was caught up in an armed robbery operation at about 3pm along the NTA-Choba road. We had entered some traffic and then a robbery ambush where 3 persons were killed and a large sum of money taken. 2 of the victims were police officers and the other a fuel station attendant in Mgbuoba area of the city. Guns were used sporadically and shots were fired towards our vehicle, causing me to abandon the vehicle and run for my life. Visibly shaken and dishevelled, it took the reassurance of close friends and associates to honour interview appointments in the area for the remaining days; my intention had been to end the data collection process and return to England immediately. Both Supervisors were made aware of the event and steps that had been taken to ensure continued safety in the region.

Reflecting on the incident, it represents one of the hazards of qualitative research where ethnographic and case study observations/ interview designs are employed. These risks do not apply to distanced qualitative data collection like archival analysis or phone interviews and neither do questionnaire based researchers face these sorts of risks. In hindsight, security considerations will be given higher priority in the planning and implementation process of future research.

### 5.4.3 Coordination and time management

Coordination and time management were critical to the successful completion of the fieldwork phase of the research. Time was critical but relatively flexible to maximise data collection opportunities. Some appointments were approved with less than 10 hours’ notice and this was unique learning or training for me as a researcher. The attitude to time within the Nigerian context was a function of the authority or “power relationship between the parties”, one was likely to be kept waiting for long if you were considered less influential than the other party. On more than one occasion, I waited more than 3 hours for appointments that were eventually cancelled and rescheduled by the interviewees.

Another important element for coordination was the travel mode. Within the major cities in Nigeria, particularly Lagos, congestion is a major problem with journeys of about 50 km taking up to 5 or 6 hours within the city. I had to plan travel to certain sites via sea, which reduced journey times to less than an hour and was also economically cheaper than road options. A field diary was used to coordinate and record activities[[5]](#footnote-5) and data was stored in copies on a secure laptop or hard drive prior to transcription to reduce the risk of loss.

### 5.4.4 Data Saturation

At the design stage, 30 to 40 interviews were projected as feasible and appropriate for the purpose of this study. Qualitative instrumentation may not always have significant levels, confidence intervals or statistical sampling minimums and this can lead to problems for the researcher and the evaluators of the research (Bryman and Bell, 2015). Qualitative researchers have to make quality judgement calls on the significance and confidence in the amount of data collected to determine if ‘new learning' has ceased and, therefore, precluding the opportunity for new learning. In their study on stakeholder perceptions of needle exchange programmes in Mexico, Philbin et al., (2009) established saturation based on the confidence between the data match and the pre-coded themes, suggesting this as an alternative confidence measure in the absence of a theoretical sampling framework. After the 15th interview, the emerging data from the interview dialogues had started to converge significantly. It seemed that the sampling criteria put forward in Table 4.3 above had been met; interviews had been conducted with managers in two major multinational firms (6 interviews), two major local private firms (4 interviews), one major public firm (3 interviews) two small private firms (2 interviews). This position was communicated to the supervisory team who advised that the probability of fresh insights could still exist within the cases and I built on the existing network to contact more firms and conduct 16 more interviews from both existing and new cases. After 32nd interview in December 2015, it was obvious that the narratives were not yielding any significantly new narratives and access goodwill was becoming exhausted; many contacts stopped responding to any form of contact. On these grounds, a decision was made to end the data collection confident that the 32 interviews, 30 hours of observation and archival documentary evidence was sufficient for theoretical sampling. It was also important not to completely erode the goodwill access of remaining contacts in the prospects of future research. Informed consent[[6]](#footnote-6) had been secured in all instances of the interviews, although some interviewees exercised their right to decline the use of electronic equipment to capture data within the premise, particularly for on-site observations.

### 5.4.5 Data Analysis

Data analysis commenced as soon as the interviews commenced and this was one of the principal advantages of conducting the interviews in person. Familiarity with the data at source sometimes led to analytical memos and follow-up questions during the interviews and this by itself was an indication of some sort iterative data analysis.

Empirical data was transcribed over a period of 6 months (August, 2015-January 2016). All recorded and annotated interviews were transcribed using “Microsoft Word” software. Some of the interview transcripts were sent interviews for validation of the transcripts by the interviewees[[7]](#footnote-7). This was to improve the reliability of the data and overall research quality, one interviewee made significant amendments to the data compared to what was recorded and this was referred to the supervisory team for advice on how best to resolve the disparity between the recorded interview transcript and the revised and abridged version from the interviewee. The compromise was to reflect the detail of first interview in areas of congruence and to make amendments where there was a variance with the abridged version. Observational data (diary memos, pictures and video) were uploaded to a personal computer system and backed-up on a separate system to mitigate the risk of data corruption or loss.

Formal analysis was executed with a combination of software and traditional paper annotation. Miles, Huberman and Saldana (2014) discuss transcription and structuring as important start points of the data analysis process and their recommendations were subscribed to. Through structuring, the data was organised into different portfolios (company cases) using NVivo11 and then re-read. Content analysis was used to search for and identify ‘In Vivo’ data for coding. Word counts, text query and word trees were used to explore for these data generated codes. Once the preliminary content analysis had been performed, nodes were created.

Coding is critical to qualitative analysis and coding is often used to establish themes or categories within qualitative research. Yin (2003; 1994) suggests that internal validity is achieved at the analysis stage of case studies. Using the research protocol and the theoretical framework construct previously designed, the first level coding involved matching the different question themes to broad node categories, e.g. ICT nodes were created as a category in NVivo11 and all the questions that related to ICT were read and coded according to that category, same for the different questions on social, economic and environmental sustainability. New nodes were created to capture those nodes that did not fit into the pre-coded node categories and the next step reviewed the 1st level nodes to identify child nodes (Bazeley and Jackson, 2013). At level 1, seventy-six nodes were established and these led to the creation of 23 child nodes at level 2 with some intermediate nodes Cluster tools and word-tree maps were then used to evaluate the data for patterns and relationships between the different emerging nodes. At the third level, thematic nodes were established through aggregation from the child nodes at level 2 (see Figures 5.4 and 5.5 below for images of coding maps and clusters).

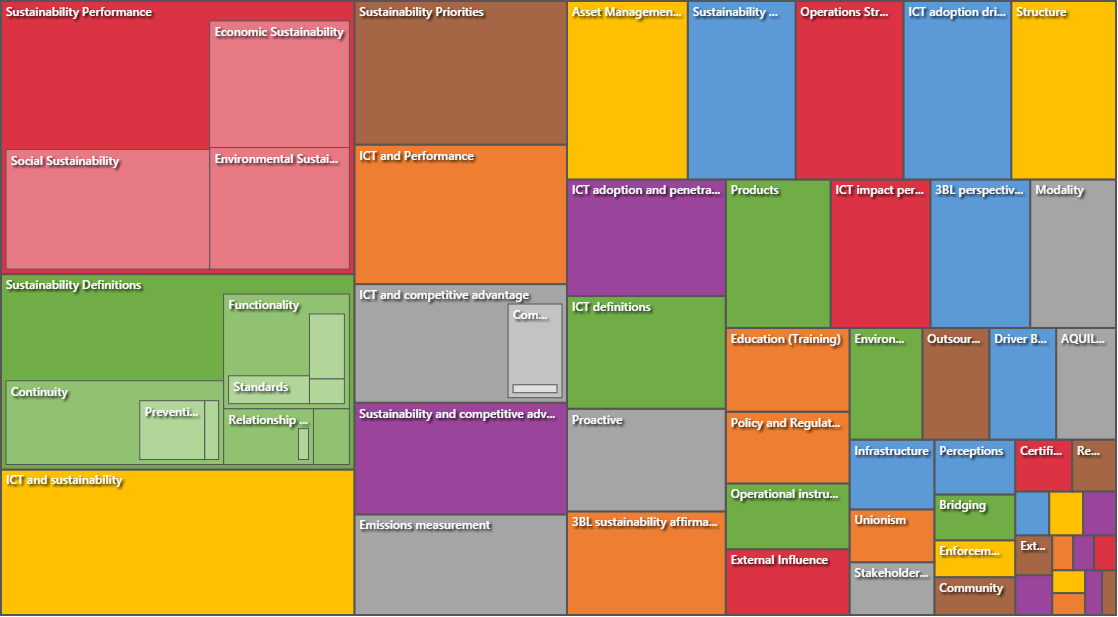


Figure 5:4 - Intermediate nodes from data analysis showing data concentration

The thematic nodes at level 3 were then subject to critical evaluation using the literature to examine theory constructs; results are presented and discussed in subsequent chapters. Similarly, ICT based themes were evaluated using the literature to compare and contract applicable frameworks and areas of priority. Visual tools like charts and tables were used to explore the data themes further.

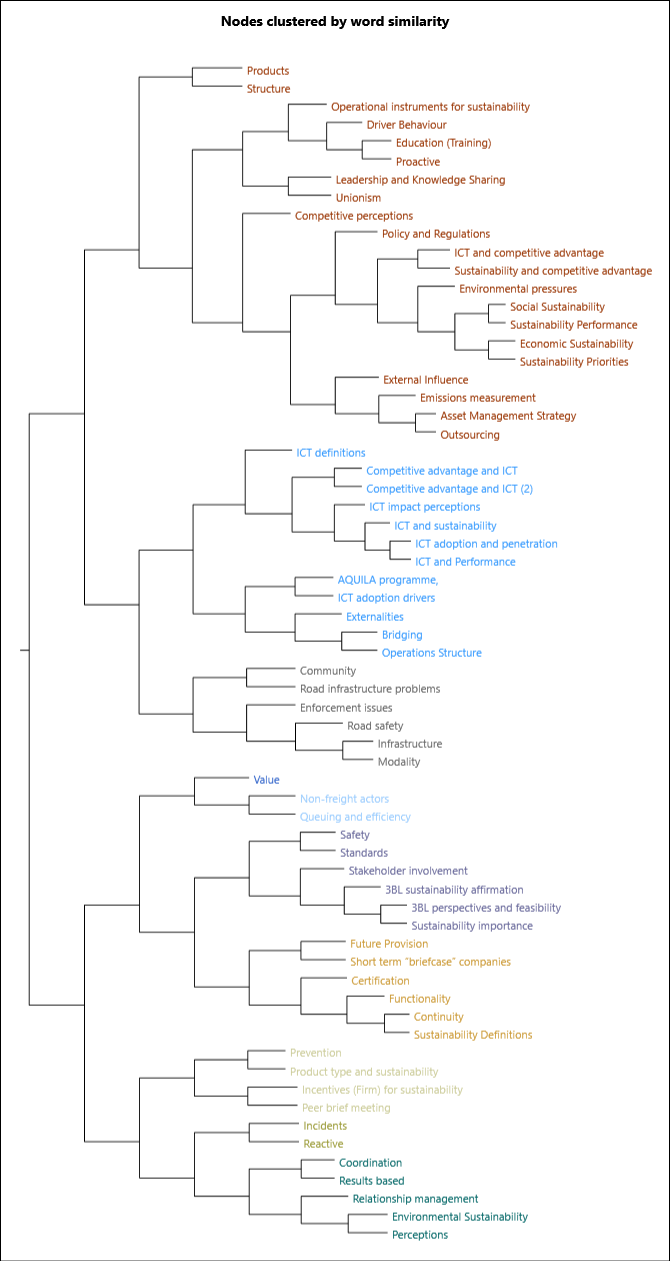


Figure 5:5 - Nodal analysis overview: Similarity index comparisons

Importantly, analyses were performed at ‘within case' and ‘cross-case' level for different objectives. In the case of the former, the data for each specific case was evaluated to identify case specific patterns for reporting, whilst cross-case analysis informed evaluation of industry data patterns and relationships. As part of the sorting process, cases were classed and grouped into 3 different categories; small, medium and large cases to aid data evaluation and presentation. The review of the data showed that a significantly large data concentration in the large cases where more interviews were conducted and observation opportunities accorded. Although data from each case was analysed individually, a decision was made to aggregate the presentation of the data from the medium and small cases. Besides the usefulness for reflecting the data skewness, this also strengthened the replication logic opportunities, where findings from similar cases are condensed to support the typologies being discussed (Eisenhardt and Graebner, 2007. The cross-case analysis mainly focused on ICT use as opposed to sustainability meanings. To achieve this, a matrix-coding framework was used to establish the patterns and relationships regarding ICT use (Miles et al., 2013). The presentation largely follows this format and theme-based theory implications were identified based on the weight of the evidence in favour of particular themes. Using the patterns from the matrix structure, categories were used to compare the data to strengthen the validity of the findings as community outcomes rather than unitary reflections. This did not lead to the discarding of any data but rather such uncorroborated patterns were reflected as outliers rather than major thematic dictates.

## 5.5 Chapter Summary

In this chapter, the implementation phase of the research methodology has been discussed extensively. The objectives of contributing to learning on case studies as a viable method of data collection and the use of specific instrumentation to support the data collection process has extended to reviews on pilot studies, field work coordination, data saturation and reflexivity. The chapter also serves as a precursor for the next chapters on within case and cross case analysis detailing the process of analysis from the conceptual framework to the findings.

# 

6. Data Analysis and Findings

## 6.1 Introduction

Chapters 4 and 5 presented and deliberated the methodological frame for this study. Key assumptions and methods implications were discussed as premises for justifying the choice of instrumentation and fieldwork design, with chapter 5 extending insight into the implementation phase of primary data collection. Chapters 6 engages discussions on the different cases, the relevant data and emerging understanding from the data examination processes. In particular, Chapter 6 focuses on the description and analysis of data from all case types. Following the polar typology, the within and cross case analysis will enhance the internal validity and replication logic of the research (Jugdev and LaFramboise, 2010; Eisenhardt and Graebner, 2007; Yin, 2003). In summary, 32 interviews were conducted with managers occupying portfolios across supply and distribution, logistics, fleet payments, IT, transport, archiving and operations functions. The interviews were supplemented with over 30 hours of observation data as well as data from the review of company archives.

## 6.2 Cases

Thirteen individual cases (excluding the regulatory agency - PEF) were involved in the data collection process of this study and this wide range of cases reflect the complex realities of the research context. For analysis, the cases were sorted and classed as large (type 1) and SME (type 2) cases for multi-level analysis and presentation purposes. This was important for theoretical and selective sampling analysis in theory based qualitative studies (Eisenhardt and Graebner, 2007; Voss et al., 2002; Sandelowski, 1995; Eisenhardt, 1991). It is advised that unlike single case studies (where the case is selected for its uniqueness), theoretical sampling in multiple case studies should reflect typologies that allow for robustness of findings that can extend beyond the uniqueness of single cases. This is thought to aid the sense-making of patterns within the research data (Eisenhardt and Graebner, 2007).

The key research objectives outlined in section 2.4.1 of this report focused on the matter of sustainability in road freight transport within the Nigerian petroleum downstream industry, an evaluation of the ICT use strategies based on ‘*In Viv*o’ sustainability narratives and the devising of an assessment framework for performance in the sector. To achieve these objectives, it was important to explore the data through substantive coding in order to promote originality regarding community conceptualisations and strategy themes. As earlier stated, the sorting strategy for this study involved categorising the data, as such interview, observation and archival data were sorted according to the different case categories; large and SME typologies. With the aid of NVivo 11, the data was coded over three stages and the findings reflect this sorting categorisation and codes.

## 6.3 Type 1. Cases (Large Firms)

Five large firm cases were involved in this study and provided both interview, observational and archival data. These were classed as type 1 firms for analysis and reference purposes because they account for the greater share (over 60%) of petroleum products distribution within the sector. Their ownership structures varied across private-foreign, private local and public local bases with one them functioning as a retail arm of national oil company with some regulatory oversight in the industry. The five large firms were ABS Nigeria\*, Lube National Oil\*, Fluid Nigeria\*, Orte Plc\* and Vertex Plc\*[[8]](#footnote-8). The succeeding sections will present a case-by-case presentation of the findings from each of the large cases.

### 6.3.1 ABS LIMITED

ABS is a leading firm in the Nigerian petroleum downstream industry sector with over 50 years’ participation in the industry. A subsidiary of an international energy firm (over 60% non-Nigerian ownership), it has more than 400 service stations within Nigeria and an even higher number of 33000L and 60000L tri-axle trucks in its fleet. The company has over 450 employees across Nigeria and is reputed as one of the best employers within the sector. As at the time of data collection, there were no indications of any extreme challenges faced by the company and the data extracted is reflective of typical perceptions and opinions in the course of normal operations for the firm and the participants.

Table 6.1 - ABS Data Summary

|  |  |  |  |
| --- | --- | --- | --- |
| **Case** | **ABS Nigeria** | | |
| Instrumentation | Details | Participant Portfolios | Recorded |
| Interviews | 4 Semi-structured interviews with open-ended questions | Plant Manager  Lubricants Manager  Distribution Manager  Fleet Payments Manager | Yes  Yes  Yes  No |
| Observations | 2 operational premises, branded assets travel | NA | No |
| Public archival documentation | 2 CSR reports (2013-2014)  Annual reports (2012-2014) | NA | No |

#### 6.3.1.1 Observation Data

**Premise**

ABS’s head office is located in Lagos alongside a number of plant depot offices for processing and storage of petroleum products. Both premises visited were visibly planned as safe zones with high security presence at the various entrances to each of the premises. No trucks were observed at the head office but there were a number of trucks moving in and out of the plant area premises. Safety and health advisory messages were signposted all over the buildings with messages addressing health, pollution and occupational wellbeing. Most office spaces were cordoned and emphasized privacy for the occupants. The road to the premises was somewhat motorable although the gradient of some of the roads were extremely poor and the state of repair gave rise to heavy dust particles and water puddles. There were no continuous, clear and safe pedestrian paths to either premise.

**Extra Premise**

On days 3 and 12 of fieldwork, two different trucks with ABS’s logo were seen parked on the roadside along the Apapa axis of Lagos. These trucks were not the only trucks parked alongside the road as other trucks belonging to different firms were also visible on the roadside and these were causing significant traffic congestion for other motorists. One of the stationary trucks had no occupants at the time of observation but this was not uncommon for many instances where the driver may have converged with other drivers awaiting access to loading bays for their vehicles. The imagery around the parked vehicles was one of ‘accustomed chaos’ where all the different parties around the area seemed to go about their businesses unsurprised by the congestion but at the same time complaining about the menace of congestion caused by trucks.

#### 6.3.1.2 Archival data

Archival data accessed from the company’s website addressed transport safety, community skill acquisition programmes, healthcare (HIV and malaria) programmes and social sponsorships and donations for communities. The 2013 annual report identified market regulation, insecurity and proliferation of tax legislations as some fundamental challenges faced by the firm in the period under review. Reports highlight the reduction of accident rates by over 60% and confirm the construction of Driver Training Schools and Truck Inspection (DTSTI) centres and Tracking Centres (TC) as part of their key developments for the period in view. The UN’s declaration of 2011-2020 as a Decade of Action for Road Safety is referenced in one of the archival documents, providing a justifying framework for initiatives outlined. Annual reports also affirm the company’s role in society as a business, with commitment to investments in healthcarare, education and economic schemes, emphasizing key drivers of sustainability practices.

#### 6.3.1.3 Interview data

**Managerial perceptions of sustainability:**

A fundamental part of understanding the relationship between road freight sustainability and the use of ICT in road freight operations, relates to the conceptualisation of sustainability by management. This is useful for understanding strategy and provides critical insight on how and why specific resources may be acquired and/ or allocated to specific functions within the companies. Figure 6.1 below captures an example of 2nd level thematic analysis of perceptions on sustainability amongst interview participants based on nodal narratives from the data.

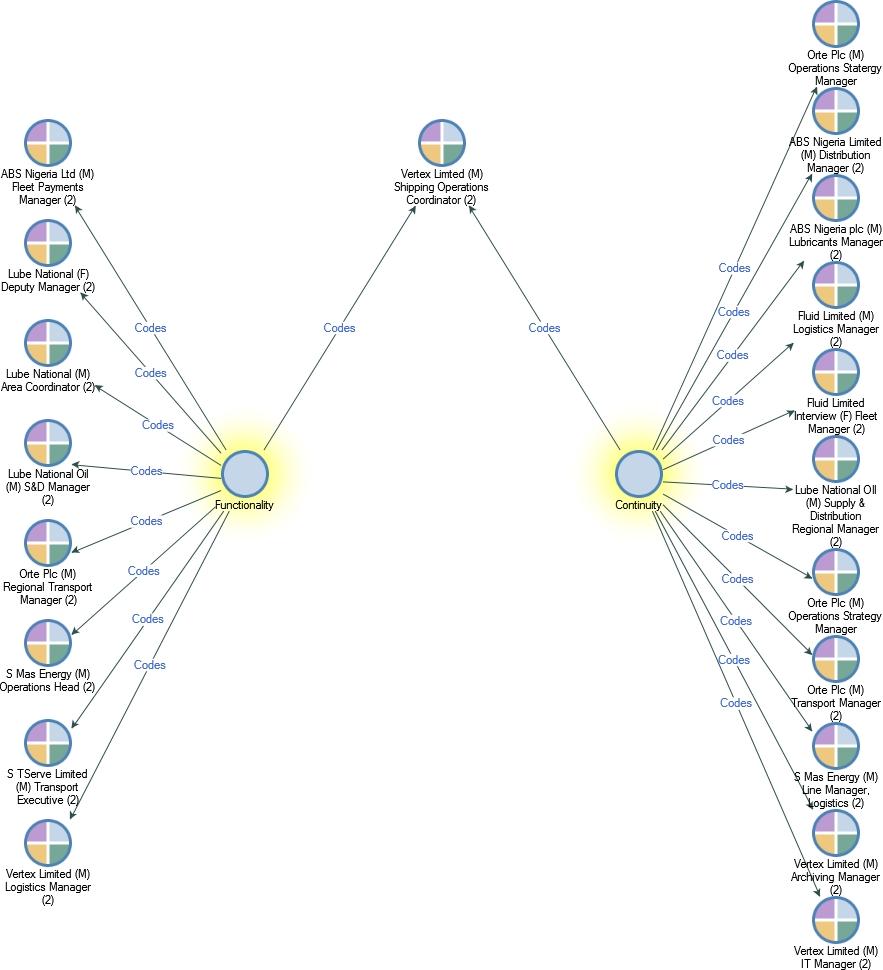


Figure 6:1 - Themes on Managerial Perceptions of Sustainability - Nodal Comparison using NVivo11

**Continuity**

Interviewee responses from ABS managers highlighted continuity as an overriding theme of sustainability. Continuity as a theme captured time and functionality as key perceptions of managers about business sustainability. Managers A and D declared:

“*Sustainability is about continuity I guess. So you would not want to be in business and then you cannot continue over a long period of time..., we are not in the business of destroying the environment, rather it is for us to add value, so based on that, we have been sustainable I can say. I know that the business has a long future to go*” – Manager A

“*Sustainability means being able to keep something going, in a layman’s language*” – Manager D

Prolonging business existence and operations was a reoccurring theme and the dominant reference for what sustainability meant in this case. This highlighted time as a critical element of how managers within the company viewed sustainability; for these managers, sustainability was to be evaluated over time, preferably long term and it would seem that business functions (like product distribution, refining, etc.) are dedicated towards achieving the continuity objective as a fundamental measure of being sustainable.

**Functionality:**

The idea of effectiveness was also a dominant theme from the data on sustainability meanings to managers in ABS. The need to ensure that the processes in place were achieving the desired goals was important in describing sustainability. Effectiveness in this case was linked to performance relative to pre-established objectives where the purpose of a particular issue is considered an intrinsic measure of whether or not it is sustainable. For example, Manager C described sustainability as:

“*Being able to initiate a policy and getting the deliverables of that policy*” – Manager C

Effectively, the measure of sustainability is tied to deliverables but even more interesting is the choice of ‘the’ as the qualifying determinant. This connotes a strict basis for evaluation of the subject of the statement, whether it relates to policies, performance, work-routines or activities. The implications extend to sustainability as an outcome of planning and performance, where businesses are actively involved in planning and working towards the attainment of planned activities.

Beyond the conceptualisations of sustainability, the inquiry extended into discussions on the dimensions of sustainable practices, eliciting accounts of social, economic and environmental performance in the company.

**Social sustainability**

Social sustainability performance was commonly tied to community initiatives. Decision-making and actions were linked to a sense of duty on the part of the company. This sense of duty extended to programmes that were built around health support, infrastructure provision and repairs, indigenous employment and standards. Interestingly, all these programmes focused on the external environment in which the business operates. For example, the excerpts below highlight this outward approach to social sustainability in the particular firm:

*“Like you know, the products we deal in are hydrocarbon products and in the course of product haulage, where there are no proper specification as to the type of trucks that are being used in terms of age, capacity and model, at the end of the day, you will find spillages occurring frequently and we will be helping to degrade the environment which is not good. So we make sure that the type of trucks in terms of their specifications on age, the make etc., are strictly adhered to so that we don’t have trucks that are breaking down and spilling products, so we can keep the environment safe”.* – Manager C

*“It is our corporate social responsibility to impact on the society and it is our duty to impact and help the community develop an understanding of how to improve their health”.* - Manager B

*“In terms of community or social, in every area we operate, there are schemes where we support them, through educational grants, youth employment schemes, malaria and disease campaigns… we distribute mosquito nets. The bottom line is the company has operated with its communities and it has sustained our operations”* – Manager A

More insightful were the details of specific measures that contributed to the performance in this area. Externalities like accidents, congestions and health impacts were recognised, however, the managers in ABS referred to institutional standards as the principal instrument for addressing these concerns. The response from one of the managers perfectly captures the approach to dealing with this transport related externalities in terms of institutional influences;

*“When it comes to health and congestions and accidents, like I said, we have a rule – \*\*\*\*\*\*\* a French acronym- which means a standard for transportation. Our trucks must meet certain standards, i.e. for the ones we contract in, they cannot be more than 10 years, we do not enlist trucks older than 5 years and if a truck comes in, it must be between 0-5 years and after 5 years that truck will have to be replaced. Also even where trucks are new, they may also be bad and so we carry out truck audits annually, we have a truck audit and driving school centre in Ibadan where all trucks that work for “C3” go once a year to do audits and also training. The drivers are trained for a week and then there is a practical session. They are trained on all that is required but I don’t want to dwell too much on that. The truck is audited and connected to a scanner and every part of the vehicle is scanned and checked and also a physical examination is conducted to be sure that it is still fit for use. Outside that, the pre and post loading I talked about earlier is also done on a daily basis or as the truck comes to load. Then we have OBCs which is ‘on-board computers’ on all our trucks that are monitored online, real-time (sic). We have staff that are employed to monitor sets of trucks, so the whole driving habit of the driver, they also know the speed, the number of stops and also they also track the vehicle to know where exactly it is and if it’s going in line with what it's being instructed to do. So all these are what we have put in place”.* - Manager D

From the foregoing, it would seem that strategies for social sustainability are evident at different strategy levels and driven by varying objectives. At the operational level, there are set or somewhat universal standards and practices that are intended for application across board, e.g. driver training, ICT use for tracking, assets procurement standards etc., At the tactical level, planning and management is evidenced along programmes and a sense of responsibility within the specific operating environment rather than universal standards, e.g. Anti-malaria health campaigns, education sponsorships etc. These may have useful implications for exploring links between sustainability strategies and firm environment.

**Economic Sustainability**

In terms of the economic dimension of sustainability, there was a common acceptance of its importance to the firm. Planning and performance measures in this area focused on market share, quality measurements, pricing and fleet condition. These measures seem to be tied to the corporate level influence and the responses from the different managers below capture this reasoning.

“*We want to be sustainable and we have the advantage of being having a high market share; because of our quality as a brand, people know that the company has high standards, so others tend to follow us. And we have had the right patronage, the business has been sustainable without compromising quality or price*”- Manager A

“*Like I said, we are a multinational company, we have both local and foreign investors in the company and if economically our product distribution, which is the core aspect of the business... because if your products lay at the plants without being taken to the selling points, it makes no sense and is a waste of investment. So if a situation obscures the marketing structure, if the policies that are designed to carry out these exercises are not sustainable economically, profitability cannot be sustained and the business will do nobody any good*” – Manager C

The data suggests links between the different dimensions of sustainability and how each dimension was pursued by the firm to achieve their overall long term and functionality goals.

“*To ensure we stay in business,* the first one (social) ties into the second one (economic) *because we do what we do; spend some money, train drivers and then we pay a bit more for our transporters because of the restrictions on vehicles age and limits, on the long run we have fewer accidents, we have fewer lost time due to breakdown and we are more efficient so our customers trust us more and then we make better business because when we tell someone we are going to deliver your product by this time, by this day, outside having good trucks, the tracking and monitoring will help us ensure that the vehicle gets there when they are supposed to get there. Also the quality of the product is also enhanced*” – Manager D

The above statement not only details how managers link investment in sustainability strategies but also accentuates the fineness of the boundaries between different dimensions in real operations. This is instructive for wholesome sustainability planning where all three dimensions are effectively addressed and help promote the long-term viability of the firm.

**Environmental Sustainability**

The predominant environmental themes centred on spills, pollution (land) and emissions. There were connections made between the fleet design and environmental issues, where the predominant measure for improving environmental sustainability. For example, managers stated that the company took extra care to ensure that truck types, age and safety are considerations made to prevent social issues like accidents, which in turn reduces the likelihood of spillages and therefore improves economic performance.

“*Talking about environmental aspects, the HSEQ is very key aspect of our business, i.e. the Health, Safety, Environmental and Quality. Like you know, the products we deal in are hydrocarbon products and in the course of product haulage, where there are no proper* specification as to the type of trucks *that are being used in terms of* age, capacity and model*, at the end of the day, you will find spillages occurring frequently and we will be helping to degrade the environment which is not good. So we make sure that the type of trucks in terms of their specifications on age, the make etc., are strictly adhered to so that we don’t have trucks that are breaking down and spilling products, so we can keep the environment safe*” – Manager C

“*When a truck is properly audited and properly checked, you have fewer accidents. Accidents are sometimes as a result of an act of nature or an act of God. But up to an extent, it is preventable, so with all these things we put in place, we have reduced accidents thereby reducing possibilities of spills, when a truck falls, maybe a tanker that is carrying base oil or carrying our finished products falls on the road, there could be a major spill into the aquafer or into the soil*” - Manager D

Of noteworthy importance is the fact that there was no mention of wildlife preservation as part of their environmental framework and despite their environmental references, none of the managers was certain about carbon emissions measurements by their firm. One of the managers in response to a question on whether his company measured and kept records of carbon emissions, stated thus;

“*And how do you achieve this? No today, we are not monitoring emissions in Nigeria (laughter). But it is something we are looking to achieve, we talked about the age of trucks; you know in Europe, there is Euro1, 2, 3, 4 5, that checks emissions and also the types of trucks you can put on the road. We are trying to use the age of the trucks and the types of trucks because they are two different things. For example, you cannot bring a Chinese truck because it’s brand new, if it doesn’t have all the power and equipment. There are certain trucks that can be used and certain age limits*” – Manager D

The response above portrays the relationship between contexts, firms and environmental performance. In this case, the focus on spillages and accidents may be driven by the nature of the product, which has implications on the freight transport process, essentially providing some links between product, road freight transport and externalities.

### 6.3.2 VERTEX LIMITED

Vertex Limited is one of the oldest marketing majors in the petroleum downstream and distribution sector in Nigeria. Having gone through a number of mergers and acquisition, the company has morphed into a local firm with over 70% indigenous shareholders. The company has 248 staff (2014 Annual report) and commissions over 200 trucks and marine vessels for product delivery across Nigeria daily. Road transportation is critical to the company’s operations; a significant number of senior staff are dedicated to transport, and logistics functions.

Table 6.2 - Vertex Limited Data Summary

|  |  |  |  |
| --- | --- | --- | --- |
| **Case** | **Vertex Limited** | | |
| Instrumentation | Details | Participant Portfolios | Recorded |
| Interviews | 5 Semi-structured interviews with open-ended questions | Distribution Supervisor  Archiving Manager  Shipping Operations Coordinator  IT Manager  Logistics Manager | Yes  Yes  Yes  No  No |
| Observations | 3 major operational premises, branded truck travels | NA | No |
| Public archival documentation | Annual Report and Accounts (2013-2014) | NA | No |

#### 6.3.2.1 Observation Data

**Premise**

The company appears to have relocated its official head office without proper communication about this action. The first visit to its listed address in Lagos revealed a sealed premise and the security staff provided directions to the ‘main’ operational area in Apapa. In total, 3 premises in Lagos, Port Harcourt and Abuja were visited and 2 interviews were conducted on site. All the premises visited had safety signs posted around and were secured by heavily armed personnel. Tank farms within the premises were clearly marked areas with safety guidelines and procedures outlined. The internal structures within the premises seemed extremely *ad hoc* and cramped in some areas. Evidence of computers and administrative ICT devices were visible although not all offices or interviewees had dedicated computer systems. Branded trucks were seen loading and leaving the premises under what appeared to be strict scrutiny and checks that were carried out manually.

**Extra Premise**

Trucks branded with Vertex Limited name and symbols were frequently seen parked on highways in all 3 areas visited. Some of the trucks looked laboured and non-roadworthy, whilst several new trucks were observed. In the Port-Harcourt and Abuja regions, it was clear that parked trucks contributed to congestion although they were not the only or main causes, where security roadblocks and bad states of road repair were the main factors inducing congestion.



Figure 6:2 - Vertex Plc truck observed as parked along motorway, presumably awaiting loading

Some of the observed trucks emitted thick, black smoke and some drivers seemed to run at speeds over and above the stipulated speed limits, although it was impossible to say if these trucks were running empty or had products when observations were made At least one truck was noted to have some type of monitoring device on the dashboard area but it was impossible to tell if this was common to all the trucks in their fleet.

#### 6.3.2.2 Archival data

As at the time of writing, the financial reports accessed from the Nigerian Stock Exchange and Blumberg archives did not provide any specific information on sustainability beyond the IFRS requirements for financial statements. Additionally, the company’s website was unavailable at the time of writing.

#### 6.3.2.3 Interview data

**Managerial perceptions of sustainability:**

**Continuity**

Continuity was again identified as a predominant theme from the interview data. The use of continuity was closely aligned with effectiveness and efficiency as opposed to just time implications. The participants combined effectiveness and competitiveness over time as important constructs of sustainability. For example, one of the managers suggests that

“*Sustainability means continued efficiency and effectiveness. If we put that in the downstream context, it would simply be a continued, efficient and effective way of improving your operations. A finance person may probably use the terms ‘bottom line’ or ‘top line’ as you know. It is thus the continued effective and efficient way of managing the downstream sector and by being efficient and effective, it enhances your productivity.*” – Manager V5

From the above reference, there was a sense that the scope of sustainability extended beyond isolated economic considerations, affecting other aspects of operations and productivity. This idea of continuity is corroborated by the archiving manager who suggests that;

“*Personally, I see two words, sustain and ability, ability to sustain but if you say a proper definition, my own little definition I will say something like the “ability to continue a defined behaviour indefinitely” that is my own little definition*” – Manager V1.

The use of the term ‘behaviour’ suggests that the determination of sustainability encompasses actions beyond the financial considerations of the company as a perpetual going concern. The absence of direct social and environmental or ethical implications in the relation of sustainability as a product of continuity planning is noteworthy in this case.

**Functionality**

As with the previous cases, functionality was a common theme in the definitions of sustainability in this case. References to efficiency and effectiveness (doing what ought to be done and doing it well), were effectually captured as implying fitness for purpose. For example, like Manager V5 above, Manager V4 in response to what sustainability meant, stated thus;

“*Sustainability is about improving the efficiency of the operations and also being HSE compliant*”.

Essentially, for this manager, one of the key indications of sustainability is the competency of the systems, to achieve set targets. Perhaps of further importance is the mention of health, safety and environmental (HSE) compliance as a measure of competence. This suggests that beyond the common operational targets, meeting HSE targets was a vital part of how managers construct sustainability over short and long terms.

**Relationship**

Another major recurring theme from the case was relationship management in terms of ‘friendliness or harmonisation with the environment’. This friendliness was linked to operations control measure, with maintenance considered an implementation strategy.

“*Sustainability means to be in control of process or function and to be environmentally friendly. It is about keeping things going in the long run*” – Manager V3

“*I think sustainability has to do with the maintenance of smooth operations in relation to the environment*” – Manager V2.

From the statements above, environmental relations or performance is a measure of sustainability for these managers. In this case, knowledge about sustainability seemed influenced by concerns about the environment and the importance to the long-term future of the business.

**Social sustainability**

In this dimension, performance seemed tied to the peculiarities of the contextual conditions where supply conditions and geographic spread combine to create intense requirement for road transport. This is confirmed by Manager V5 who states:

“*Congestion and social risk; what you have brought up is a robust question; in the sense that I have informed you that Nigeria is an oil importing country, that is our refineries cannot meet local demand hence products are concentrated along coastal lines and therefore distributing these geographically means there is going to be high volumes of products and trucks moving in and out of the coastal regions into the mainland areas. By the coastal areas I mean Lagos, Rivers, Cross River and some parts of Delta state. You would agree with me that the trailer traffic in Abuja couldn’t be compared with the trailer traffic in Port Harcourt. I will tell you that in the south now, it is worse than what you experienced. Now if we were to cut off these people (truckers) without proper alternative distribution channels, it will automatically cause the country to stand still petroleum wise, because one, our railway lines and cargo trains are not functioning, our pipelines are being vandalised*” – Manager V5.

In the light of the above, the main theme of social sustainability was ‘community’, where targeted social programmes are used to ‘pacify’ communities in order to forestall interruptions to the company’s operations. This is evident in the responses of managers who stated that;

“*We work as part of an industry and I am sure that you are aware of the key community issues that obtain in this part of the world. The location of our tank farms and the routes that our journey planning takes are all-important parts of communities. If our business does not give back, then we cannot have anything because our operations will be disrupted. So we always liaise with our communities and provide social amenities in our own little ways. Things like road construction, donation to schools, sponsoring of programmes and other charity stuff are part of the social objectives that we set and pursue as a business…None of our trucks are unduly disturbed on the road and we do not have problems with any communities…In terms of the operations and logistics part of things, we know that some of our operations cause damage, e.g. the consistent travelling of trucks up and down the road can have adverse effect on the life span of the roads, the parking issues, the traffic when there is scarcity and so on and so forth. We cannot pretend that these things don’t happen, so we have to look for ways to compensate our communities and also look for ways to reduce these incidents*.” – Manager V4

“*We do a lot of community work as part of our social responsibility, including things like trainings on IT workshops, skills trainings, gifts, employment and other social programmes that contribute to the welfare of the host communities where we have our depots and other facilities. We also pursue some charity causes supporting homes and different causes. We think that we have a role to play in the welfare of the communities and our responsibility to give something back to our communities*” – Manager V3

“*The Company has a well-packaged social programme with the host community in terms of employment. We have some staff from the community as part of our social objective and in terms of maintaining the access road to this place. Like in the area of employing the community youths, like I mentioned, we have a lot of community youths working here and this is one of the areas that we have the company impacting the social wellbeing of the community. Also in the area of road construction, this is another area where we try to maintain good social relationships with the community*” – Manager V2

From the foregoing data representations, an emerging pattern of social sustainability performance appeared to be focused on developmental programmes that are essentially proactive and reactive measures to keep things going. Proactive measures would include youth employment schemes, charity donations and causes, etc., whilst road construction or reconstruction can be considered reactive measures that directly address some externalities from the company’s general operations and road transportation in particular.

**Economic Sustainability**

Decisions on sales and company assets provided the strongest indicators for economic sustainability performance. Subcontracting part of the transportation arrangement was used to curtail financial risk and thereby enhance opportunities for profits. Manager V5 stated:

“One angle that I will revisit is the decision to sub-contract our transport management. The reason being due some associated risks with managing it all in-house. So from a sustainability angle, it’s not something that we have the complete in-house to manage it all strategically. So by sub-contracting, we share the risks and also improve our economic profits by getting committed transporters on board to help manage these part of our supply chain”.

This claim was corroborated by the logistics manager (V4) who reiterated thus:

“*Economically, we always have to look at what works for us and how best we can operate to stay profitable We are part of the upstream parent body and we all have various objectives. Our decision on where to site our depots, the offices that we have, the number of people we have, the use of technology and using 3rd party transporters are part of our social and economic sustainability decisions. If it can help us save costs, then that means more profits for us and more room to do more and expand more*”.

Of further interest was the reference to technology as a means for enhancing economic sustainability performance as stated above. This point corresponded with the opinion of Manager V3 who repeatedly referred to the economic gains of sustainability.

“*Our IT systems are a critical part of our economic performance and monitoring. Things like profitability are important for us and we have set sales targets for the year that we work with to keep costs down and margins stable*”.

Examples of this practice were linked to the use of IT to monitor drivers’ movements, thereby reducing drivers’ delinquency, which can lead to product loss, quality compromise and security risks. Despite the reference to IT systems as being useful for economic performance, none of the managers had expressly linked IT investment to economic performance.

**Environmental Sustainability**

In terms of environmental sustainability, much of the responses seemed to focus on generic performances that were beyond the logistics and transport functions. In terms of environmental sustainability in the road freight transport process, ‘behavioural influence’ was the main theme in this case and simple measures like speed control and training were proffered as performance aids for the transportation process.

“*Environmentally, we are conscious of a safe working environment and we always make sure that our internal premises are safe spaces, adequately equipping our people to do the right job in the right way. We also know that speed can generate higher pollution risks and spillages, so we train our drivers on good driving and the need for speed limit compliance.*”- Manager V4

Behavioural influence in this case helps to address spills and pollution risks, which are considered the main risks associated with product transportation via road.

### 6.3.3 LUBE NATIONAL

Lube National operates as a subsidiary of one of the national oil companies and identifies growth, market leadership and profitability as key strategic objectives. Just over 15 years in operation, the company is one of the most diverse and largest major companies in the Nigerian petroleum downstream sector. Staff strength is over 1000 and it operates with a fleet of over 4000 branded trucks (largest in the industry) responsible for transporting the majority of 2 billion litres of petroleum products daily. The company controls about 12.5% of the petroleum downstream sector market share and considers transportation as a strategic function that requires an enterprise resource planning (ERP) approach for coordination and optimisation. The firm has 5 main departments (sale and marketing, strategy and planning, finance and accounting, special products and operations) that are jointly responsible for the supply and distribution of petroleum products in conjunction with other national agencies.

Table 6.3 - Lube National Data Summary

|  |  |  |  |
| --- | --- | --- | --- |
| **Case** | **Lube National** | | |
| Instrumentation | Details | Participant Portfolios | Recorded |
| Interviews | 5 Semi-structured interviews with open-ended questions | National Distribution Supervisor  Deputy Manager Supply and Distribution  Area Coordinator  Supply and Distribution Manager (West)  Regional Manager Supply | Yes  No  Yes  Yes  No |
| Observations | 4 major operational premises, branded truck travels | NA | No |
| Public archival documentation | Online statements on CSR, Public Relations and HSE | NA | No |

#### 6.3.3.1 Observation Data

**Premise**

Site visits and observations were made on the 4th, 5th, 10th, 11th and 15th of September, 2015. Supply divisions in the southern part of the country were visited on the 4th and 5th, with some useful visuals around transportation and logistics operations, scope of administrative work and freight loading procedures from the jetty. The head office was heavily secured but with lesser than health and safety signage compared to the other companies visited. Within the S&D departments, computers were clearly visible and in use by employees who seemed to be predominantly occupied with data entry from heaps of paper documents on and around their worktables. Within the tank farm and jetty areas, policy information on safety, health and environmental preservation were auspicious although the condition of some of the internal building structures did not lend credence to practice in these areas. Despite these signs and policy information, the reality in some of the premises was far from safe. For example, hygiene conditions in 3 of the four premises were appalling with visible bio and non-bio wastes lying around. Some of the office spaces were overcrowded and no regard was given to safety or health concerns from the transport vehicles with noticeably dark fumes from exhaust, careless human and vehicle intersections, absence of designated pedestrian pathways and excessive lobbying. Computers, hand held scanners, mobile communications devices and electronic access keys were visible within the different premises visited.

**Extra Premise**

Observation of transportation trucks outside the premises disclosed a range of branded and non-branded trucks as part of the company’s fleet. Branded trucks were seen parked along roadsides and often with visible security escorts. In some areas, trucks queued for loading were observed as visibly contributing to congestion on motorways in Apapa and Port Harcourt areas. There were no observed accidents involving any of their branded trucks. There were both new and old trucks among the truck fleets observed and no observation of truck computers was noted although mobile phones were visible and used by drivers whilst parked along the Apapa areas.

#### 6.3.3.2 Archival data

As a division, no specific data on sustainability was available; however, the group’s policy statement on the issue emphasized its “global citizenship”, investments in social programmes, international certification and technology as some key fundamentals of its management systems to enable corporate social responsibility. Specific references are made in regards of developing risk assessment tools, environmental impact assessment studies, training programmes and waste management guidelines for the group. No specific data on road transport management was available online or otherwise.

#### 6.3.3.3 Interview data

**Managerial perceptions of sustainability:**

**Functionality**

In regards to the question on sustainability conceptualisations, the predominant theme of the managerial narratives was one of functionality. Functionality was used in terms of practicality and pragmatism, i.e. what works for the objective of the organisation at any given point in time. This gave a tone of flexibility to the construction of sustainability within the organisation and this is evident in the response of some of the managers;

“*What we are doing is sustainable in the present situation that we find ourselves, because you can’t find depots in all the states of the country and the fact that there is this rampant vandalization of the pipelines, so the pipelines that link the states and the depots around the country are not available so the only way that you can move the products from one part of the country to the other is through this process of bridging and local loading because we also load to Lagos. So it’s thus sustainable because the depots here are close to the water and vessels are used to bring products to us. Almost all the private depots have their own jetties with pipelines linked to the jetties from where products are discharged to the tank farms…Sustainability is something that works and functions.*” – Manager L3

*“Sustainability to me is the process of sustaining your process or operations to achieve your goals*”. - Manager L4

*“With sustainability, I am sure you know at a time, we had problems of product scarcity where people had to queue and move around to get products. We had a target, which was to make the products available and after meeting that target, it was about attaining a stage where there was product reliability. In this way, the term sustainability now means to sustain that level of availability; making sure we do not go back to the days of scarcity by doing what we can to make sure that the product supply is stabilised and sustained and that is the sustainability we are talking about*”. – Manager L5

Of striking importance in this case, were the contrasting views on time and sustainability, where the ideas on sustainability is closely tied to prevailing conditions at different times and the specific goals of the organisation. At the time of the interviews, the country had just gotten through a bad perennial patch of product (PMS, AGO) scarcity and it would appear that for this organisation, the measure of performance was its ability to make products available rather than profitability or socio-environmental considerations. This also suggests that in times of availability, the construct of sustainability may vary into a more responsive construction of the business environment. Additionally, the futuristic element of sustainability seems to be missing from these conceptualisations of sustainability although one of the managers alluded to this in terms of long-term continuity.

**Social sustainability**

Performance in this area was exemplified through a number of scenarios ranging from cultural influences to bargaining themes. Managers were quick to point out that issues like noise and congestion were not necessarily priorities within the Nigerian culture and therefore did not come as one of the key strategic social issues for addressing. Performance was more targeted towards job opportunities where it was common custom for companies to be seen as providing employment for members of the different communities where they operate. Additionally, the welfare contribution or activities were closely tied to reasons of responsibility or bargaining. Managers presented practices in terms of how the company is demonstrating concern for the welfare of the various communities and this is evidenced by Managers L3 and L1 who both suggest that;

“*We see it as the responsibility of our organisation to also think of the way forward for our host community*” – Manager L3

“*We have built roads as part of our social sustainability, Scholarships to host communities, provision of portable water, roads, schools, hospitals and supply of manpower to operate these facilities*.”- Manager L1

During the coding process for this case, many sub themes like relationship management, infrastructure commitments and governance substitutes were identified as important underlays of the relationship theme as considerations based on the assumption of a responsibility arising from the relationship between firm and the society and the need to demonstrate commitment to these responsibilities via infrastructure commitments, which would ordinarily be perceived as the responsibility of government.

In terms of the bargain theme, social performance was presented as a bargaining tool for the firms where the provision of social services served as an instrument for preventing disruptions to their operations. This point was reiterated by Managers L3 and L5 who suggests that:

“*We see it as the responsibility of our organisation to also think of the way forward for our host community. What if they decide to be restive and disrupt your activities*?” – Manager L3

*“In Nigeria the main issues are around poverty, community welfare and infrastructure. If we have to be sustainable as you say, then the main focus has to be on how we as a company can contribute our quota towards these things otherwise if there is youth unrest or some type of other community problems, we will suffer it too. So most of these things that we do are based on the need to contribute to the most important part of things and that is society”.* - Manager L5

The above impresses the importance and connection of sustainability as a functional issue rather than an abstract consideration for these managers. Other salient themes relating to training and technology were also identified during the coding process.

**Economic Sustainability**

Economically, cost management to prevent losses was the predominant measure in this case. All managers agreed that profit making was not a principal objective of the company. Perhaps the influence of price control mechanisms within the industry, in conjunction with the government funding for the organisation combine to reduce the emphasis on economic sustainability. In this regard, Manager L5 asserts that;

“*Economically, I will say that things are a bit less pressured. We are a big firm but profit making is not our main objective although it is important now that we are no longer internal to the main group. Our economic targets are set around sales and cost management, where we ensure that we do not operate at a loss and we have been doing well so far*”

**Environmental Sustainability**

The predominant theme under this category was “standardised checks”. This reflected the use of visual observation standards to determine acceptable environmental performance. Vehicular checks for *‘smokey exhausts*’ fire indicators, tyre weight checks, were some named measures adopted to promote environmental sustainability. Again, none of the managers linked this to image or economic concerns but rather focused on potential control outcomes as reasons why these measures were put in place. This theme was aggregated from the responses of managers, in regards to how they manage for environmental sustainability in their organisations.

“*In terms of environmental, especially in our inland depots, we ensure that trucks must have a level of safety compliance before they can be allowed into the depots to load. They must carry fire extinguishers such that in the course of loading or driving, if there is any smoke or fire, they should be able to deal with it, the tyres should not be such that the weight can cause it to burst, we wouldn’t also allow a vehicle that is almost dead and “smokey”, causing carbon dioxide to fill the air… we ensure that we do not allow such trucks to load our products*” – Manager L2

Furthermore, Manager L4 also asserted that:

“*On the environmental part, you will see that if we do not make sure that this product is available, people go into all sorts to have it and then go into hawking it in the open (black market). This is not healthy to the environment and in managing petroleum products, one has to look at the safety aspect of it as there can be accidents, spillages and most of these hawkers do not consider these things and this is very unhealthy for the environment*” – Manager L4

The above statement exemplified the social considerations that are linked to environmental performance in this particular case. In addition, the safety rhetoric was less pervasive in this case, seeing that it rarely came up as a substantial part of the discussion with most of the managers interviewed. Overall ideas of environmental sustainability issues centred on product spills, land degradation and carbon dioxide.

### 6.3.4 ORTE PLC

Orte Plc is a leading distributor of petroleum products and distributes over 2 billion litres of products annually. The company has been existence for over 15 years and operates its marketing and distribution in all parts of Nigeria. The company has over 420 branded retail outlets with over 500 staff and controls an average of 18% market share in the downstream sector. The downstream operations comprise of 3 divisions; marketing, supply/ trading and terminals and these are jointly responsible for managing the sourcing, distribution and retailing of petroleum products. Reported fleet size is in excess of 2000 trucks through partnerships and the firm has specialised vendor managed inventory (VMI) facilities, which are coordinated through its Oracle e-business integration platform.

Table 6.4 - Orte Plc Data Summary

|  |  |  |  |
| --- | --- | --- | --- |
| **Case** | **Orte Plc** | | |
| Instrumentation | Details | Participant Portfolios | Recorded |
| Interviews | 4 Semi-structured interviews with open-ended questions | Operations Manager  Regional Transport Manager  Transport Manager  Logistics Manager | Yes  No  No  No |
| Observations | Head office, Operational base | NA | No |
| Public archival documentation | Sustainability Report, 2012-2013, Consolidated Accounts | NA | No |

#### 6.3.4.1 Observation Data

**Premise**

On site visits and observations were made on three occasions (30th July; 19th and 24th August 2016). Truck loading bays and maintenance spaces were observed as part of the visit. Head office design was very contemporary and there were clear and visible signs regarding safety, pedestrian safety, truck standards and environmental policies. Unlike all the other companies visited, the office area was predominantly open-plan, with a visible number of interrelated departmental staff interacting. Product loading areas were visible from some lobbies but no dedicated bulk parking bays were observed within the premise. ICT equipment was visible all around the complex, with barcode scanners, digital monitoring equipment and a dedicated IT server station visible. Contrastingly, at the operational tank farm premise was neat although the space and arrangement seemed compressed in some areas. Heaps of paperwork and filing cabinets were visible and only 2 computers were seen. Mobile phones were observed as being actively used for communication with drivers and discussions over the phone often focused on updated location of deliveries. Some equipment could not be explicitly identified and request for information about their names and use were declined.

Of interest in both instances were roads leading up to the premises. One was under construction and the operational base had a one-sided reinforced path and another half that seemed abandoned. In both cases, the managers stated that the company in conjunction with other companies within the area were responsible for repairing and fixing most roads in the area. Some trucks were noticeably parked alongside the roads leading up to both premises, with drivers waiting to load products for onward delivery. It was unclear how long the trucks had been parked in those locations.

**Extra Premise**

Outside the premise, trucks were observed parked along major motorways, often waiting to be loaded with products or queuing to discharge products at retail stations. In fact, some areas were so badly affected by the incidents of congestion from parked trucks that commuters like me were forced to use alternative sea and motorcycle transport. Some staff suggested that the complex congestion problems influence their choice of where to reside and departure times for work, with some leaving their houses 3 hours before working hours in order to beat the congestion that could last up to 4 hours if they left 20 or 30 minutes later. This also extended to closing times for many who stayed back until very late in order to escape the chaotic traffic from work. It must be said that this was not attributable to just this company’s trucks alone, it was rather prevalent for all the firms observed.



Figure 6:3 - Picture of Orte Plc trucks parked alongside each other on a dual carriage road

Similarly, the condition of some branded vehicles did not seem good enough to be considered roadworthy. Some of the trucks seemed very old, with thick smoke emitting from exhausts indiscriminately. There were no accidents observed and some on-board communication equipment was noticeable upon close inspection of two trucks; recording was declined.

#### 6.3.4.2 Archival data

The company has group sustainability reports that covered all the divisions within the group. These are published in addition to the corporate financial reports and provide useful information regarding the sustainability framework for the divisions within the group. As at the time of searching, only archival reports from 2012-2014 were available although specific information on their website related to sustainability. Specific reference was made regarding the commissioning of a new yard for managing truck parking and easing congestion on the adjoining roads; a direct recognition and response to an externality from their road freight operations. None of the documents specifically addressed carbon emissions from truck travels although the 2014 annual accounts and report (pg. 76) refer to certification by the Standards Organisation of Nigeria (SON), British Safety Institute and ISO 9000/ 14001 as evidence of environmental, health and safety performance. In the 2013 Annual Accounts and Reports document, a plethora of social initiatives relating to education support were outlined as illustrative of CSR performance in addition to safety records. This has been interpreted with caution because it does not specifically address the downstream subsidiary performance but that of the group.

Additionally, web archives reveal that safety is of paramount importance, with references of ‘fitting standards’ for the company’s fleet, regeneration programmes to reduce waste and improve efficiencies, truck tank steel plating thickness to reduce spill in cases of accidental impacts, bonding cables etc. were the topics covered under their transport and logistics segment. Information about drivers training support, reward scheme for efficient performance in line with delivery targets was also indicated in the archives. Conspicuously, none of the information addressed wildlife or carbon emissions.

#### 6.3.4.3 Interview data

**Managerial perceptions of sustainability:**

**Continuity**

In total, four managerial interviews were conducted and the analysis of the interview transcripts highlighted continuity as the predominant theme reflected in the managerial responses regarding sustainability meanings. Phrases like ‘keep things going’ and ‘long period of time’ were commonly used to describe sustainability, making connections between economic, social and environmental dimensions. Excerpts from some of the responses are captured below;

“*Sustainability is based on the way our decision-making activities is harmonised in relation with the environmental, social and economy. The reality for us in Nigeria is that sometimes things are in a mess and we have to make the best of it, so if I can make my operations fulfil the goals of product delivery at the right place and time without any accidents or deaths, then my prospect of continuing in the business is long term and I am not doing anyone any harm*” – Manager O2

“*For me sustainability is practically being able to keep things going for a very long time. I know that there are important responsibilities that we as community stakeholders have to live up to and by being focused on the long term, we have to preserve the environmental integrity of our communities. I also think that sustainability is tied to quality issues, i.e. the ability to do things with good quality reference*” – Manager O3

“*Sustainability basically talks about carrying out a business or process in a manner that it’s repeatable for a long period of time. It doesn’t damage the environment; the business and the business can keep rolling over for a long period of time*” – Manager O1

Continuity seemed constructed along the lines of purpose for which the decisions and actions regarding the environment, communities etc. were maintained. That is to say, however positive the impacts of a performance may be, if they do not promote the continuous existence or operation of the firm, then that performance or action is not a sustainable one. The continuity theme in this case was a useful indicator of the ‘self’ theme, where organisations assume responsibility for their failures and successes. Additionally, the ideas of continuity seemed to correlate with the links between present action and future outcomes, where the decisions and actions by these firms are viewed as directly affecting their prospects, whether immediate or otherwise.

**Relationship**

The idea of relationships as represented by positive harmonisation between the firms and their environments was also common in this case. This was unsurprising since their archival reports revealed some policies around this area. Relationships in this case reflect a sense of responsibility that accompanies the managerial decision-making processes. Again, for what may be considered an obvious link, relationship was very much constructed around the internal and external business environment, where the specific nuances of the peculiar environment affect the nature of the sustainability decision making between firm and company. A good example of how this coded as a result can be seen from the response of Manager O2, who suggested that sustainability involves harmonising decision-making activities in relation with the environmental, social and economic spheres of the business, adding:

“*The reality for us in Nigeria is that sometimes things are in a mess and we have to make the best of it*”. – Manager O2

In summary, the data analysis emphasised these two themes; continuity and responsibility as the dominant categories in this case and they represent the common constructs of sustainability as used in this case.

**Social sustainability**

Social sustainability theme was fairly compliant with the community responsibility angles previously reported. Performance objectives were closely aligned with the perceived requirements of the business environment, where companies played roles in providing community infrastructure at their own costs, whether as a bargaining tool or as a demonstration of their responsiveness to the needs of their communities (see excerpts below).

“*We have had to reconstruct the road at this… street because the single-track nature of the road was causing a lot of hardship to the neighbouring communities. So I guess that as a company that social responsibility is very key for our operations*” -Manager O1

“*The company is very serious about social issues and takes time to make provision for what we consider the best interest of our communities. Orte plc is very much involved in many school programmes and I believe we have won awards in this category. All of this is in addition to road construction works at our different depots areas, participation in training and improving the festive experiences of our people, working across several communities. You know how Nigeria is and the value that people place on these things*”- Manager O4

“*We provide CSR to our landlords and neighbours, e.g. town hall/ people's meetings, dispute resolution. School based management committees*” – Manager O2

As depicted in the statements above, the firm participated in meetings but also importantly engaged in the construction of roads, sponsorship of school programmes and provision of dispute resolution frameworks for their communities. Another manager emphasised the importance of ‘good working relationships’ with their communities, suggesting that the alternative meant disruptions to their trucking operations. Social objectives also extended to preventing accidents although none of the managers specifically addressed the prevailing problem of congestion.

**Economic Sustainability**

Again, cost management was very importance to managers in this case. Transportation outsourcing decisions were driven by cost considerations in addition to expertise. Cost management impacted truck routing decisions and vehicle optimisation strategies. Profits were tied to these practices and it was important for managers to get things right. Similarly, customer objectives contributed as a keen measure of economic sustainability where managers suggested that the ability of their customers to meet their (customers’) business objectives determined whether they could continue to do business in the long run. For example, Manager O4 stated:

“*Useful measures are taken to see beyond the immediate part of our logistics and transport service. The margins are small and volume is important, therefore we need to ensure that our transport and logistics systems are rewarding and enable our customers and partners meet their own business objectives otherwise we lose them and that’s not good*” – Manager O4.

The above statement is corroborated by another manager who suggests that the company’s main measure of economic sustainability is:

“*The ability of our business partners …to meet their business objectives*” – Manager O2

Additionally, the use of technology to aid economic sustainability was mooted by Manager O1, who suggested that a computer aided distribution matrix was employed to aid loading and travel decisions, using modelling software that provides the ‘cheapest possible’ options for optimisation.

**Environmental Sustainability**

The use of health and environmental policies to guide performance was commonly referenced in this case. The company’s policies, which were, developed to meet international standards whilst operating in Nigeria provided the main basis for environmental performance. In line with the nature of their road freight operations, issues like pollution, spills were at the forefront of the environmental issues to campaign against. Manager O3 dictated that due to what he termed as ‘obvious limitations within the Nigerian context’, the firm did not have measures in place to monitor and tackle carbon emissions although the issue was important to the company. This view complies with the findings from the review of the archival documents, where none of the sections on logistics discussed emission control as a key environmental objective.

“*My friend, it is a difficult situation here in Nigeria. We are concerned about the level of pollution in our environment and how the general environment is affected by our actions. Corporate head office in Lagos, we always have the annual CSR and other health and safety programmes, which serve as broad guides for our environmental responsibility. We are concerned about pollution and spillages, particularly from the transportation process and we have frequent trainings for all the involved persons to ensure that these issues are contained and minimized... I must say though that because of obvious limitations within the Nigerian context, we do not really have measures in place to monitor and tackle air emissions although it’s something that we are concerned about*.”- Manager O3

Furthermore, the Operations Manager (O1) was quick to refer to the company’s ISO14002 certification as evidence of their environmental sustainability, suggesting that the ‘standard’ provided the broad scope for their environmental sustainability. This assertion was an interesting point in the sense that it represented a contrasting balance between internal and external measures environmental sustainability where the latter is driven by international practices and the former by the nuances of the operating environment.

### 6.3.5 FLUID PLC

Fluid Plc is one of the major marketing firms in Nigeria and has participated in the distribution and retailing of refined petroleum products for over 100 years trading under different names. It has over 200 branded retail outlets across Nigeria and lays claim to transportation standards leadership within the industry. Revenues over the last 5 years have averaged about £200,000,000.00 (or 70 billion Naira) and staff strength is in the region of 400. The company’s fleet is in excess of 300 trucks mainly held through partnerships with third party transporters and road transport is its main means of moving its petroleum products from one part of the country to another.

Table 6.5 - Fluid Plc Data Summary

|  |  |  |  |
| --- | --- | --- | --- |
| Case | Fluid Plc | | |
| Instrumentation | Details | Participant Portfolios | Recorded |
| Interviews | 3 Semi-structured interviews with open-ended questions | Logistics Manager  Fleet Manager  Transport Executive | Yes  Yes  No |
| Observations | Head office | NA | No |
| Public archival documentation | CSR Report, 2012-2015 Accounts and Reports | NA | No |

#### 6.3.5.1 Observation Data

**Premise**

Two visits were made to the company’s head office in Apapa on the 6th and 27th of August 2015. The premise was heavily secured by armed personnel with a number of security post checks prior to entry. Tank farms and loading areas were clearly marked out from the rest of the premise with some semblance of clear pedestrian pathways. Office areas were mostly open spaces, with desk cubicles in the fleet, transport and logistics department areas. It would seem that most senior management offices were private rooms with opaque glass demarcations between each office. ICT infrastructure was noticeable throughout the office premise, with computers, mobile phones, ICT servers, scanners, LCD screens and machines within the fleet management and logistics office. The loading bay was sighted but not visited as it was closed to members of the public and designated high risk. Overall impression from the observation was one of careful procedures and presentation to minimise risks within the premise. The building and the settings were quite contemporary in design and layout, staff seemed to engage effectively with the transport function, exchanging phone calls, processing travel permit orders, confirmation of loading and fleet allocation during the course of the three-hour observation.

**Extra Premise**

Fluid plc trucks were visible along motorways, freighting refined petroleum products or parked by the road sides. As common with all the other cases, their parked trucks contributed to congestion and sometimes obstructed travel for other vehicles. It was not possible to get into any of the trucks to observe the nature of the equipment on the trucks and so it is difficult to affirm or reject the claims of on board computers (OBCs). Over the course of observations across 30 days, no Fluid plc trucks were seen as involved in accidents or collisions or noticeably broken down along any of the motorways. Some travelling trucks emitted thick smoke from their exhaust but this was a rarity rather than the norm.

#### 6.3.5.2 Archival data

The company’s website offered little information about its own transport values and sustainability although the group (downstream, upstream) website held some useful information about local CSR initiatives and policies that were specific to the downstream operations. Additionally, the CSR and Audited Accounts reports provided some useful themes about the company’s sustainability initiatives and the areas of priority. Archival documents point to social issues like health campaigns, education and training, youth employment, road safety and infrastructure construction as the focus of the company’s sustainability strategies. For example, within the company’s annual reports (2012 to 2015), malaria and teacher training interventions are the only noticeable trace of sustainability performance within the reports.

#### 6.3.5.3 Interview data

**Managerial perceptions of sustainability:**

**Continuity**

Managers in Fluid Plc described sustainability in terms of being able to continue over the long term. This was the common theme of all three responses from managers in this case, linking long term to elements of community partnership, environmental responsibility and safety issues. Expressly, one of the managers advanced their century-long existence within the industry as being evidence of sustainability and emphasizes that the industry is one for long term.

“*Sustainability means continuity, which is long term duration. Logistics in oil and gas sector is a long-term operation. It is a long-term business no doubt about that. The company has been in existence for over 125 years, it’s a long time and it’s bigger*” – Manager F2

Perhaps the reference to continuity is implicative of the ability to survive, grow and remain relevant within the industry. In this sense, all of, community relationships, health and environmental measures are all geared towards enabling the achievement of continuity. As captured by the response below, the idea of sustainability as a measure of a firm’s ability to endure in its operations is potentially influenced by the need to adjust to the requirements of the business environment.

“*Sustainability for me is about how we stay in business and ensure that we respond to the changes in our environment in the right way. We want to be here for the long term and I believe that our records speak for themselves in terms of our revenues, our principles and our commitments to the environment*”. - Manager F3

“*Basically, a starting point is for us to get the types of trucks that meet our standards. The type of standards we operate in Nigeria are typical to the ones operated by \*\*\* in the US, Europe and elsewhere. Because of our peculiar challenges, we sometimes struggle to meet those standards*” – Manager F1

This common long-term dynamism theme was predominant in this case and highlighted the reoccurring meaning of sustainability in this case, whether in terms of its links to community initiatives, environmental responsibility or set standards.

**Social sustainability**

Social sustainability was pursued through a combination of instruments themed along standards, behaviour modification, community contributions and infrastructure development. Standards involved the use of existing external and internal regulatory standards to drive action in this area. For example, the logistics manager referred to the influence of its parent company’s standards as significant source of influence for their performance in this area. Standards were executed through a range of training and inspection regiments for drivers, equipment and travel processes.

“*Then with our drivers, we also ensure that they are properly kitted, as a driver, you must have your helmet, you must have your overall, shoes, goggles etc., and of course if you are going to discharge, you must have the right cables, hoses and the proper safety gadgets. Another thing we also do is to conduct intermittent drugs test to be sure that the drivers are not on drugs and we do this via random sampling upon drivers’ arrival. We take them in for tests on alcohol and drugs, and these are part of the things done to ensure that drivers are not driving under any influence.*” – Manager F1

In addition, reference was made to the numerous community donations that involved the company making regular monetary and infrastructure commitments to different social programmes and persons within local communities.

“*We have built roads as part of our social sustainability.”* – Manager F2

“*We engage our communities in different ways in order to improve the experience as a social community. We have programmes that range from supporting good initiatives and \*\*\* has been known to donate health centres, school blocks and roads to communities as a way of improving our working relationships. It is what has come to be expected in our environment, especially where the government may not be pulling their weight with infrastructure development*” – Manager F3

These community-based commitments seemed to focus largely on areas where the company had bases or were of a visible presence. The use of the term ‘working relationships’ by one of the managers highlights a logic of functionality in the nature of social relationships between the firm and its social sustainability performance. It would also seem that the social commitments like road construction were a direct response to a recurring problem of fuel trucks rolling over and causing accidents. In the opinion of the logistics manager, the bad roads were responsible for the rolling over of trucks; resulting in accidents, fatalities, pollution and economic costs to society.

Perhaps of more interesting significance was the ‘behaviour modification’ theme that strongly featured in the data regarding the use of training and ICT equipment to check corruption amongst drivers on one hand and to appease communities on the other hand.

“*As part of what we do, we believe a lot in training and for the drivers that drive \*\*\* our trucks, just like you have international passports, before any driver drives a \*\*\* truck, they must have gone through our fleet training. After they have gone through both the theory and practical training, they will be certified that they are qualified to drive our trucks and they will be handed what we call a passport. Also periodically, we do refresher trainings periodically to ensure that they do not forget the things that they have learned*” – Manager F1

There was a strong representation of drivers as prone to sharp practices, encouraged by strong trade unions that frustrated firm actions to take preventive actions. One manager suggested that these conditions fostered difficulties on the firm and constrained its ability to curb drink-driving and corruption in the process of transporting their products. In one instance, local ‘area boys’ or touts were also highlighted as a social problem that was unique to Nigeria.

“*In Lagos, Port-Harcourt and most cities in Nigeria, we have the National Union of Road Transport Workers that engage themselves as looking out for the good of the drivers and transporters but are really and truly stumbling blocks to business. They harass transporters, collude with different people and force standards down in exchange for bribes. These are our realities and we have to now engage in training for members of the union, whenever we can lure them to workshops and additionally, we are having to monitor our drivers consistently. People always take advantages of loopholes and we continue have to work to ensure that we curtail loopholes*” – Manager F3

“*I referred to the tanker drivers’ union example. In logistics business in Nigeria, the trade unions are very powerful because whether you like it or not you cannot operate without them and so it has both social and economic implications because if they down tools, it will affect your projected trips and operations. Secondly, the fact that some of these unions get involved in some sharp practices that could lead to shortages and also impose some levy that could be illegal and add to the cost of the products, leading to tampering and causes a shortage on the part of the owners. Sometimes, if you decide to paralyse their operations, the power of the union leadership can lead to blackmail and because there is a union, no one will supply you and you are therefore stranded so these things do have direct implications on your plans…Also in Lagos we have what we call the ‘area boys’ who influence things and these are some of the things that you cannot push away in a developing environment like ours, such that someone in the UK may find very strange but that’s the peculiarity of our environment*” – Manager F1

These “touts” act openly and often disrupt operations for all transporters, sometimes colluding with drivers to divert products, increase journey times and drive recklessly. Companies seem required to commit significant resources towards managing the impact of the actions of ‘area boys’ and this was best done through interventions that helped to moderate behaviours of these actors. In his opinion, the unions and the touts were of the same group and created difficult conditions for the movement of freight trucks. This peculiar conditions required specific social interventions to improve the company’s social performance and its prospects of the firm continuing in business long term. The data also highlighted some instances of potentially worrying social development outcomes where behaviour management initiatives may be creating a less skilled workforce where strict standards lead to the loss of decision making ability by the drivers who were reported as having to abide to a “route card” regime in order to prevent them tampering with products or causing loss of efficiencies.

**Economic Sustainability**

Economically, there was common understanding of profitability as an underlying aim of the business, with key performance indicators set for haulage partners, drivers and units.

“*No company can be successful without being sustainable because sustainability includes manpower and everything. So if you cannot sustain that, then you cannot be successful. If a company is able to meet the P&L (profit and loss) and at the end of the year, you are able to meet your P&L margin and you are able to sustain it. Every company has a target of what they are looking at and so they know their position and should be able to sustain it. And your goals and objectives at the beginning of the year should drive that. Once you are able to achieve that year-end, you know you are on the right track. For us, I can state clearly that we are one of the most ethical companies in Nigeria, if not the best of them all*”. - Manager F2

The data emphasised the importance of safety, quality and brand over strict economic measures like profitability.

“*In \*\*\*, as much as we want to make money (the economic factor) we are very critical about safety and the environment. If you create a business where you are a 100 million naira but if you do not do right and are not considering safety, let’s assume a spillage occurs and people sue the company; you may end up paying over 500 million naira. So when it comes to \*\*\* we say safety first. We do not play with it. We can afford to lose money, we can play down on the economics but we cannot compromise safety and the standards of the environment to ensure that we have a good environment over our economics*” – Manager F1

To paraphrase, profits are only useful to the extent that they are not more expensive than the other costs, hence where economic decisions on profits, efficiencies, sales are in conflict with environmental or social issues, then the expected cause of action is to deprioritise the economic issue because to act otherwise is considered costlier in the long term.

**Environmental Sustainability**

Closely linked to social sustainability, the prevention of spills and waste management was a priority area of environmental performance at Fluid Plc. Certification was the main theme in this case and reference was constantly made to the securing of certification that showed compliance with existing local and international standards on operations within the industry. The attainment of these certification implied compliance and this seemed to have some impact on the brand’s market value. The data did not yield any specifics on the scope of the certifications or the areas that they addressed; however, it would seem that the firm also went beyond ‘certification requirements’ to address other issues like noise pollution and land use. This was deduced from the instructions to drivers to use their horns conservatively and not abuse its use. A similar interpretation was deduced from the provision of dedicated parking spaces for trucks in some areas as stated by the logistics manager (see excerpt below)

“*With respect to noise, one of the things we have said is that ideally, drivers do not use their horns at night unless it is very necessary. In Nigeria, people do not bother but we do this to ensure that our drivers are knowledgeable about sound*.”- Manager F1

It would seem that these extra initiatives did not have significant impact on the value of the brand based on the idea that people do not bother about it. The preventive theme did not apply strongly to carbon emissions although its status as an area of concern was emphasized. The fleet manager referred to ongoing procedures to reduce vapour escape from the trucks during the loading process and stated that this helped to reduce emissions. As with the other cases, it was clear that environmental practices involving intangible factors or substances were not priorities for the firm.

The above concludes the within case analysis of the large firms. This section has seen the presentation of the analysis and results from the large cases that account for over fifty percent of the data. The next section (overleaf) presents the aggregated data for the type 2 cases according to small and medium categories.

## 6.4 Type 2 Cases (Small and Medium Firms)

Small and medium companies account over 35% of the marketing and distribution of petroleum products in Nigeria. They often operate under the umbrella of independent marketer association of Nigeria (IPMAN) and collectively have significant influence on the distribution of products, despite their relatively smaller market share. The firms in this category vary in size and some only operate under business names for the purpose of trade. Although initially excluded from the research design, feedback from conference and journal submissions (Sheffield Doctoral Conference, 2014; European Operations Management Association Conference, 2015), highlighted the prospects of the polar approach to exploring the research phenomena and these category of firms were included in the design and implementation stages of this research.

Archival, observation and interview data were collected from **8 firms** in the industry; Mash Limited (2), AIT Ltd (1), Radar Oil Ltd (1), Phalco Limited (2), Water Energy (1), Honeywell Limited (1), TServe Limited (1) and Skin Limited (1). Semi-structured interviews were conducted with 10 managers/ managing directors, whilst a total of 8 hours of observation and site visits contributed to the findings presented. Due to the eclectic nature of these firms and their business forms, the data from the cases has been aggregated and presented in two categories: small firms and medium firms. All but one of the firms in this category was locally owned and the general management structures varied with some having management boards and some run by single individuals. The next section presents the findings on the medium sized companies with similar market characteristics.

### 6.4.1 MEDIUM FIRMS (Mash Ltd, Phalco Limited, TServe Limited and AIT Ltd – Table 6.6)

**Mash Limited** is a medium sized firm, with over a decade of operational experience within the Nigerian petroleum downstream industry. The company has over 68 staff employed across southern Nigeria and their distribution fleet is in excess of 60. The company has its own trucking and maintenance facilities and provides transport logistics to other smaller firms as part of its asset optimisation programme.

Table 6.6 - Medium Companies Data Summary

|  |  |  |  |
| --- | --- | --- | --- |
| Case | **Mash** | | |
| Instrumentation | Details | Participant Portfolios | Recorded |
| Interviews | 2 Semi-structured interviews with open-ended questions | Line Manager  Head of Operations | No  No |
| Observations | - | NA | No |
| Public archival documentation | Web archive | NA | No |
| Case | **Phalco** | | |
| Interviews | 2 Semi-structured interviews with open-ended questions | Community and HSE Manager  Transport Executive | No  No |
| Observations | - | NA | No |
| Public archival documentation | Web archive | NA | No |
| Case | **TServe** | | |
| Interviews | 1 Semi-structured interview with open-ended questions | Head of Operations | Yes |
| Observations | Operations Office | NA | No |
| Public archival documentation | Web archive | NA | No |
| Case | **AIT Ltd** | | |
| Interviews | 1 Semi-structured interview with open-ended questions | Assistant Manager; Distributions | No |
| Observations | Head office | NA | No |
| Public archival documentation | Web archive | NA | No |

**Phalco Limited** is also a medium sized company in the Nigerian oil and gas industry and has an estimated fleet of between 20-28, 33000-litre trucks that support the distribution of products across southern Nigeria. The company is based in Port Harcourt, Rivers state and has retail outlets from where it often sells products to non-corporate clients.

**TServe** occupies a unique position as a distribution/ transport supplier with little first-hand interest in the marketing of products. The firm has no retail outlets but is a provider of specialised logistics and transport distribution services to the Nigerian petroleum downstream sector, with about 15 years’ industry participation. Unlike the other medium firms, TServe has over 500 trucks within its fleet (some owned and others held under third party logistics arrangements).

**AIT Ltd** is an oil and gas major with interests across upstream and downstream sectors of the Nigerian oil and gas industry. The company has over 20 branded trucks as well as other managed trucks within its fleet. Although the company has been in existence for over 15 years, it only started building its downstream capacity in 2007 and has managed to build competing storage and distribution facilities in less than 8 years.

In presenting the rest of the findings for this set of firms, the limited data from each case and paradigmatic guidelines on community reality influenced the decision to aggregate the findings across the cases, reporting thematic representations that are common to the cases surveyed.

#### 6.4.1.1 Observation Data

**Premise**

Visits were made to one of TServe’s operational bases and the head office of AIT Ltd in the southern part of Nigeria. Security risks prevented visits to either of Mash Ltd or Phalco’s premises in Port-Harcourt Nigeria. Both premises were secured by armed guards with extensive checks at 3 different points prior to entry into the main office area. None of the premises visited had dedicated pedestrian pathways although the TServe premise had many safety instructions, signs and markings across the premise. It was also the only premise where it was compulsory for visitors to have hard hats on as they entered the premise and this was a safety regulation under strict enforcement. A wide range of ICT equipment was visible in both premises with computers, printers and servers visibly strewn across the working areas. Some other electronic devices were seen in use at TServe and these were mostly used for monitoring purposes.

**Extra Premise**

Moving trucks belonging to AIT ltd, Phalco Ltd and Mash Ltd were observed along motorways or parked along smaller roads as depicted in figures 6.4 and 6.5 below.



Figure 6:4 - Trucks parked indiscriminately on roads outside AIT premise, Lagos



Figure 6:5 - Trucks parked in a designated park outside Lube National, Apapa, Lagos

There were clear infrastructure problems in the environment with many roads plagued by potholes or simply in terrible states of repair. Due to the nature of the roads, it was not uncommon to see badly balanced trucks trying to plot their way through treacherous road terrains.

No trucks belonging to any of the firms were observed as involved in accidents although a small number of trucks (3) belonging to Mash Limited and AIT Ltd were observed as emitting visibly thick smoke from their exhausts as they travelled along motorways.

#### 6.4.1.2 Archival data

All four medium-sized firms had websites from where information on sustainability was sourced and examined over the course of 12 months. These pages were monitored for sustainability content in order to identify policy or strategy changes over time. In these cases, web pages contained information about sustainability under the corporate social responsibility themes where each company makes policy statements about sustainability commitments and achievements. In all 4 cases, website data indicated an overwhelming focus on social issues. Commitment areas focused on host community education scholarships, financial donations, infrastructure projects and even ‘political awareness training’. Commitments and performance measures for economic and environmental sustainability are rare, with some references to governance and compliance with international regulatory requirements. TServe and AIT both refer to the use of technology to improve efficiencies for better value delivery to customers, whilst Phalco provides some revenue projections for the group over a 6-year period (2013-2018). Interestingly, some of these company websites capture policies on environmental issues like waste management, water scarcity and environmental impact assessment research as part of their sustainability commitments. The examination of the web archives also suggests that all 4 companies use certification as evidence of performance or at least compliance in terms of sustainability management. These certifications ranged from local awards to international certification like ISO9001.

#### 6.4.1.3 Interview data

**Managerial perceptions of sustainability:**

**Functionality**

The data from all four cases was analysed individually and collectively in order to identify the main themes across these case types. This was important to generate themes that reflect shared community knowledge rather than individual opinions.

In these cases, a predominant theme was functionality in terms of what works. Functionality in this instance was closer in reference to set standards by big contracting companies or regulatory standards to which they had to comply in order to participate in the industry. Perhaps the standards set by the ‘big corporate customers’ was a crucial construct in how these companies make sense of sustainability. Of equal importance was the ability to meet their business obligations without disruptions from and to the environment.

“*It is important to get these things right in today’s business environment and so for us to continue to operate we must be HSE complaint*” – Manager M2

“*For me, being sustainable is about continuing with the methods that work. I know a lot of companies say fancy things but the reality is no one goes further than what works just to impress themselves. Businesses are about profits and this should be in accordance with what the system allows. So we use certain trucks because that is what works, we cannot place age restrictions on our fleet because of what works, so it’s the important thing for me and that’s why I am confident that if you come back next year, this business will still be here*” – PH2“

*Sustainability is all about meeting the needs of our clients in an effective manner while doing this ensuring that the image of the company is protected and causing no harm to people or our environment*” – Manager T1

Functionality was about explicit requirements rather than perceptions of the managers. As with companies, communities were said to often make demands upon the companies and these companies have had to respond to these requirements in order to remain relevant and continue with their operations in the Nigerian petroleum downstream sector. Functionality helped to meet the ‘requirements’ of the environment as a minimum and where possible the maximum for some managers

**Continuity**

Equally, frequent reference was made to long-term survival through the prevention of harm and learning. Sustainability was defineded as essential for continued performance or participation in the industry even affecting competitiveness in the opinion of some managers.

*“In \*\*\*\*, Sustainability for us is how well we are able to keep our business going at the same high level of performance we have set without going bust*” – Manager M2

“*Sustainability literally means that providing for tomorrow today, that is taking the future of all the stakeholders into consideration in all our decision making process*” – Manager AT1

“*In my area of business, sustainability is the process that you engage to make provisions for the future by preparing today with the benefit of hindsight as a guide…sustainability means maintaining our operations in line with the set standards so as make the company compete in the future*” – Manager M1

The above responses allude to learning sub-themes in terms of how continuity is achieved by these businesses. Nonetheless, the role of standards, rules, regulations and expectations cannot be overlooked as influencers of sustainability perceptions amongst managers. Overall, the data on sustainability conceptualisation from these cases suggests strong links between present and future implications, with references that seem to echo survival. Specific dimension themes are discussed next.

**Social sustainability**

In this regard, the key focus was on community initiatives through CSR commitments that ranged from outright philanthropy to bargaining. Philanthropy extended to the provision of monetary and infrastructure support to communities, sometimes without specific links to the firms. In some examples, social sustainability commitments were used as tools to maintain business relationships. Below are some excerpts from responses to how these companies set and pursue their social sustainability objectives;

*“Socially we have to work with different communities and the smooth operation of any business in Nigeria depends on how well the company is settled within and with their community. We carry out projects and often have to liaise with community leaders and representatives over time. We do things at different places and also try to organise some job spaces, contracts and even training for our different communities*.” - Manager T1

“*Sustainability literally means that providing for tomorrow today, that is taking the future of all the stakeholders into consideration in all our decision making process*” - Manager AT1

“*We pay taxes regularly, we have charity and community contributions, we support education and contribute towards small infrastructure here in Port-Harcourt*” - PH1

“*The reality for us is that social issues are very important and things like unemployment, hunger and illness affect our local communities. If you have had some experience, you would notice that we have important issues in our communities and as operators in the community, we need to do something to support our people otherwise we suffer the backlash. I don’t want to go into too many details but we have festive contributions and projects that we execute, we have employment programmes, we have people that provide healthcare services and we do a lot of philanthropy as part of our annual goals* – Manager M1

“*In trying to adhere to our social sustainability objectives we have some rules that guide us and some set standards that dictate what we do to make sure we are totally compliant. The important thing is to operate in a way that helps our community and us a s a business. Nigeria is a tough place and communities have strong powers these days. If you do not cooperate with the community, you will have yourself to blame*”- Manager M2

Bargaining involved commitments to job provision, contract and training for ‘involved communities’ in order to avert confrontation between the company and its host communities. In these instances, the stakes were higher and it would seem that the terms were less arbitrary and more from a negotiated process. Some of the responses raise concerns about the claims as to philanthropy by managers as it would seem that some communities compel these firms to act and this in itself is an interesting dynamic to the corporate responsibility pictures they argue for.

**Economic Sustainability**

The data from the participants in these cases highlighted profits, cost management and compliance as main objectives for economic sustainability. Profit margins were mostly regulated through government estimates and road freight transport efficiencies were critical to achieving those margins. One strategy for economic sustainability was through investments in research and development that enabled better operational efficiencies that help to improve profits; this was a unique reference from the interview data. Another account linked economic sustainability to social priorities, suggesting that the social practices influence profitability;

“*Our economic sustainability is tied to our social sustainability. In fact, we believe that the whole things work as one. To ensure you stay in our type of business, everything must be working well together…our aim is to make continuous and sustainable reasonable profit by making sure we have the best trucks, pay our drivers better than others to deliver and keep up the quality of our goods. It may sound like a waste of money at first, but in the long run it helps because our drivers are well motivated to do their jobs the right way which reduces the cases of accidents and loss of products and other compensations. It also helps retain our customers and save us money in adverts*” – Manager M2

Some very interesting claims but clear strategy deductions in terms of linking good social practices like driver pay to road transport performance and savings on externality costs. This is particularly instructive in an industry sector where margins are small and economic efforts are mostly concentrated on managing costs.

In terms of compliance, this stretched to the regulatory requirements that govern the way companies operate in the industry, including taxation, levies etc., which form part of pre and post transportation costs. The alternative to compliance is grave with reference made to closures as a result of sharp practices.

“*For example I know some people who have had their businesses closed down for sharp practices but they are sometimes trying to survive*”- Manager M1

Sharp practices refer to malpractice or corruption of processes where transporters and marketers may avoid paying for products, tampering with product quality or quantity, or fabricating costs for unfulfilled deliveries.

As earlier stated, the majority of economic performance was centred on cost-cutting measures that improved sales and enhanced profits. Almost all the managerial responses cited the need to cut costs in order to break even or make profits and transportation was one of those areas where they saw opportunities to lower cost margins. The information on cost cutting did not provide any specific measures or narratives.

**Environmental Sustainability**

Equipment quality was the main theme in this dimension. Across these cases, managers placed emphasis on the conditioning and suitability of the trucks and tankers that their firms used. The common belief followed the perception that investing in the right kind of equipment provides environmental benefits that can help stem degradation, carbon footprint and spillage. Additionally, maintenance and regular checks were mentioned as important part of the health, safety and the environment.

*“We invest heavily on equipment that will help reduce pollution. Oil and gas leaves a lot of environmental degradation, we train all our staff on the basic ways of reducing our carbon footprint, we encourage recycling thereby reducing the waste that goes to the landfill. We have a procedure to temporary address spillage from our trucks; we religiously carry out check on our trucks. We train our health and safety to all our staff, there is a health and safety expert in all our offices and installations*” – Manager AT1

“*We do this by the way we approach our transportation. We start with making sure that our trucks are in very good condition and that our drivers are qualified to drive, well trained and physically fit to use the road. What this does is that it helps reduce the harms done to the environment by exercise carbon emissions from bad truck, reduce cases of avoidable accidents which lead to the spillage of petroleum products on the roads which you know have adverse effect on the environment*”. – Manager M1

“*Although nobody pays serious attention unless you have accidents or big fires, we have a good sense of responsibility and are investing in our trucks to make all our fleet new and current. New trucks don’t smoke and we think that’s the right way to affect the environment as per transport*” – Manager PH2.

Admittedly, whilst spillages from accidents may be the biggest environmental concern in the industry, some of the responses in this case, demonstrate a wider concern that covers the impact of smoke and other air pollutants.

The above discussion concludes the report of results from medium sized companies. The next section (overleaf) will discuss the data on the small companies. As previously mentioned, the presentation is aggregated to highlight the predominant content and thematic findings across the different data sources.

### 6.4.2 SMALL FIRMS (Skin Limited, Radar Oil Ltd, Honeywell Limited and Water Energy - Table 6.7)

**Skin Limited** is one of the fastest growing downstream operations firms in Nigeria. Their staff strength is estimated at about 25 people and the company is mainly focused on the distribution of petroleum products. They do not own any transport assets but engage third parties in order to transport and distribute their petroleum products.

|  |  |  |  |
| --- | --- | --- | --- |
| Case | Skin | | |
| Instrumentation | Details | Participant Portfolios | Recorded |
| Interviews | 1 Semi-structured interview with open-ended questions | Head of Operations | Yes |
| Observations | - | NA | No |
| Archival documentation | Web archive | NA | No |
| Case | Radar | | |
| Interviews | 1 Semi-structured interview with open-ended questions | Regional Manager | No |
| Observations | - | NA | No |
| Archival documentation | - | NA | No |
| Case | Honeywell | | |
| Interviews | 1 Semi-structured interview with open-ended questions | Managing Director | No |
| Observations | - | NA | No |
| Archival documentation | - | NA | No |
| Case | Water Energy | | |
| Interviews | 1 Semi-structured interview with open-ended questions | Managing Director | No |
| Observations | Head Office | NA | No |
| Archival documentation | - | NA | No |

Table 6.7 - Small Companies Data Summary

**Radar Oil Limited** is also based in the southern parts of Nigeria and they transport and distribute products from Lagos to other parts of Nigeria. Daily number of loaded trucks average about 5 trucks with maximum peak of 12 trucks (33,000 and 60,000 litres) daily. The company also employs other water systems to transport products using barges to make deliveries to big corporate clients and remote riverine bases. Staff strength is less than 30 and all delivery trucks are not owned but held under hire agreements from third parties.

**Honeywell Limited** is a small firm based in southwestern Nigeria with staff strength of less than 10 persons. The company’s M.D oversees the planning and day-to-day operations in conjunction with a manager who also oversees their retail base. The company distributes about 20-30 tankers of petroleum products on a month basis, using third party trucks to move the products. The company has ownership of two trucks and is focused on growth prospects within the industry.

**Water Energy** Ltd is a small business with interests in the procurement and distribution of petroleum products. The managing director (MD) runs the business in conjunction with four other staff, which includes the company driver. Deliveries are ad hoc and based on allocation success from bids. Based in Rivers state (southern Nigeria) the firm has one truck and hires it out to other contractors when the opportunity arises. On average, their truck undertook 4-6 deliveries monthly and sometimes less when products were scarce.

#### 6.4.2.1 Observation Data

**Premise**

Only the office of Water Energy was visited and observed during the course of empirical data collection. The premise was an open gas station, with a service building that house about 3 offices and conveniences. A number of safety signs were visible and the ground area showed signs of oil spill stains that were possibly from the transfer of products from the trucks into the underground storage tanks. 2 computers were noticeable within the complex, one in the MD’s office and another in the reception office. Other office equipment like printers and document holders were also visible alongside a number of certification and licenses that were on display for all to see.

**Extra Premise**

No specific observation of trucks belonging to any of the small firms was made. It was impossible to tell which truck belonged to which company since they were mostly non-branded trucks.

#### 6.4.2.2 Archival data

No specific archival data that related to sustainability was found in most instances. Only Skin Ltd had a functional web page and it offered no information on sustainability.

#### 6.4.2.3 Interview data

**Managerial perceptions of sustainability:**

**Continuity**

The data analysis highlighted continuity as the main conceptual theme from these cases. Management was quite concerned about ‘being able to continue’ and ‘long time’. This objective of time was used as a connection between the present performance of the business and its aspirations to continue as a growing concern as captured by the managers below

“*Sustainability is to be able to sustain business for a long time. You have to do what you have to do to make sure that your business operations are smooth. Pay taxes, comply with HSE and keep your employees happy so that they do not try to cheat you. If you combine this with good philanthropy, then things are positive*” – Managing Director W

“*Sustainability means capacity to endure i.e. being able to continue something. So for us in \*\*\*, we have a new slogan that says ‘committed to better energy’, that is the new slogan for \*\*\*, so everything \*\*\* engage in, we offer solutions and structure our processes in a way that it creates a sustainable business environment and also we function in a way that it wouldn’t impact so much on our business network and the environment. Also sustainability incorporates quality, security, safety and all that. Therefore, being able to carry out activities in a way that you can continue doing them without affecting the business*” – Managing Director H

Coincidentally, the two responses quoted above represent the views of business owners who also acted as managing directors in their companies.

**Relativity**

Relativity encompasses the localisation of sustainability constructs to reflect the nuances of the local community in which the business operates. The views of the Operations Head and Regional manager for Skin Ltd and Radar Oil focused more on the performance aspects of sustainability without necessarily linking these performance objectives to long term or continuity. For example, the Operations Head at Skin Ltd and Regional Manager for Radar Oil describe sustainability as;

“*The management and coordination of the environmental, social and financial demands to ensure success. It encompasses for example the social understanding of the social and environmental ways of the local people in Calabar area and harnessing such understanding to our organisation’s success*.” – Operations Head S

“*The way we organise our operations so as not affect the various local stakeholders which is usually quality of human life, environment*.” Regional Manager R

Perhaps the focus on the operational outcomes is influenced by the performance measures that the different managers are exposed to; yet, the relevance of their conceptualisation remains noteworthy. The localisation of sustainability and the critical roles of quality, social understanding and environmental performance underline the relativity of sustainability understanding among the various managers. For them, where performance met the expectations of the immediate business environment, then that performance is adjudged as sustainable.

**Social sustainability**

In terms of sustainability, the focus was predominantly on social issues. In all four cases, there was a strong sense of relationship between the firms and their local communities where investments in social programmes like the ‘Hide Trust’, which is an orphanage initiative that caters to underprivileged kids; community awareness and developmental projects.

*“We also educate the communities on the reason not to scoop fuel from an accident truck. We get involved with community-based projects. We promote the three Rs; reduce, reuse, recycle*.” - Manager R1

“*As a company, we have a programme called “Hide Trust” that was initiated in our operational communities. It’s a way of getting to know the community and then providing support to the less privileged children*” - Manager S1

“I will say we practice good business and also help our neighbours and local communities when possible. Some of the people employed here today are from the community and the business donates to good educational causes from time to time” – Manager W1

As referenced above, whilst these issues seemed critical to the companies, there was little to link these initiatives to competitive benefits beyond the ‘bargaining’ perception of community necessities. The ubiquity of this understanding and performance was interpreted as an indication of its widespread acceptance in the business environment.

**Economic Sustainability**

Economically, the profit was the main theme. All managers acceded to the point of their businesses being for reasons of making profits and this extends to pricing decisions, routing and location as well as fairness.

“*Economically, we try to do business in the most fair and conducive manner. We work to reach mutual expectations and benefits with our partners and customers and ensure that we meet these goals as well as stay within regulatory boundaries. We try to import and distribute products according the laws of the land.*” – Manager S1

“*Well business is about profit. Our company is in business to make profits and we have to look at this carefully. In some areas, we have to sell above the official price if we are to make profit and this is because we have to create some margins after the different charges. We hope that the government will open things up or pay more for transport when we deliver to certain locations. Some marketers may do so to cheat people but we stay within the margins of what is right making about 5 naira per litre or even less*” – Manager H1

Pricing/ cost decisions seemed to be the main mechanism for achieving profits, with some emphasis on regulatory limitations for distribution etc.

**Environmental Sustainability**

Environmentally, performance ranged from the reducing journey times, tree planting, spillage prevention and relationship management. Spillage prevention was the main environmental challenge and the prevention of spills was a principal aim of these firms. The managing director of Honeywell Limited sums this up by saying that;

“*We do not do anything that damages the environment and although we cannot always do everything like the western people, we are trying as a company and if you check, spillages etc. have all reduced. Things are much better now than they were many years ago but the states of our trucks have to improve*”.

Again, the remit of environmental performance was intriguing because unlike all the other cases surveyed, one manager in this instance addressed tree planting as one of the performance activities of his company although the link between this activity and the firm was not established.

## 6.5 Sustainability Perceptions and Practice Summary

The aim of the results presented in the section was to report the results from content and thematic analyses of the data relating to sustainability meanings and application in the downstream industry. This was tailored to address parts of RQ2 (managerial perceptions of sustainability) as well as RO1 & RO2 (RFT operations in the downstream industry and managerial narratives on sustainability). These results provide a good foundation for the subsequent discussions on ICT deployment and strategies (RO2, RQ1, RQ2 and RQ3) which will in turn enable the fulfilment of RO3 as an outcome of RQ4 (assessment tool for ICT based sustainability performance in the industry).

Overall, the data from these sets of cases confirm the appropriation of the triple bottom line approach to sustainability albeit in varying degrees of importance. These results from the thematic analysis of the empirical data revealed sustainability as an important area of business knowledge and performance in the Nigerian petroleum downstream industry. The predominant grasp of sustainability in this instance can be best understood alongside a situational framework that accounts for operating environment and time considerations, with functionality and continuity as the main constructs around which managerial perceptions of sustainability are built.

Additionally, the 3BL sustainability dimension is uniform across the industry with affirmation of social, economic and environmental dimensions as key performance areas across all the class of cases sampled. However, it would seem that concentration on social and economic practices are prioritised over and above environmental practices, where commitments to tackling external social challenges are voluntarily or involuntarily prioritised by firms in the industry. Furthermore, the reported results of the analysis highlights weak links between environmental performance and company prospects compared to social issues where performance was commonly used as a bargaining tool to promote community and firm interests. The next section of this chapter narrows in on the findings to the critical component of ICT from a cross-case perspective.

## 6.6 ICT Use (Cross-Case Analysis)

The use of information and communication technology was common within the industry and all the cases surveyed had some form of ICT mechanism in use. The most common ICT mechanisms were computers and mobile phones, with Microsoft office software as the basic software component of computer infrastructure. Mobile phones were the most common items in use, providing essential communication links in the road freight transport operations within the industry.

To determine the concept and scope of ICT within the cases, managers were asked what ICT equipment was used in their respective companies and in their day-to-day running of the operations. The next step was to extract the information relating to ICT and then make sense of the typologies, uses and importance of each of the items that were mentioned. Table 6.8 below highlights these items and their use.

Concerning ICT information component, the data analysis revealed three main themes; monitoring, accountability and visibility. These themes captured the predominant reasons for ICT use during the process of transporting products via road and they are discussed in further detail below.

1. **Monitoring** captured information relating to the exercise of oversight over the activities of different parties during road freight transport.

*“Importantly, we have a tracking platform and a tracking department that monitors all trucks and ensure they comply with assigned authorized routes. In this plan, drivers are expected to drive for some hours and rest for some hours daily*.” – Manager T-Serve

The most common ‘subject’ of monitoring were truck drivers. Many managers were quick to highlight drivers’ inclinations to act unprofessionally in the absence of monitoring information.

*I think it is very important. Drivers we know can be dishonest, they don’t tell the truth, some of them are not properly trained, they don’t know how to do the right thing and these things are there to monitor them. Because if someone knows that he is being monitored, someone knows that if he stops where he is not supposed to stop, if he is parked on the express, if he is over speeding, someone is checking and is going to sanction him at the end of the day, then it will reduce and mitigate such occurrences.*” – Manager D (ABS)

Mobile phones, on-board computers (OBCs) and computers (desktops and laptops) were the most common complementary hardware in these cases, with Microsoft Office and some specific GIS programmes providing the software elements of the systems.

1. **Accountability** relates to information for records and audit purposes. ICT infrastructure helped managers to generate reports, file records and fulfil their obligations as part of their performance goals.

*“I think that because we have accessible and accountable systems, many clients see us as reliable and it has positioned us as the number one transporting service firm in the industry… This is useful for making a good case for how ICT is helping our business. Also none of our products go missing or have problems because we are accountable to our clients and so ICT is enabling us to achieve these things and giving us the advantage over the other firms” Manager* - T-Serve

*Well communications is crucial in this business. Sales, deliveries can be dependent on communication and records. E.g. PEF requires proof of delivery, they require different documentations and all the rest, without these communication devices, we cannot meet up –* Ops. Head Mas Energy

*The whole company is automated so without the computers, you cannot operate. … so without those devices the company is shut down. No work, it is as simple as that* – Manager F2

*It’s quite important, it is important because our processes are designed around ICT. So, it important for me to be able to program a truck on oracle and send the truck on out. Now can I literally tell the truck to drive out? Yes, I can but it wouldn’t be recorded as a sale if it’s not done via the platform; it’s not a sale until oracle has seen it*.” – Manager O1 (Orte plc)

For example, the information objective of using computers seemed geared towards enabling managers use software to generate Microsoft worksheets and reports. In the same vein, the use of ORACLE and SAP systems was reported as aiding records of transactions and this was a key part of the firm strategies to aid evaluation and stewardship. In particular, the AQUILA[[9]](#footnote-9) program’s main purpose is to generate tracking and tracing information on the movement of petroleum products via road in order to help the federal government compensate firms for transport mileage. This system was setup to improve records and audit trails were considered crucial to stemming the rising corruption of the transport miles claims systems in the industry. In an interview, a regional coordinator of the programme emphatically stated that the accuracy of records and payment audits would be impossible without the use of ICT.

1. **Visibility** was the most common ICT theme and it provided both social and economic benefits across the road freight transport operations. The access to and sharing of information about truck movements, truck inventories, truck availability as well as supplier and customer access to data were considered vital information components of ICT.

“*We have tracking systems to track wherever the driver is. We also have radio systems for communicating and they all have emergency contact numbers on a card. We know the implication of having spills because apart from the fact that if there is an explosion, people could lose their lives, we know that it can lead to contamination of underground water and others and we are very mindful. In event of an accident, the drivers get in touch with the haulier, the office, fire-fighters to ensure that these things do not go out of hand…They are very important to ensure that we are notified or informed of the loading and arrival of the products at different terminals. It does make things a lot easier for us in terms of keeping track of our products. So, for example if we are supplying a customer, we have to be aware and keep track of the product movement through the tracking devices…A few years back in Nigeria before we had GSM technology, to communicate was very, very difficult but now with Internet facilities and connectivity, everybody is virtually online. A common driver can now send messages online. So, technology has actually helped out …, I will say that a lot of efficiency is aided by technology*” – Manager F1

*“Like I said, with the trucks that we use, we have the on-board computers (OBC) that people monitor. If there is an accident, there is an alarm, if there is a hijack or robbery, there are alerts to the office as to what is going on, so it helps us to know the movement of the trucks”* – Manager A (ABS)

Again, enterprise resource planning programmes like SAP, ORACLE, GAL, Phones (mobiles) were advanced as important components of the visibility infrastructure for all the companies. Visibility via mobile phones was determined as somewhat limited in terms of the integrity of the data that it generated for managers; this was due to the inability of drivers to give accurate information about their travels. Importantly, none of the interviewees highlighted the associated road safety risks from the use of mobile phones whilst driving as opposed to other devices that aid visibility without interrupting the drivers’ ability to concentrate on their road tasks.

### 6.6.1 ICT and Sustainability

Table 6.8 gives an overview of the findings from the cross-case analysis detailing scope, use and rationales for ICT use. In reference to the information matrix in Table 6.8, the interview data suggests that the use of ICT is mostly concentrated on the social and economic aspects of the business’ operations.

#### 6.6.1.1 ICT and Environmental Sustainability

Few firms referred to environmental gains through ICT, with emission avoidance from reduce travel frequencies and spill-valve control systems presented as the main environmental gains from the use of ICT in road freight operations. Of the thirteen firms, only three established significant links between their ICT components and environmental issues although it would seem that the absence of stronger links was influenced by limited perceptions on integrating strategy into their planning and practice for ICT use in road freight transport operations.

Table .- ICT use across cases with details of components, outcomes and stated rationales for use

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Case | ICT Use | | | ICT Component | | | Perceived Outcome | | Rationale |
| Soc. | Eco. | Env. | Software | Information | Hardware | Comp. Adv. | Other | Themes |
| ABS Limited | ✓ | ✓ | ✓ | SM Web, SAP, Optitune, MS Office, EQ | Sales, driver location, training, records, speed, delivery confirmation | OBCs, Printers, Computer Servers, Phones | Yes | Safety, accessibility | Efficiency, accident prevention, travel emissions control,  Community training |
| Lube National | ✓ | ✓ |  | SAP, MS Office, ORACLE,  AQUILLA | Driver location, speed, delivery confirmation, training delivery | Accuload meters, Computers, Printers, iPads, OBCs, Flow meters, Cameras Barcodes, | Yes | Image, reliability, | Visibility, efficiency, accident prevention,  Community training |
| Fluid Plc | ✓ | ✓ | ✓ | ERP, SAP, | Driver routes & location, sales, scheduling | Computers. Tracking device, Phones | Neutral | Threshold, safety | Efficiency, accident prevention |
| Vertex Plc | ✓ | ✓ |  | SAP, EBT, ORACLE, GIS programmes, QR Coding, MS Office, AQUILLA | Sales, monitoring, inventory records, training content | Radios, Computers, phones, OBCs, GPS trackers, intercom | Yes | reliability, accessibility, safety | Efficiency, communication,  Community training |
| Orte Plc | ✓ | ✓ |  | ERP, SAP, MS Office, geo- trackers | Speed, scheduling, records and reporting | Computers, phones, printer scanners, computer servers, tracking devices | Neutral | Threshold, accessibility,  short-term adv. | Fleet optimisation, visibility, industry standard |
| Mash | ✓ |  |  | Google maps, | Records, Reports | Mobile phones, computers, printers | Yes | Safety, accessibility | Visibility, efficiency, sales |
| Phalco | ✓ | ✓ |  | ERP, Google maps, AQUILLA | Sales, records, | Computers, phones, | Yes | Safety, image, reliability | Accident prevention, efficiency |
| TServe | ✓ | ✓ |  | Barcodes, AQUILLA | Records, location, sales | GPS trackers, computers, | Yes | Safety, image | Visibility, efficiency |
| AIT | ✓ | ✓ |  | MS Office, Google Maps | Records | Computers, GPS trackers, Phones | Yes | Image | Records, training, accident prevention |
| Skin |  | ✓ |  | GAL software | Accountability  Visibility | Phones, Tracking devices, | Yes | Accessibility | Efficiency, audit, learning |
| Honeywell |  | ✓ |  | MS Office | Visibility | Computers, phones | Yes | Loss prevention | Visibility, communication |
| Radar | ✓ | ✓ |  | MS Office, WhatsApp | Monitoring, | Computers, phones | No | Threshold | Inventory management, monitoring |
| Water Energy | ✓ | ✓ |  | MS Office | Monitoring,  Accountability | Phones, trackers, computers | Neutral | Threshold | Inventory management |

#### 6.6.1.2 ICT and Economic Sustainability

From the table above, the use of ICT to achieve economic goals like cost reduction and profitability was significantly high across all the firms surveyed. There was some acceptance of ICT systems as a threshold requirement in the industry, i.e. every firm should have them to operate in the industry. ICT devices were stated as helping to improve efficiencies through employee monitoring, travel route planning, communication ease and improved process visibility. For example, the Distribution supervisor at Lube National claimed that the use of tracking devices and SAP had enabled the company to better manage its product transportation processes. This was because prior to the introduction of ICT, sub-contractors would often make claims for services that they had rendered improperly and the company would have to pay even though there was no independent way of verifying the sub-contractors’ claims. The introduction of tracking devices has helped reduce these incidents drastically, helping to save costs and improve profits. This narrative was corroborated by the coordinator of the Petroleum Equalisation Fund’s (PEF Agency) AQUILA programme who (as captured below) emphasized problems within the road freight transport operations in the industry.

“*What we do is to make sure that the products actually reach their destinations. This is because my organisation pays claims called bridging allowances for the people transporting products over a particular distance; for example, the people transporting products from Lagos to Kaduna. The reason why the government started doing this is because its wants to ensure the uniform pricing system; such that the person buying in Kaduna can buy at the same price as the person buying in Kaduna and the marketer (sic) cannot charge that to the customer. So bridging is a transportation allowance that ensures that the price is uniform across the country. Wherever you pick your products, it is not an excuse to sell above the regulated price. In order to make sure that people do not ‘beat us to it’ we monitor them to ensure that they actually take the products to destinations that they are claiming that they are going to…people divert products. They can tell you that they are going to Kaduna but we find out that this wasn’t the case, they may sell the product in Lagos or take the products to Ibadan but yet they would want to claim the transportation allowance to Kaduna*.” - PEF Coordinator (West)

For managers, ICT systems helped to promote economic visibility that was important for their profitability, however it would also seem that nature of the industry itself as a highly regulated environment created specific problems for these businesses. The government’s attempts to fix prices and pay transport compensation were considered responsible for the sharp practices managers complained about.

Additionally, the idea of ‘bridging’, which meant that all trucks travelling into certain zones, had to report first to the zonal headquarters before moving on to make their final deliveries was extremely wasteful. This practice was compulsory, even in scenarios where the trucks had to drive past the delivery destinations to the zonal headquarters that was over 50 miles away and then return back to make the delivery discharge. It not only increased costs and risks, but also encouraged extra miles that were unjustifiable for the environment and drivers’ welfare. This made it plausible for products allocated for farther areas to be diverted to nearer areas whilst still putting in claims for mileage to the original destinations. Whether or not this fraudulent practice was implemented in connivance between management and the drivers was unclear but there seemed to be a strong case that the drivers often acted on their own volition, to the detriment of the company who had to manage disappointed customers.

Additionally, generic ICT systems like computers and the accompanying software were presented as efficiency enablers. The managers believed that these systems helped improve their ability to do their jobs and in some cases, managers suggested that they could not perform at all without these systems in place. In ABS Limited, the distribution, plant and lubricant managers all linked ICT to competitive advantage citing customer sales access, internal cooperation and speed as some benefits of ICT that have translated to competitive advantage.

Additionally, managers in ABS Limited, Lube National and Vertex Limited stated that they believed that some of their customers chose them because of the positive image that their deployment of ICT created for their business. The expansive use of ICT was seen as a desirable attribute in these firms and ‘made the customers see them as reliable’. In complete contrast to the rest of the cases, Mash Limited’s managers did not state any economic benefits from the use of ICT. Although they both acknowledged its role in improving market accessibility, they did not link this accessibility to any economic indicator in terms of a causal relationship outcome.

Surprisingly, managers in cases like Fluid Limited, Orte Plc, Radar and Water Energy refused to link ICT to competitive advantage. For the managers in Fluid Limited, the challenge was the issue of ‘sustained advantage’, i.e. the advantage gained from these systems (if any) were open to imitation and therefore could not provide any sustained benefits over the competition. The managers in Orte Plc and Water energy aligned with this position but put their opinions down to the absence of reliable data to drive such claims.

#### 6.6.1.3 ICT and Social Sustainability

ICT deployment for social sustainability was also a common theme from the data. The main themes associated with objectives in this area include personnel/ community training, accident prevention through speed-management devices and for the improvement of road transport safety.

On board computers (OBC) and speed tracking devices were the common ICT instruments used for addressing accidents. The transition to use or adopt ICT mechanisms for addressing accidents was not without some resistance from drivers and unions who objected to their use. For example, Orte plc reported a reduction in accidents by over 60% over the period that they have implemented them, ABS Limited and Lube National had experiences of having to run consultations and conducting overseas demonstrations for driver and union representatives.

In terms of the use of ICT devices for community trainings, the data revealed the use of computers, mobile phones and printing devices to aid social programmes by the firms surveyed. For example, Vertex Limited, Lube National, ABS Limited and Phalco all conducted community health and skills programmes for young people within their communities using ICT. ICT was the principal mechanism for implementing these programmes, with many examples of skill acquisition workshops being run using ICT devices owned by these companies. Also, many community health programmes were being implemented and supported using ICT mechanisms like websites, laptops and other mobile phones. These practices were connected to sensitisation programmes on malaria, air quality and petroleum fires sensitization, some of which are direct social consequences of petroleum products transporting. It was impossible to reach any credible conclusions on the impact of such uses of ICT to aid social practices.

From the foregoing, several topical issues seem to be of significance in promoting sustainable road freight transport in the Nigerian petroleum downstream industry. These issues include, *accident prevention* *and recovery*, *brand management, congestion management, training (community and employee), profits, safety, sales, spill prevention and recovery, security, efficiency and communication*. These issues represent some specified objectives that management are currently pursuing within the industry’s transport operations. For example, managers from ABS Limited link their use of ICT to sales, superior profits, accident prevention and spill recovery. This is similar to the accounts from the managers in Orte Plc, Vertex Limited and Tserve, who also link profits, safety and welfare objectives to ICT use. With the exclusion of the community projects, trainings, spill prevention and health campaign objectives, several of these objectives correspond with the literature around ICT use for road freight transport sustainability (Wang et al., 2015; Sternberg et al., 2014; Palsson and Kovacs, 2014; Marchet et al., 2012). For example, Wang et al., (2015) identify strategic links between emission control and ICT use, corroborating the previous works of Davies et al., (2007), whilst Sternberg et al., (2014) and Button et al., (2001) establish safety, health and communication benefits from the deployment of ICT in road freight transport operations. However, the data analysis highlights some unique characteristics of industries like the Nigerian petroleum downstream, with implications for product freight and transport sustainability. One important outcome from the literature and empirical data analysis is the absence of specific sustainability framework tools to support management strategy in an industry like the petroleum downstream sector (Yusuf et al., 2013; Dong and Burrit, 2010).

With regards to the specifics of emissions control, energy management, gender opportunities and land use management as some sustainability objectives to pursue in future. It may be useful to develop a bespoke framework that will help to highlight these objectives and support managers within the industry in terms of integrating social, economic and environmental objectives within their road freight transport sustainability framework. This observation is discussed in Chapter 7.11, where a draft tool is proposed to address the gap.

## 6.7 Summary

This chapter has discussed the data analysis structure and the results of both the content and thematic analyses of the data. Themes across sustainability meanings, sustainability dimensions and ICT use for sustainability were discussed from both within and cross case perspectives. Results highlighted emphasis on economic and social sustainability objectives that reflected in the use of ICT resources for sustainability across the firms. In the next chapter, the reported results are subjected to evaluation against the extant literature. The outcomes and implications are reviewed in line with the set research objectives, questions and conceptual framework for validation.

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7. Discussion

## 7.1 Introduction

The previous chapter presented the results and findings from the triangulated analyses of the empirical data. Findings relating to local sustainability conceptualisations, ICT mechanisms and strategies for promoting road freight sustainability as well as strategic objectives across the 13 cases were established. This chapter presents a deliberation of the findings in the context of the extant literature, with specific reference to the objectives of this study. In contrasting the findings against the literature, the discussions in this chapter establish the significance of the research findings relative to the extant literature and the research questions that were set in chapter 2.

## 7.2 Rationale

The subject of sustainability in road freight transport operations continues to be a topical issue in the literature (Wang et al., 2015; McKinnon, 2007) and researchers have explored topical issues on efficiencies, emissions and public impacts (Richardson, 2005; Ubogu et al., 2011). Although information and communication technology (ICT) mechanisms have been studied, the discussion has not extended to the evaluation of ICT strategies from a triple bottom line (3BL) perspective. One intention of this study was to explore the localised perspectives on sustainability as a base for evaluating the deployment of ICT as a sustainability intervention mechanism. Insights from the findings not only advance empirical knowledge on ICT roles in road freight transport sustainability but also extend theoretical understanding of why managers elect to pursue specific ICT based sustainability strategies in their business environment contexts.

## 7.3 Research Objectives

The fundamental focus of this study is centred on addressing sustainable road freight transport within an emerging economy context. This emphasis is underpinned by the adoption of ICT as a viable intervention mechanism following a systematic review of the literature. To achieve this research goal, research objectives (ROs) were set to;

i) Enable a conceptualisation of road freight transport operations within the Nigerian petroleum downstream industry,

ii) Evaluate the nature and strategies for ICT deployment within these operations and

iii) Develop a framework tool for improving ICT based sustainability performance in the industry’s road freight transport operations.

These objectives are consistent with identified gaps in the extant literature, providing suitable measures for evaluating the research findings presented in the previous chapter. In the next sub-section, a summary of the research findings is presented to guide ensuing discussions on sustainability themes, ICT deployment and the developing discussion on sustainability priorities by managers.

## 7.4 Findings recap

The data analysis revealed two main themes associated with sustainability across all the case types. The first theme; ‘continuity’ captured the future intentions of the firms, i.e. their aim to remain operational for the near future. The second theme; ‘functionality’ highlighted commitments to meeting current market requirements in the industry. It revealed a pragmatic outlook on performance, underlining the pressure on managers to act in particular ways. A relationship sub-theme was also identified although its use was not considered widespread and thus reflective of community acceptance as required with a moderate constructionist philosophy (Elder-Vass, 2012; Jarvensivu and Tornroos, 2010).

Additionally, the data analysis confirmed the conceptualisation of sustainability as tri-dimensional, with social, economic and environmental scopes to it. This was evidenced by way of managerial affirmations across all thirteen cases as well as responses to specific performance objectives under these three dimensions. In this regard, a noticeable pattern indicated prominence of social and economic performance over environmental considerations across the cases. This prominence of social performance over environmental performance was dissimilar to the reviewed literature and suggests the influence of contextual factors as stated by some managers.

### 7.4.2 ICT deployment and sustainability dimensions

The findings indicated that ICT use was pervasive in the industry’s road freight operations although the scope and purpose of usage differed significantly. For example, the results from the analysis showed that mobile phones and computers were common components of the operations infrastructure in all the cases. Some companies were more invested in ICT for their operations extending their ICT infrastructure to include on-board computers (OBCs), radio frequency information devices (RFID), specialised software and general packet radio services (GPRS). The results revealed firm size as a plausible factor in the deployment of ICT systems among the cases, where the technology range of ICT systems in medium and larger sized firms were more varied and specialist compared to the smaller firms.

Like the hierarchy of sustainability dimensions, the data infers that ICT resources are more likely to be used for economic and social purposes, with very limited focus on environmental practices. Loss prevention, cost management, accident prevention and training (behaviour reform) were some principal themes that were extracted from the data analysis. This outlook was linked to the nuances of the business context where a number of factors like high accident rates, driver corruption and union pressures all combine to influence managerial discernments of their environment.

Finally, the findings highlight some disparity behind the strategy objectives for ICT deployment in the road freight operations of the firms surveyed. Some of the firms linked the use of ICT to achieving competitive advantage by being sustainable whilst others did not consider ICT as affording any advantage beyond the threshold requirements for participating in the industry.

In the following sections, these findings are discussed in juxtaposition with the extant literature, providing comparisons and contrasts that will help evaluate their relevance and unique contributions to the literature in this area.

## 7.5 Sustainability themes: Continuity and Functionality

The meanings attached to managerial perceptions on sustainability fit into the dominant literature conceptualisation of sustainability as captured by the Brundtland Commission report (WCED,1987) “*development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs*” (pg. 43).

Continuity represents the futuristic element of sustainability and considers the outlook for the companies in the future, whilst functionality focuses on the efficiencies of meeting present day challenges or needs. Although these themes correspond with the nucleus of the Commission’s definition, they highlight some critical drawbacks that have been advanced against the definition in terms of clarity and unitary application (McKenzie, 2004; Jacobs, 1999).

Jacobs (1999) examined and classified perspectives on the Brundtland definition into political and technocratic views, advancing criticism about the relevance of the definition beyond political rhetoric that provides little accountability for operations. It is a common contention that the objectives of political structures differ significantly from operational objectives and this creates a multi-tier approach to sustainability. The views of managers in this study represent an integration of the complex dynamics of first and second level connotations of sustainability (Jacobs, 1999). In this instance, these themes represent a consistency of rhetoric that has become localised in the operations of the different organisations. For example, whereas business survival may not be interpreted as a political matter, it is intrinsically linked to compliance and performance issues that emanate from political structures. Managers are aware of and act in accordance with these political issues, recognising that the ultimate goal of their decisions, actions and performance is the future prosperity of their firms. However, in the case of this study, the recognition of links between functional managerial decisions, actions and their prospects is an encouraging demonstration of long-term outlook that underlines the meanings that have been generated from the data. The impacts of these meanings are consistent with the arguments on harmonisation of normative and operationalized scientific definitions within the literature. Normative in the sense that both themes represent elements of the standard designation on sustainability (Becker, 1997; Brundtland Commission, 1987), yet scientific in terms of capturing the operationalization of the standard designation by way of perceptive evidence. This creates useful insight into the local context and can help to significantly improve our understanding of sustainability performance within the context.

Furthermore, an important consideration in this discussion stems from the notion of continuity and the future; i.e. who are the beneficiaries of the long-term outlook (Rauch et al., 2016; Santos et al., 2010; Boschmann and Kwan, 2008; Becker 1987). In this study, where sustainability meanings focus on firm continuity rather than ‘future (firms) generations’, it highlights some level of divergence between the guiding literature definition and the application in real terms. For example, it is unclear that firms are under obligation to act in such ways that promote the ability of future start-ups to grow and compete. A secondary consideration in this instance would be to explore how the links between organisations and the generic ‘future generations’ are established and what they constitute (Jacobs, 1999). The unifying link between both functionality and continuity themes is the positive outcome that is attached to both, i.e. sustainability as action that enables the firm efficiently meet its obligations as well as promote its ability to continue as a viable going concern in the long term.

It is plausible that the meanings of sustainability are influenced by the ‘remedial action’ point of view; where sustainability is evidenced by the actions of organisations to correct the ill effects of their activities (Robinson, 2004). This approach is dominant in transport related studies on road freight transport sustainability, where the focus is on ‘creating sustainable operations’ rather than challenging the actual business operation itself (Wang et al., 2015; Oberhofer and Dieplinger, 2014; Furst and Oberhofer, 2012; Behrends et al., 2008; Litman and Burwell, 2006; Richardson, 2005). Remedial action can include educative and preventive arrangements and this is supported by the idea that road transport as a business activity is a negative activity *ab initio,* such that society is always going to be working towards mitigating road freight problems(Robinson, 2004). Sustainability expressions will therefore subscribe to this idea; presenting business operations as societal necessities that require accompanying strategies for managing the negative outcomes. The impact of this position is consistent with the idea of sustainability as a development issue that focuses on enhancing economic activity rather than challenging the basis of the activity, as some stakeholders would advocate (Robinson, 2004; Jacobs, 1999).

## 7.6 Sustainability dimensions: Application and Priorities

Following through from the discussion on meanings and the associated findings; the empirical data validates acquiescence and adoption of the triple bottom line approach to sustainability (Nikolaou et al., 2013; Boschmann and Kwan, 2008; Elkington, 1997). All the respondents affirmed sustainability performance as spanning social, economic and environmental action and parameters. However, the findings revealed some unique data relating to the allocation of firm resources for sustainability at both generic (scope) and specific (ICT intervention) levels. Generic level findings are discussed first and then the ICT intervention implications are discussed subsequently.

At the generic level, the data suggests that all three dimensions apply to the context with similar indicators for some of the dimensions as captured in the extant literature. For example, the findings suggest that managers see profitability as an important indicator of the firm’s ability to endure in the industry and this is very much an accepted notion within the literature (Palsson and Kovacs, 2014; Norman and MacDonald, 2004). This was not the case for all the dimensions and as discussed below, this potentially impacts the focus of strategy and resources for sustainability.

Social and economic objectives were more important parameters for operationalizing sustainability compared to environmental issues. This finding is at variance with the predominant position of the reviewed literature that emphasizes environmental performance (M’raihi et al., 2015; Wang et al., 2015; Palsson and Kovacs, 2014; Yusuf et al., 2013; McKinnon, 2012; Dong and Burritt, 2010; Piecyk and McKinnon, 2007; McKinnon, 2007; Richardson, 2005). For example, in terms of operational priorities, Jacobs (1999) had rightly argued that since the publication of the Brundtland report alongside a series of subsequent agreements on sustainable development, there has been much greater levels of activity and debate on environmental policy, however the findings suggest that this is not the case in the Nigerian downstream sector’s road transport operations. This ‘anomaly’ has been discussed in the literature on sustainability hierarchy or priorities. Specifically, Marshall and Toffel, (2005; pg. 39) advance an interesting framework for evaluating sustainability priorities. They modify Maslow’s Hierarchy of Needs model to classify and rank sustainability actions at four different levels;

1. Actions that endanger human existence or survival if left unchecked
2. Actions that significantly affect life expectancy or health
3. Actions that affect non-human species or contravene human rights
4. Actions that reduce quality of life or are inconsistent with values, beliefs or aesthetic preferences of society.

The framework highlights the ‘hierarchy’ problem in sustainability studies and provides a useful approach to understanding contextual differences in sustainability approaches. However, its ranking assumptions may be limited in its application if there is any intention to correlate findings across different contexts.

In this study, it does appear that the society context significantly impacts operations as well as the nature and prioritisation of social, economic and environmental issues by firms. For example, the main environmental issue that firms sought to address was product spills, which could cause damage to the ecological structure of the environment and this focus is consistent with the study by Dong and Burritt (2010), which highlights spills as a key environmental indicator in the Australian oil and gas industry. However, in comparison to the extant literature, very little consideration is given to the issue of emissions and this possibly reflects a direct consequence of the perceptions of managers whose opinions about their environment determine the actions that their firms focus resources on (Sutcliffe 1994; Anderson and Paine, 1975).

As earlier highlighted, environmental performance seems to be an area of limited expectation in the Nigerian petroleum downstream context and this reflects in the nature of sustainability focus across the different dimensions where priority attention assigned to social and economic. In some ways, this corresponds with previous findings of Palsson and Kovacs (2014), Eng-Larsson and Kohn (2012), who establish that external factors in business contexts affect firm objectives on sustainability, although it did not establish its impact from a 3BL dimension perspective. Similarly, the limited focus on environmental objectives is perhaps affected by what may the dominance of the *remedial approach* to sustainability, whereby firms are more likely to prioritise ‘issues’ that are perceived as most important in in terms of perceived expectations from their operational environments (Robinson, 2004). The implication of this is that the literature’s emphasis on environmental issues reflects the priority expectations and objectives of the environments in which the studies have been carried out. By extension, the adoption of a research philosophy that underplays the importance of context or community may not have revealed the nature of this relationship between business contexts and sustainability priorities.

Additionally, this nuance of contextual impacts on sustainability actions also extend to social performance objectives and this reflects strongly in the data. For example, the targeted investment in local communities via health campaigns, public infrastructure development and gifts does not feature as performance indicators in many of the road freight transport literature reviewed. Dong and Burritt (2010) highlights similar issues and expresses caution that information about social sustainability is still relatively neglected in corporate disclosures. The results from this study are slightly different in this sense, seeing that the information on public health campaigns, community donations, health campaigns and public infrastructure development featured prominently in the data. It is plausible that these factors are better indicators in developing or emerging economy contexts and therefore compel greater emphasis from these companies compared to developed economy contexts where disclosures on these issues seem more muted.

This link between meanings and operationalization remains topical in the academic literature, with some authors questioning the pragmatism of using literature definitions to evaluate business decisions (Marshall and Toffel, 2005; Norman and MacDonald, 2004). This link is accentuated by management perceptions of sustainability with continuity and functionality that in the context of this study require targeted economic and social actions. The results support this link, with evidence of managers qualifying their definitions of sustainability according to what was obtainable in the industry.

## 7.7 ICT strategies and sustainability dimensions

At the specific level (ICT mechanisms) the findings conform to the generic level results, i.e. showing a greater concentration on social and economic interventions compared to environmental interventions across the case typologies. ICT mechanisms were being used across all the cases surveyed, with varying degrees of scope in terms of variety and objective. The range was consistent with the classification of Marchet et al., (2009), with ICT applications for transport management (TM), supply chain execution (SCE) and fleet & freight management (FFM) purposes and fleet force automation (FFA) purposes across the 13 cases surveyed. In addition, non-specialist administrative use was a common use of ICT with base infrastructure like desk and laptop computers. In particular, TM and FFM use was mostly centred on routing and tracking of transport assets, SCE and FFA uses applications were mainly used for inventory management purposes and administrative use extended to daily routine documentation as well as specialist activities like trainings for both internal and external (community) audiences. In these cases, ICT application mechanisms were commonly deployed for promoting economic efficiencies (speed, cost management, fraud prevention, inventory management and logistics visibility) and social equities (accident prevention, safety and community training/ learning). The data did not yield any meaningful findings on integration of the different ICT mechanisms within or across the different cases.

Size seemed to be significant in determining the range and use of ICT in the firms surveyed. The larger firms (local and multinational) had bigger scopes, applications and variations in their use of ICT compared to the smaller companies. This finding is consistent with the literature and lends further evidence to the need for ICT providers to promote the business impact benefits of ICT to improve organisational uptake amongst smaller firms (Harries et al., 2015; McKinnon, 2013; Marchet et al., 2009; Evangelista and Sweeney, 2006; Pokharel 2005).

In terms of sustainability dimensions and ICT use, the findings highlight the continued concentration of ICT use on economic performance compared to social or environmental use. As captured in Figure 7.1 below, ICT use for environmental performance is the least prioritised area of all dimensions and the area details in Figure 7.1 depict the proportional use of ICT, with the outliers representing focus of ICT instruments across the 13 cases surveyed.

EC

SC

EN

Figure 7:1 - Proportional representation of ICT use for sustainability across cases: Environmental issues (EN) is the smallest of the three.

For the small firms, ICT deployment for environmental performance was completely lacking, however the results for the medium and larger firms were also very minimal with only 2 of the 10 cases in these categories linking ICT use to environmental performance purposes. This finding is consistent with the studies by Wang et al., (2015), Sternberg et al., (2015), Evangelista et al., (2013) and McKinnon (2011) where the potential of ICT as a viable mechanism for addressing environmental sustainability issues like GHG emission reductions, environmental education, spillage risks and energy consumption in road freight operations is highlighted. Also, the results show that operational efficiencies are common objectives of ICT use in the industry however only one manager established links between these efficiencies and their environmental performance through reduced journeys time, energy savings and emission avoidance. It is therefore plausible that managerial awareness and communication of these issues is still relatively low and this reflects in the responses that underpin the results in this case.

ICT use for social sustainability performance was quite common among the cases. The direct correlation between the major externalities from the road freight transport operations and the use of ICT resources highlighted the correlation between managerial perceptions and strategies. It is believed that managerial perceptions about their operating environments influenced the deployment of firm resources, whether as reactionary or response measures (Sutcliffe and Huber, 1998).

Accident safety, congestion, community relationships and driver behaviour modification were the most common social externalities that were identified in this study. These issues were comparable and not largely dissimilar to the results reported in the extant literature on oil and gas industries but equally distinct for road freight operations (Yusuf et al., 2013; Dong and Burritt, 2010). Advancing on previous literature findings regarding social issues in logistics and transport (Carter and Newnam and Goode, 2015; Jennings, 2002; Henrikson, 1992), the findings on ICT use highlight a pattern that focuses on curbing *corrupt* behaviour rather than on the up-skilling of the workforce in this case. For example, tracking devices like OBCs and RFID tags were implemented not to help improve the drivers’ ability to do their jobs or decision making but rather to provide the managers with monitoring capabilities that serve as deterrents to bad behaviour (Newnam and Goode, 2015; Thompson and Stevenson, 2014). This is understandable when the high rates of product loss, diversions and sabotage during the road freight process are taken into consideration, with reference to the image and profits of the firms concerned.

The use of ICT systems to improve accident safety was also a very common narrative with a pattern of opinion centred on over-speeding as a common cause of road freight accidents. The use of speed tracking devices and other ICT components was reported to have greatly reduced accident rates with one manager citing an 80% reduction in road transport incidents over 4 years. This result is consistent with and provides empirical evidence to support previous claims for ICT deployment for traffic speed control in road freight transport operations (Stefansson and Lumsden, 2008; Giannopoulos, 2004) This finding is however a departure from many of the extant literature on ICT use, where the focus has been on the quickening potential rather than the safety benefits of ICT use in road freight transport operations (Crainic et al., 2009; Davies et al., 2007).

Conversely, the deployment of ICT for community relationship purposes as a measure of social sustainability was mostly concentrated on up-skilling. Engagement with local communities was a common precept in all cases, however the link between ICT and community relationship objectives like youth trainings, health communications was only made by the larger firms. None of the small and medium firms identified ICT deployment for community relationship purposes albeit the fact that good community relations formed a key part of their social sustainability performance objectives. Through the deployment of ICT for training local youths, promoting health campaigns and improving community communication, these firms were positively impacting their communities and providing indirect mitigation for externalities from their road freight operations.

As earlier emphasized, loss prevention, profitability and accessibility were some common economic themes across all cases. ICT use for improving economic efficiencies was mutual to all the firms with uses like improving customer accessibility for sales, auditing and payment claims, improved operations speed. For example, the use of enterprise resource planning (ERP) software like SAP, ORACLE, AQUILA helped firms improve visibility across freight management processes, including order confirmation (Wang et al., 2015). Similarly, managers reported ICT as crucial to the fulfilment of their daily operations, with many suggesting that they ‘could not work’ without ICT components like their laptops, mobile phones and associated software. This evidence further strengthens the literature on ICT use for improving freight transport operations (Sternberg et al., 2015; Evangelista et al., 2010; Marchet et al., 2009)

A methodological advantage of qualitative studies is the depth and richness of information that good inquiries generate (Bryman and Bell, 2015, Blumberg et al., 2005; Yin, 2003). Accordingly, an important observation that can be drawn from the findings relate to the importance of managerial awareness in linking ICT use to specific uses/ outcomes as a crucial part of sustainability reporting. For example, the minimal evidence to support ICT use for environmental sustainability also reflect the levels of managerial awareness about the impacts of travel reductions and visibility on emissions output, air quality and energy consumption. Opportunities exist for improving adoption and deployment through increased training and education, which can influence managerial perceptions and further drive sustainability performance in the industry.

## 7.8 Theoretical rationales – Conceptual framework appraisal

In section 3.7, (pg. 101) a pre-empiric conceptual framework was presented describing the assumptions of this study (See Figure 3.6). In this section, the previously reported findings are weighed against the conceptual framework to examine and promote theory insight. Primarily to establish links between the way managers use ICT to promote sustainability in their road freight transport operations and the strategic theory literature reviewed in chapter 3. This addresses fundamentals of RQ3 and RO2, i.e. understanding the strategic principles that best explain the decisions, actions and goals of managers for using ICT mechanisms to improve the sustainability of their road freight operations.

Primarily, the findings affirmed the stated assumptions that firms in the Nigerian petroleum downstream industry seek to be sustainable, with performance objectives across social, economic and environmental categories. The findings highlight some correlation between sustainability performance emphasis and managerial perceptions, with the evidence indicating a prioritisation of economic and social sustainability performance over environmental performance objectives. The literature already discusses why firm’s road transport firms may seek to be sustainable, identifying external and internal drivers that influence firms based on their strategic objectives (Palsson and Kovacs, 2014; Eng-Larsson and Kohn, 2012). However, the relational assumptions in this study narrows in on the discussions regarding why managers use ICT for sustainability performance in their road freight operations, extending the enquiry lens to examine if the use is driven by the objective of gaining competitive advantage over their competition or if the achievement of social responsibility motivates the use of ICT by managers in the Nigerian petroleum downstream sector.

### 7.8.1 ICT and RBV

To recap, RBV proponents conceptualise the firm as a bundle of heterogeneous resources that are coordinated towards sustainable competitive advantage (Eisenhardt and Martin, 2000; Hoskisson et al., 1999; Barney, 1991; Penrose, 1959). Firm resources assume both tangible and intangible characteristics with emphasis on the ability of the firm to routinely coordinate these resources as a basis for competitive advantage (Grant, 1991).

ICT as a resource encompasses both tangible and intangible qualities that different firms may exploit for different purposes like profitability, (Mihalic, 2013, Barney, 1991) innovation and cost leadership (Porter, 1985), productivity enhancements (Barney et al., 2011; Grant, 1991) and social development (Thompson, 2008). The findings align with the variation in purpose regarding ICT deployment across the thirteen cases and the objectives for ICT deployment for sustainability differ across cases in terms of dimensional objectives. The stated rationales affirm that managers in the industry consider ICT as a viable resource for enabling competitive advantage through their sustainability performance. This evidence supports the conceptual level assumptions of ICT as an intervention resource for gaining competitive advantage through enhanced efficiencies (Palsson and Kovacs, 2014). For example, some managers linked their logistics effectiveness, safety performance and accessibility improvements to ICT use and some believed that their leadership positions in the industry was linked their use of ICT that was making their business more sustainable. Although the common use of ICT as a homogenous resource in the industry falls short of Barney’s (1991) ‘rarity’ requirement, the noted variations in scope (equipment and software types, dependence, integration) are perhaps good indicators of the heterogeneity of ICT as a resource that is available to managers.

This understanding, supports the assumptions about ICT as a valuable and inimitable resource. For example, many managers who linked ICT to their competitive advantage considered their ICT resource as unique, i.e. beyond what some other managers termed ‘threshold’ or ‘participatory’ requirements of the industry. It is noteworthy that although some managerial claims in this regard were corroborated by the observational and archival data, some claims were contrary to the evidence from the observational and archival data. For example, managers in Phalco Limited and Honeywell Limited suggested that ICT tools like phones and desktop computers gave them competitive advantage; yet the observation data did not yield any evidence to show peculiar configurations or innovative uses of ICT systems that may be providing competitive advantage.

Similarly, control has been identified as evidence of RBV strategy applications, where the in-house retention of a resource or process is considered an indication of its value as a core capability for sustainable advantage (Palsson and Kovacs, 2014; Sternberg and Anderson, 2014, Davies et al., 2007). In this study, the data analysis revealed a wide variation in the use of ICT in road freight transportation with corresponding control variations. It was observed that while majority of the surveyed firms have their road freight transport operations outsourced in some measure, the control of ICT resources for road transportation of petroleum products was often managed in-house or in combination with external parties; ICT control was never completely outsourced. For example, ICT mechanisms for environmental performance measures such as emission reduction was managed in-house in some companies despite general outsourcing of their freight transport operations (ABS Limited, Fluid Limited). Also, ICT infrastructure for social performance was largely managed in-house (Vertex plc., TServe Limited, ABS Limited), and ICT infrastructure for economic performance was often co-managed, i.e. managed by both the firm and external connected parties (Third parties or government agency; e.g. Government’s AQUILA programme, Lube National, Water Energy, Orte Plc, Skin Limited).

The co-management of ICT for economic performance is moderated by regulatory impact that makes it increasingly compulsory for firms to register on the AQUILA programme as opposed to the purely voluntary action by managers. The decision to set up parallel ICT control mechanisms for managing economic sustainability implies that managers conceive it as core capability within their operations and therefore are unwilling to voluntarily outsource its control (Harris et al., 2015; Sternberg et al., 2013, Barney, 1991). This explanation is consistent with Wang et al.’s (2015) findings that ICT mechanisms enable efficiencies in road freight transport and that retail firms consider the control of ICT components as a source of competitive advantage making them reluctant to collaborate with other firms in this area.

Accordingly, the findings affirm links between ICT uses and competitive advantage, evidencing links between management’s deployment of ICT and efficiencies that enhance the way some customers value the firm. Examples of this evidence include monitoring of drivers’ behaviour, reducing travel times, improving customer accessibility and improving community relationships (Harris et al., 2015; Davies et al., 2007; Button et al., 2001).

Heterogeneous and control evaluation reveal relationships between ICT use for sustainability and RBV theory, however the findings also suggest that moderating factors like regulation impact the reliability of RBV principles to explain ICT use for sustainability in the industry. This weakness is evidenced when ICT use for social and environmental performance is examined. For example, the use of ICT to monitor ‘bridging’ practices that promote unnecessary journeys in the distribution of petroleum products via road does not positively impact environmental and social sustainability. Its impact is limited to the ability of the firms to claim financial compensation for mileage without any consideration for speed management, emissions control, low energy consumption or personnel welfare.

Granting the information and opportunism risks mitigation uses, there is a need to address questions regarding the suitability of transaction cost economics (TCE) theory to support this study. A key factor is the consideration that TCE principles require a discounting of the intervention objectives of internal efficiencies, which is of importance to the firms surveyed (Hoskisson et al., 1999). Additionally, it is important to note that the investigation of transactional decision motivations vis-à-vis transaction or agreement enforcement costs are not objectives of this study, further raising doubts about the suitability of TCE for this study. Finally, the literature is largely of the view that TCE principles do not apply in the context of intra firm explorations and therefore limits any investigation to mainly inter firm transaction scenarios (Tate et al., 2014; Williamson, 1981). Consequently, the insight from the intra firm perspectives revealed from the cases justifies the decision to exclude TCE from the theoretical framework. The stronger argument remains in favour of the findings being evaluated with RBV principles, where competitive advantage from resource efficiencies rather than make or buy decisions influence the use of ICT for road freight transport sustainability in this industry.

The implication of this extends in part to the previously discussed ‘contextual culture’ that prioritises economic and social sustainability over environmental issues but also significantly espouses RBV’s limitation to explain the use of ICT for socio-environmental measures in this context. Critically, this extends the relevance of Zhu and Sarkis’ (2004) findings on correlations between economic and environmental sustainability performance, where they establish that firms with overly focus on economic performance are less likely to implement environmental practices. A progressive compromise is for managers to harness the economic benefits of using ICT to promote good environmental practices in their road freight transport operations (Palsson and Kovacs, 2014).

### 7.8.2 ICT and RCSR

The findings infer that ICT use for sustainability extends beyond competitive goals. Given that deployment includes effecting social performance like community trainings and safety improvements that are perceived to have no direct impact on the profitability of the firms, it is practical to explore the corporate social responsibility principles as valid explanations for ICT use by firms in the industry.

The relational CSR theory conceptualises the firms as citizens of their contextual environments with implicative benefits and responsibilities through some form of social contract. It is the social contexts that give legitimacy and intelligibility to firm activities that also determine the type of corporate social responsibilities that the different firms embrace (Seechi, 2007). Actions or performance by firms outside their economic, technical and regulatory requirements are thus best explained as indicative of their acceptance of social contracts and the requirements to meet their assumed responsibilities under these implied contracts.

The findings give emphasis to the perception of duty by managers, who distinguish their firms as having responsibilities towards their communities. The nature of these responsibilities varies across the different firms, however the performance themes of social justice (compensation), access, safety and wellbeing were common across the cases surveyed. The use of ICT instruments to achieve social performance objectives without profitability links undermines RBV principles and their capacity to offer wholesome explanations for ICT use for sustainability in the industry. Consequently, it is completely conceivable to explain ICT as an enabling resource that enables companies to effectively meet their social responsibilities to the communities where they operate (Thompson, 2008; Seechi, 2007; Marrewijk, 2003).

It is arguable that ICT use for sustainability practices like skills training for communities, health campaigns and safety is either determined by compelling forces outside the company or by internal management’s recognition of a need to act (Marrewijk, 2003; Meyer and Rowan, 1977). Again, the above recognition may offer some suggestion of institutional theory application to explain these results, however the “threshold” perceptions of some of the managers avail no evidence that ICT is significantly driven by normative industry practices as a whole, rather the prominence of these contextual norms drive organisational actions as opposed to purely economic decisions by managers (Tate et al., 2014). Additionally, although the results highlight increasing regulatory measures that may be construed as coercive, the data does not support the interpretation of these establishing coercive isomorphism in terms of ICT use by firms rather they emphasise managerial initiatives that are driven by economic considerations at the very least. For example, the decision to use OBCs to monitor and reduce accidents or fatalities from freight travel incidents is driven by economic concerns in addition to ethical considerations and none of the results support ICT use as driven by coercive or normative requirements. (DiMaggio and Powell, 1983).

Additionally, the findings do not reveal any evidence of consequential goodwill costs to the firms and neither did the data highlight any particularly adverse legal implication for the firms; in fact, the literature points to a weak enforcement system that fails to pressure firms to act sustainably (Obasanjo and Nwankwo, 2014; Ubogu et al., 2011). Consequently, the weightier argument is in favour of interpreting ICT use for sustainability performance without credible economic links as indicative of altruistic action by the firm, in recognition of their responsibility to society (Seechi, 2007). In this sense, the most suitable theory view is that of the relational corporate social responsibility theory.

In terms of mimetic pressures shaping ICT deployment, the findings provide some evidence that competitive benchmarking guides the use of ICT for sustainability amongst some medium and large firms but not the small cases. The strength of such evidence is weakened by the inconsistencies which highlight variances between leading industry rhetoric on sustainability and actual practice in some cases. For example, the data on environmental practices was inconsistent in some cases, revealing disparities between the claims by managers and the observed practice or archives. Additionally, while the data identifies ABS Limited as an industry leader in ICT use, there is little evidence to support imitation by other firms within the industry. This makes it improbable to establish mimetic links based on the ‘mere’ acknowledgement of industry leadership without credible data to support imitation or copying (Tate et al., 2014).

Mayer and Sparrowe (2013) infer that many research questions cannot be fully addressed by singular theory insights. In addressing RQ3 relating to managerial rationales for using ICT to achieve road freight transport sustainability, the weightier explanation is premised on a combination of both RBV and RCSR theories. The findings support the assumptions that ICT is a valuable intervention resource with heterogeneous applications across the different cases surveyed. Its heterogeneity supports both competitive and altruistic activities of the different organisations, such that considerable focus is on using ICT to improve economic efficiencies; inventory management, fleet optimisation, visibility, whilst at the same time enabling environmental and social practices that are purely philanthropic; safety, community skill trainings.

## 7.9 Review of Conceptual Framework

The findings largely validate the conceptual framework presented in chapter three (page 101; 3.7 Conceptual Framework), however, the assumptions regarding the operationalization of sustainability from a triple bottom perspective require some moderation to reflect the findings.

Firstly, the findings indicate that although companies in the sector focus on improving their sustainability practices across social, economic and environmental dimensions, the objectives and implementation of these practices are prioritised. Although an already captured phenomena in the literature on sustainability hierarchy, the findings identify generic level socio-economic hierarchies over environmental practices as well as specific intervention level corroboration concerning ICT use. It is important that the progressive framework reflect this hierarchical structure as it contrasts with the focus of the extant literature that seems to afford higher priorities to environmental sustainability practices.

Secondly, the theoretical evaluations give credence to the application of RBV and RCSR as viable explanatory frameworks for management’s use of ICT for sustainability in their road freight transport operations. However, the evidence for RBV as a driver of ICT use for purposes besides economic and social practices is weak. The findings do not support ICT use for environmental practices as driven by competitiveness but rather gives weightier impact to altruistic objectives. Conversely, the connection between RSCR, ICT use and economic objectives is not significantly established by the findings, with greater emphasis on ICT use for socio-environmental purposes from an RCSR perspective. To this end, the progressive framework presented in Figure 7.2 overleaf reflects the modifications to the earlier presented conceptual framework diagram (pg. 101) and this is instrumental to the development of an ICT use self-assessment tool for the industry.

Significant influence

Weak influence

Hardware

Computers

Mobile phones

On-Board Computers

Network accessories

Meters and trackers

Software

Applications

Programs

Operating Systems

AQUILA

**ICT**

Information

Data

Databases

RCSR

**Sustainable Road Freight Transport**

Social

Reduced Congestion

Zero Accidents

Training and welfare

Improved monitoring and road safety

Improved communication

Economic

Good Profits

Increase Shareholder Wealth

Improved Efficiencies

Improved visibility and access

Loss prevention and freight Inventory management

Downstream Managerial Perceptions

RBV

Environmental

Low GHG emissions and reduced freight mileage

No Spillages

Low Land Requirement

Low Energy Consumption

Figure 7:2 - Revised Conceptual Framework

From the revised conceptual framework, the discussions in Chap. 6.6 underline the importance of robust systems that support strategy and practice across all three dimensions. The data and the revised framework support the notion that ICT can support sustainability across all the triple bottom line dimensions, with examples ranging from community trainings to emissions control. This implication is useful for improving practice in this regard and contributes to the identification and inclusion of 21 items that are infused into the self-assessment tool that is presented in Chapter 7.11.2. As an introductory measure, it is expected that management may be able to expand on the items within the tool to reflect the uniqueness of their own operations, however, these items have emanated from the data and are considered fundamental to the development of strategic road freight transport sustainability planning within the industry.

## 7.10 Improving triple bottom line sustainability through ICT use

In line with RO3 and RQ4 of the findings and discussion outcomes, two principal gaps relating to awareness and application are identified as major limitations to the more effective use of ICT in road freight transportation within the industry. Awareness relates to the updated management knowledge of ICT resources and targeted rationales for their ownership in terms of business objectives and performance for sustainable outcomes. Application entails strategic use of ICT devices to impact social, economic and environmental practices across operations in the industry. The neglect of environmental practices is not without consequences and conscious application of ICT mechanisms to improve economic performance will significantly improve overall sustainability performance. As indicated in the revised framework, ICT has the capacity to support these objectives and the inclusion of these topical items in a strategic planning framework can aid performance in this area although no such tool exists within the literature or the industry as highlighted in chapter 6.

The absence of accessible collaborative structure for guiding companies in their use of ICT to improve sustainability performance can be addressed by the development of an industry specific ICT deployment tool. This tool will complement firm strategies for sustainability by helping management to better plan and evaluate their ICT infrastructure, deployment options and targeted outcomes from social, economic and environmental perspectives.

As a result, I have developed a pilot version of a self-assessment management tool: Downstream Road Freight Transport Sustainability Assessment Tool (DRoFTSAT), which is intended to promote planning for ICT use in road freight transportation within the industry. Designed to be flexible, the final goal is to create a web based platform for administering the tool subject to further consultation. The next section presents the guidance and sample format of the DRoFTSAT assessment tool.

## 7.11 Downstream Road Freight Transport Sustainability Assessment Tool (DRoFTSAT) - Pilot

DRoFTSAT is designed as a new self-assessment tool to provide guidance for clear planning, implementation and evaluation of ICT use for sustainability performance in the transportation of products within the Nigerian petroleum downstream industry. The tool is based on the findings from empirical engagement in the industry and is aimed at improving managerial decision-making on ICT use using a simplified checklist format that enables informative and targeted methodology for improving sustainability performance.

Based on the triple-bottom line conceptualisation of sustainability, DRoFTSAT covers the use of ICT for positive intervention across economic, social and environmental performance. Specifically, DRoFTSAT will enable the use of ICT to:

1. Examine and identify road transport based social, economic and environmental sustainability performance targets;
2. Identify impact outcomes and milestone measures;
3. Explore and identify applicable ICT resources within the local and international market;
4. Identify risks to performance targets and impact outcomes, using a trade-off checklist to determine and rank risk management priorities
5. Monitor, record and evaluate performance
6. Develop reports on road freight transport sustainability

### 7.11.1 DRoFTSAT Guidance Recommendations

This section of the report explains how the DRoFTSAT self-assessment tool should be applied, including the rationale for the different segments within the tool.

The findings of this thesis indicate that the petroleum downstream industry is freight intensive and faces significant challenges to improving its sustainability performance. The following outlined guidance will significantly help improve awareness of sustainability challenges and promote coordinated management activities for both profit and philanthropic outcomes using ICT infrastructure:

1. Transport sustainability officer (TSO): There is need for dedicated transport sustainability structures within the industry. These officers should be responsible for managing the road freight transport sustainability practices including ICT for sustainability training, evaluation and planning in conjunction with other responsible officers. Whilst small companies may lack the resources to create dedicated positions immediately, it is recommended that they may consider role training for existing employees who may undertake TSO duties until the company can afford to employ a dedicated staff for the role

*NOTE: This is a direct response to addressing the limited awareness of opportunities for ICT use for sustainability within the industry. The creation of TSO positions will put sustainability performance at the fore of business agenda and improve organisation commitments*.

1. Sustainability planning: Firms need to have specific and dedicated planning platforms for sustainability performance using ICT resources. Planning platforms should include specific objectives, performance targets for each objective, strategies for achieving these objectives and the expected outcomes with timelines.

*NOTE: This is a direct response to the problem of uniform reporting and evaluation frameworks for road freight transport sustainability performance. Importantly, it will enable more managers reflect on the environmental impacts of their road freight transport activities and plan to address these impacts*.

1. 3BL Sustainability and Profits: The findings corroborate results from a previous study, i.e. linking profits to environmental practices will improve environmental performance. Marketing and distribution companies can look to harness this through communications about the sustainability of their road freight operations. Public relations teams need to promote achievements in this area. This can create margins for profiting within the industry and highlight environmental and social issues as competitive factors.

*NOTE: The literature establishes links between sustainable environmental practices and economic profits yet the findings highlight environmental practices as very limited within the industry. Driving environmental awareness and sharing practices through reports and other media publications can improve general awareness, influencing different stakeholders and creating new opportunities for differentiation and practice*.

The DRoFTSAT self-assessment tool will help implement these guidance recommendations and a draft version is presented overleaf.

### 7.11.2 DRoFTSAT (Version 1.0) Pilot Version

**Name:**

**Job ID:**

**Organisation:**

**Classification**: (S, M, L)

**Products**: AGO, DPK, PMS, Lubricants

**Transport Modes**: Road Water Pipeline Air

**Average Volumes**: Daily Monthly Annual

1. **Please tick per importance to your operations for the period:**

Minor Moderate Major

Objectives:

1. Accident prevention \_

2. Brand Image

3. Community projects

4. Congestion control

5. Costs

6. Education

7. Emissions control

8. Energy consumption

9. Ethnic Opportunities

10. Gender opportunities

11. Health campaigns

12. Infrastructure

13. Land use

14. Noise Management

15. Profits

16. Safety

17. Sales Revenue

18. Spill prevention

19. Security

20. Time efficiency

21. Training

1. **Resources available to achieve operational objectives (Please identify specific resources and the intended use where applicable)**
2. Human
3. Technology
4. **Information and communication technology resources available to support your objectives relative to road transport:**
5. Hardware
6. Software
7. **Estimated costs of ICT resources required (summary)**
8. **Importance of the identified ICT resources to achieving each of the listed objectives (please rank according to priority)**

Important Neutral Not Important

Objectives:

1. Accident prevention \_

2. Brand Image

3. Community projects

4. Congestion control

5. Costs

6. Education

7. Emissions control

8. Energy consumption

9. Ethnic Opportunities

10. Gender opportunities

11. Health campaigns

12. Infrastructure

13. Land use

14. Noise Management

15. Profits

16. Safety

17. Sales Revenue

18. Spill prevention

19. Security

20. Time efficiency

21. Training

1. **Perceived benefits of using ICT resources to enable performance objectives**

High Low N/A

Objectives:

1. Accident prevention \_

2. Brand Image

3. Community projects

4. Congestion control

5. Costs

6. Education

7. Emissions control

8. Energy consumption

9. Ethnic Opportunities

10. Gender opportunities

11. Health campaigns

12. Infrastructure

13. Land use

14. Noise Management

15. Profits

16. Safety

17. Sales Revenue

18. Spill prevention

19. Security

20. Time efficiency

21. Training

1. **Risks associated with the transport of products via road**

1

2

3

4

1. **Management strategies: Collaboration, Outsourcing, Commitments**

1

2

3

4

1. **Impact of ICT to eliminate or reduce risk**

1

2

3

4

1. **Limitations to ICT use**

Costs:

Expertise:

Availability:

Regulation:

Other:

1. **Review - Impact ranking of using ICT resources to enable performance objectives**

Minor Moderate Major

Objectives:

1. Accident prevention \_

2. Brand Image

3. Community projects

4. Congestion control

5. Costs

6. Education

7. Emissions control

8. Energy consumption

9. Ethnic Opportunities

10. Gender opportunities

11. Health campaigns

12. Infrastructure

13. Land use

14. Noise Management

15. Profits

16. Safety

17. Sales Revenue

18. Spill prevention

19. Security

20. Time efficiency

21. Training

**Milestones – Implementation timeline for achieving outcomes**

0-3 months 3-12 months 12-24 months

Objectives:

1. Accident prevention \_

2. Brand Image

3. Community projects

4. Congestion control

5. Costs

6. Education

7. Emissions control

8. Energy consumption

9. Ethnic Opportunities

10. Gender opportunities

11. Health campaigns

12. Infrastructure

13. Land use

14. Noise Management

15. Profits

16. Safety

17. Sales Revenue

18. Spill prevention

19. Security

20. Time efficiency

21. Training

Notes:

## 7.12 Chapter Summary

In this chapter, each of the motivating objectives and guiding research questions for this study have been reviewed and the key findings were subjected to further scrutiny against the extant literature with some noteworthy outcomes.

Firstly, paralleled with the extant literature, the influence of local environments and management’s perceptions exert weighty influence on sustainability priorities of organisations; in the case of this study, an overt emphasis on socio-economic objectives over environmental objectives. Although unique, this trend is not completely surprising since previous studies have established counteracting impacts between economic and environmental practices (Zhu and Sarkis, 2004).

Additionally, the viability of ICT mechanisms as an intervention tool for promoting sustainability performance in road freight operations is linked to management’s perceptions of their immediate business environment. This finding strengthens the link between ICT and road freight transport sustainability, furthering extending the discourse on the importance of managerial awareness in the use of ICT resources for road freight transport sustainability (Harris et al., 2015; Wang et al., 2015; Davies et al., 2007).

This chapter has also seen the evaluation of the theoretical framework for exploring the use of ICT for road freight transport sustainability by firms within the empirical context. The discussion validated the combination of RBV and RCSR theories as adequate for explaining the practices of firms in terms of how they use ICT for 3BL sustainability. The outcomes of these discussions are reflected in the moderations to the revised conceptual framework as well as the development of a pilot self-assessment tool for managing ICT based interventions in the industry’s road freight operations; DRoFTSAT.

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8. Conclusion

This chapter concludes this thesis, recapping the findings and outcomes as discussed in chapters 6 and 7, re-evaluating how the research objectives and research questions have been addressed as well as highlighting this study’s contributions to the logistics and supply chain management literature and practice.

## 8.1 Thesis summary

The logistics and supply chain management literature establish the importance of road freight transport as a critical part of the value delivery chain. However, the literature also highlights many negative outcomes from road freight transport with consequences that include fatalities, infrastructure depletion, property losses, air and land pollution, social inequalities and congestion. Based on the literature review in Chapter 3, ICT is identified as one of many viable intervention mechanisms for reducing these negative outcomes and therefore promoting the sustainability of road freight operations. However, the literature review identified that studies on ICT use in freight transport operations are limited, particularly in emerging economy contexts where a significant proportion of the associated externalities occur. Additionally, it was found that whilst a few authors had investigated this phenomenon, none of these studies had explicitly explored ICT interventions in road freight transport from a triple bottom line perspective and this was considered a limitation to the robustness of the scant literature in this area.

Adopting a management approach, this thesis focuses on the critical elements of managerial perception and strategic theory to investigate the use of ICT mechanisms in the Nigerian petroleum downstream industry. As a road freight-intensive industry, the movement of products by the marketing and distribution companies is a complex and challenging process with common occurrences of fatal accidents, congestion, economic sabotage and GHG emissions. These characteristics validated the choice of empirical investigation and the development of a theoretical framework, which combined the resource-based view (RBV) and relational corporate social responsibility (RCSR) principles to underpin the research.

Consistent with the moderate constructionist philosophy, qualitative strategies were adopted to implement the research objectives. Using the case study method data was collected from 13 polar cases by means of semi-structured interviews, non-participant observations and documentary reviews. 32 interviews were conducted with logistics, transport, IT, plant and operations managers and directors in small, medium and large firms within the industry over a period of 9 months. Considering the bias potential of interview instruments, non-participant observations were conducted concurrently and over 30 hours of within and off premise data was generated to support the data from the interviews and documentary archives. This triangulation enhanced data credibility and robustness, as the observation and archive data were free of participant or researcher bias, thus enabling a consistent evaluation of the use of ICT in road freight operations.

Manual and digital methods were employed to implement content and thematic analysis of the data. NVivo11 software was used to aid data sorting and analysis post transcription. Particularly, search and cluster functions were used to perform content analysis and the coding, matrix and chart relationship functions were powerful tools for thematic analysis and interpreting the data. Additionally, manual notes, field diaries and the protocol tools were valuable tools for iteration and the key outcomes highlighted below.

## 8.2 Research Outcomes

1. **RO1 and RQ2**

In terms of managerial opinions on sustainability, *In Vivo* meanings of sustainability conform to the universal constructs of sustainability; establishing continuity and functionality as the main themes of sustainability within the industry. Also, whilst the 3BL framework is commonly accepted in the industry, social and economic objectives are significantly prioritised over environmental objectives. A departure from the predominant focus of the extant literature, this was linked to managerial perceptions of their business contexts.

1. **RO2, RQs, 1, 2, & 4**

Correspondingly, the allocation of ICT resources for sustainability performance is concentrated on social and economic practices with very little deployment for environmental practices. This discovery is possibly moderated by management knowledge and focus, whereby companies limit their communications to socio-economic practices even when ICT instruments may be positively affecting their environmental performance. It is recommended that training and sensitization could positively impact knowledge and awareness in this area.

1. **RO2, RQs 3 & 4**

The findings establish that theoretical frameworks that combine RBV and RCSR theories are adequate for explaining the use of ICT for sustainability performance in road freight transport operations. RBV adequately explains ICT use for competitive advantage through socio-economic efficiencies, while RCSR is suitable for explaining the socio-environmental practices of the firms in the industry. This research outcome is particularly instructive because it also demonstrates the limitations of single theory frameworks in terms of promoting a reliable understanding of ICT use in road freight transport operations.

In line with the objectives and outcomes prior discussed, a self-assessment tool (DRoFTSAT) has been developed and proposed for improving ICT use for sustainability within the industry. The tool is designed to aid the planning, implementation and evaluation of ICT use for sustainability in road freight transportation. Despite the recognisable complexities of road freight transport operations, DRoFTSAT can provide a good platform for collaborative and comparable management of ICT, which can improve the environmental performance, in addition to social and economic benefits to the firms.

## 8.3 Research Contribution

Following the research enterprise vis-à-vis the innovation of a pertinent research problem, identification of suitable empirics and validation of a substantive conceptual framework, this thesis makes significant contributions to the road freight transport literature (Wang et al., 2015; Sternberg et al., 2014; McKinnon, 2007).

Specifically, chapters two and three contribute to the innovation of the research problem. Chapter two provides the research rationale identifying links between economic growth, road freight transport externalities and industry contexts. Importantly, it makes a case for empirical inquiry into an industry context where growth is engineering road freight transport intensity. In addition, specific evidence about the industry context is advanced to justify the research inquiry. Following the traditional review of the modal and externality problems in the literature, an original systematic review of the literature conducted in chapter three helps to aggregate the intervention mechanism literature in unique categories that support current and future research. In contributing to the research innovation, an evaluation of the industry background data against the findings of the systematic review helped to identify ICT mechanisms as relevant and for the research inquiry. Further, the development of a conceptual framework that incorporates a unique theoretical framework is distinctive to this thesis, the validation of which will extensively support future research in a complex field like logistics and transport.

### 8.3.1 Academic contribution of Thesis

Addressing sustainability in road freight transport requires wholesome understanding of the complexities that drive management actions, particularly with the use of ICT as an intervention mechanism for sustainability. To the best of my knowledge, although a couple of studies have recently investigated ICT use in road freight, no published study has explored ICT use from a 3BL perspective or contributed to understanding 3BL sustainability hierarchies in the use of ICT in road freight transport. The value of this extends to the robustness of the study to match real management problems, as managers do not experience any of social, economic or environmental challenges in isolation. The literature on ICT and sustainability in road freight transport has been largely tied to environmental practices without effective explanations on why this is the case, compared with other sustainability dimensions. However, this study has been able to establish links between sustainability hierarchy choices, ICT and local business contexts, indicating that contexts significantly influence management perceptions on how ICT is used to support sustainability performance across different dimensions.

Theoretically, this thesis contributes to the burgeoning literature on theory appropriation in logistics and transport research, supporting the application of management theories to explain managerial decision-making and firm level actions in an emerging country context (Palsson and Kovacs, 2014; Eng-Larsson and Kohn, 2012; Defee et al., 2010; Naslund 2002). The combination of the resource based view (RBV) and relational corporate social responsibility (RCSR) theories in a single theoretical framework is an innovative contribution that was validated by the findings, thereby strengthening insights on management use of ICT in road freight transport. Our understanding of ICT use for sustainability in road freight transport is more robust than previously established and this contribution may not have been achievable if pursued by existing theory frameworks. In this sense, our understanding of why firm management may use a resource like ICT for sustainability practices that are not linked to economic benefits is advanced by this theoretical framework. This opens up future prospects for management theory development and testing in similar industry contexts.

The systematic review of the literature in chapter 3 provides an original and updated overview of the topical discourse around road freight sustainability. Existing reviews by Demir et al., (2014) and Marchet et al., (2014) focus on environmental publications only whilst the systematic literature review in this thesis adopts a more robust perspective to road freight sustainability and is the only review that has attempted to aggregate and classify intervention mechanisms for road freight transport sustainability until recently. Although it identifies ICT as appropriate for the research inquiry, the review will help focus future research inquiries and ease the conduct of future comparisons of mechanisms. This is the first step towards synthesizing studies on road freight transport sustainability, providing future researchers with a useful start point for matching mechanisms to research problems.

Methodologically, chapters 4 and 5 highlight the importance of methodological thoroughness in management research. The adoption of a moderate constructionism perspective to explore the research problem using qualitative strategies is validated by the outcomes. To the best of my knowledge, this is the first time that this perspective has been adopted in a logistics related study, however the findings suggest that it is a useful paradigm to support future inquiries in this field. The extension of sense-making to account for materiality beyond the dialogical exchanges from the interview data helped balance out bias and improve the overall community representation of research data. As logistics and transport research advances towards increased qualitative contributions, moderate constructionism is positioned to support balanced enquiries.

### 8.3.2 Practice Implications

Practical implications of this thesis highlight original contributions in two main areas; engaging management focus on sustainability and the development of a bespoke assessment tool for managing ICT based interventions in road freight transport within the industry sector.

Despite the difficulties, the empirical process refreshed and challenged existing management awareness of sustainability within the Nigerian petroleum downstream sector. The feedback from the interview sessions suggested that fresh awareness was brought to issues previously overlooked by some managers. Many managers suggested that the conduct of the research and the engagements helped broaden their recognition of sustainability as a more robust challenge than previously considered. There are prospects for future reviews of this impact in future, helping to explore how engagement has improved performance in this area.

The proposed DRoFTSAT tool is the first of its kind for the Nigerian downstream industry. An outcome of the findings, the self-assessment tool will help managers to integrate strategy and objectives in a simplified manner. This has the potential to improve planning and implementation of ICT use for sustainability once fully functional. At the time of writing, three distribution and operations managers have expressed willingness to review and incorporate the tool into their planning framework. There are prospects for commercialisation and data congruency that could support future research inquiries in this area.

## 8.4 Research Limitations

The outcomes of this study have provided useful contributions to literature and practice as discussed in the preceding sections, however there are some limitations that require discussion.

Time and contextual constraints may have created pragmatic boundaries in terms of the number of cases and interviews included in the research. Whereas cogent measures like triangulation as well as theoretical and purposive sampling were incorporated to promote rigour and robustness, it is plausible that a longer study with some level of ethnographic embeddedness in the community can provide further insights beyond what has been reported in this study. Particularly, phased studies that explore these issues at policy, firm and community levels may help promote our understanding of the different actors and their use of ICT resources to promote sustainability in road freight transport operations.

In addition, as exploratory study, the findings have opened up new frontiers for further research inquiries. For example, this study has not specifically investigated or measured performance outcomes from ICT interventions in road freight transportation although it has identified performance objectives and practices. Also, this study has focused on the specifics of the downstream sector in an emerging economy context. Although product uniformity enhances the objectivity of the outcomes, it also places restrictions on their application to multi-product industry road freight operations that have not been explored in this study.

## Directions for Future Research

As an exploratory study, the contributions of this thesis to the literature create opportunities for future academic inquiries. In particular, the findings on emerging economies and context can be further enhanced by comparative studies that explore and compare developed and emerging economy contexts to establish key factors within the environments that drive managerial perceptions differently. Such studies will help to address underlying questions about performance measurements. Methodologically, whilst the use of triangulation has enhanced the replicability and rigour of this study, there is still scope for further investigation that advances on the findings of this study to develop hypothesis constructs for quantitative testing. In this sense, a mixed methods approach may enhance the robustness of future enquiries and increase methodological integration in this discipline. Finally, specific studies may want to replicate this study in a multi-product industry, promoting learning on how product ranges may affect managerial perceptions and use of resources like ICT for sustainability performance.

## 8.6 Personal Reflection

The reward of the qualitative research process is often captured by the richness of the data and the quality of the experience. Although I expected the fieldwork to be quite challenging, it ended up being a little more than I had presumed. Developing and emerging economies have always been difficult environments to collect data, and the Nigerian experience can be described as both exciting and daunting. At the development and planning stages of the research, the opportunity to engage the context directly, to travel across different regions via road in order to assess the road infrastructure and prospects of seeing tangible contributions emerge from the process seemed fantastic, however the realities of the political and security issues in Nigeria seemed overwhelming at times. Fortunately, my cordial working relationship with my supervisory team helped me focus on the objectives despite the drawbacks. It is also rewarding to note the open disposition of some of the managers and executives, who have expressed keen interest to review and explore options for adopting DRoFTSAT in their organisations.

The difficulties experienced in the process of securing access required multiple strategies like cold-calling, referrals and rescheduled meetings provided useful learning for future research inquiries. One key outcome was the implication of timing to research and fieldwork planning. In this study, fieldwork coincided with a period following a change of government and there was significant apprehension among many businesses which were keen to avoid threats of probes and indictment. The result was that in many cases, previously amenable contacts became opposed to interviews or meetings. A different political timing could have significantly improved the number of participants and reduced the challenges faced during fieldwork.

Additionally, the role of local contacts and helpers cannot be over-emphasized. Despite my previous knowledge and contacts in the industry, the role of helpers in accessing top management, making appointments, mobility planning and safety management was critical to the fieldwork; an impossible task I would say. In hindsight, this highlights one of the unique characteristics of qualitative inquiries where the researcher must seek active access to the research population. Although this was quite inconveniencing compared to the quantitative options, the outcomes validate the enterprise.

Finally, the use of software to support the analysis process was extremely helpful to meeting schedules. Miles et al., (2013) discussed the daunting challenges that may emerge from the data sorting process, identifying it as one of the hazards of qualitative inquiries. The use of NVivo11 was very helpful for avoiding pitfalls like data loss, conceptual derailment and time loss. Besides the capacity to hold the data transcripts, it helped ease comparisons, review, writing and integration.

# References/ Appendix/ Notes

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Appendix

Appendix 1- Systematic Review Protocol

Protocol for systematic paper review

1. Purpose of Review:
2. Data Sources
   1. Online:
   2. Print
   3. Others
3. Databases
   1. Taylor and Francis
   2. Google Scholar
   3. Science Direct
   4. Emerald
   5. Sage
   6. Endnote/Web of Science
4. Inclusion criteria:
   1. Date – 2000-2016 (Millennial papers)
   2. Type – Peer reviewed journal papers only
   3. Topic – Matching search strings on sustainability
   4. English Language
5. Exclusion criteria:
   1. Date – Papers outside 2000-2016
   2. Type – Reports, Conference proceedings, Working papers, Bills etc.
   3. Topic: Generic papers, non-sustainability papers
   4. Non-English
6. Search strings – Boolean, Verbatim, Word combinations

Acceptance

|  |  |  |  |
| --- | --- | --- | --- |
| Reviewer | Paper no. | Decision | |
| Accept | Reject |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

1. Report structure
2. Data Synthesis
3. Report

Appendix 2 – Interview Protocol

Research Interview Consent Form

Participant number: 23

**Informed Consent for Participation in Research**

**(*To be completed after reading participant information sheet)***

I have read the information sheet and I consent to participate in the research conducted by ABIYE TOB-OGU from the University of Sheffield, United Kingdom. I understand the purpose of the research is to gather information for academic purposes and I consent to being one of the persons interviewed for this research.

1. My participation in this research is voluntary and I understand that I will not be paid for my participation.
2. I have read and understood the information provided to me. I have had all my questions answered to my satisfaction and I voluntarily consent to participate in this study.
3. I understand that I can withdraw and/ or discontinue participation at any time without any penalty.
4. I understand that my participation is limited to the pre-interview and observation arrangements, the interview and access to the final report if I request for one. I am aware that the interview will last approximately 60-90 minutes and will involve the use of audio and manual recording materials. I am aware that I may object to the interview session being recorded at any time.
5. I understand that the researcher will not identify me by name in any reports using information obtained from this interview and my confidentiality as a participant in this study is protected by the guarantee of anonymity. Subsequent uses of records and data from my participation will be only within the permits of the Data Protection Act, 1987.
6. I understand that this research has been reviewed and approved by the Ethical Approval Committee of the University of Sheffield, United Kingdom.

Signature Dates

**Participant**

Signature Dates

**Researcher**

Research Interview Information Sheet

**Research Title**

Investigating the Relationship between Sustainability and ICT (Information and Communications Technology) in Road Freight Transportation:

*A qualitative inquiry into the Nigerian petroleum downstream sector*

**Introduction**

You are being invited to participate in this research study. Before you decide whether or not to participate, it is important for you to understand why this research is being conducted and what your participation will involve. This document provides useful information that will assist you to make an informed decision about participating in this study. Please take time to carefully read through the information provided and where appropriate discuss with your superiors if you wish. I am happy to be contacted if you find any part of the information unclear and would like more clarity before making a decision to take part in this study.

*Thank you for taking time to read this information.*

**Purpose of the study**

This study seeks to engage, explore and understand the relationship between road freight transport sustainability and ICT. It will help management improve the sustainability performance of their road transport operations with potential cost and efficiency savings.

**Participant Selection:**

You are being invited to participate in this study because you have been identified as someone in a position to give useful insight on this topic. You meet the requirements for inclusion as a participant because of your experience, location, portfolio and position as a management staff in a major product marketing and distribution company within the Nigerian petroleum downstream sector. It is believed that the findings of this study will offer your organization significant benefits through the understanding of how ICT can aid sustainable road transport performance with tangible economic and social benefits.

**Scope of participation**:

Your participation in this study will entail three levels of involvement; they are outlined below.

1. Access and pre-interview discussions: Your informed consent to participate in this study will provide permission for further contact regarding the conduct of an interview and (where applicable) an observation of your product distribution processes via road. It will also permit me to pass on information about the interview with a set of questions attached.
2. Interview and observation: One interview session at a convenient location (preferably within your organization). The interview session will last between 60-90 minutes and will adopt a semi-structured format to allow you the opportunity to express your views on how you manage for sustainability in your product distribution processes. It is intended that the interview will be recorded using audio devices and subsequently transcribed into text form for analysis. You can object to recording at any time during the interview. All recordings will be will be archived with the University of Sheffield research office for 4 years and subsequently destroyed. Where applicable, observations will be conducted anonymously with your permission. None of your employees or staff will be directly identified in the reports generated and no recording equipment will be used in the observation process. A notepad may be used to take notes of the processes and items of interest.

Please note:

* 1. You can withdraw from the interview without reason at any time
  2. You can stop the interview at any time.
  3. You do not have to answer any question(s) that you do not wish to, and,
  4. Your name and personal information will be anonymized so you cannot be identified from the reports produced from this study.

1. Information: A final copy of the study’s report will be provided to you for your records. Similarly, participation accords your organization priority opportunity to engage the researcher and the University of Sheffield in discussions to implement useful outcomes, subject to terms and conditions.

Note: As part of the presentation of the research results, your words may be used by way of direct quotes or references. In the event of such usage, your words will be anonymized to ensure that you cannot be identified from their usage. It is also important to make you aware that you can contact the University of Sheffield research office and the research supervisor using the details below to provide information about the conduct of this study and any concerns you may have. This information will be treated in confidence and addressed accordingly.

If you are happy to continue and participate in this study, please sign the attached consent form any time before the conduct of the interview.

Thank you for your time and cooperation.

**Researcher**

ABIYE TOB-OGU

Doctoral Researcher,

Sheffield University Management School,

The University of Sheffield, Sheffield

United Kingdom

[a.c.tob-ogu@sheffield.ac.uk](mailto:a.c.tob-ogu@sheffield.ac.uk)

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**Supervisors:**

Professor John Cullen

Professor of Management Accounting,

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S10 1FL

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Dr. Niraj Kumar

Lecturer in Operations and Supply Chain Management,

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Conduit Road, Sheffield.

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[n.kumar@sheffield.ac.uk](mailto:n.kumar@sheffield.ac.uk)

+44(0) 114 222 3360

,

**Research Office**

Sheffield University Management School

The University of Sheffield,   
Conduit Road, Sheffield

S10 1FL

+44(0) 114 222 3477

**Interview Questions**

Thank you for electing to participate in this study. This interview is part of a research that seeks to understand particular challenges within road freight operations in the oil and gas industry. Data is being collected from a number of organisations to enhance the representation of the overall outcomes.

1. Please describe your role and responsibility within your organisation?
2. Can you please provide some detailed information on the range and volume of products that your organisation distributes on a daily, weekly and monthly basis?
3. Are your operations organised nationally, regionally or locally (State or Local government levels)?
4. Can you please describe in (as much detail as possible) the processes of distributing and marketing your petroleum products via road networks?**I am interested in the process between the requisition and loading of the products from the depots through to the offloading of the products into the fuel station storage tanks for dispensing**
5. Can you describe your distribution and marketing structure/strategy? i.e. does your organisation own and control all the assets used in the distribution of your products via road or do you have sub-contracting and 3rd party logistics partners in place?
6. People use the term sustainability commonly; please can you tell me what the term “sustainability” means to you?
7. How important would you say the issue of sustainability is to your operations as a petroleum products distribution and marketing firm?
8. In what ways would you say your operational structure/ strategy influence your objective to keep your operations sustainable?
9. In your opinion, do you think that sustainability is important to all organisations in your industry and what are the possible reasons for your answer?
10. Sustainability is commonly viewed from 3 different perspectives, namely the Social, Economic and Environmental perspectives; do you agree that these perspectives apply to your operations as a petroleum products distribution and marketing firm?
11. Bearing in mind the different perspectives to sustainability, can you give some examples of
    * 1. *How your organisation sets its social sustainability objectives, preferably with examples?*
      2. *How your organisation sets its economic sustainability objectives, preferably with examples?*
      3. *How your organisation sets its environmental sustainability objectives, preferably with examples?*
12. Would you say the processes you have in place are socially, economically and environmentally sustainable, i.e. are your operations meeting the sustainability objectives?
13. Do you think that the level of sustainability being achieved in your distribution and marketing process gives you any advantage over your competitors?
14. Can you please give some reasons for your answer to question 13?
15. Let me draw your attention to the Okobie incident in 2012 where lives were lost as a result of an overturned fuel delivery tanker whose contents were being siphoned by members of the public;
    * 1. *Are there any procedures, measures or methods proactively put in place to prevent or mitigate such occurrences?*
      2. *Do you employ information and communications technology tools like computers, computer applications and other devices to enable these procedures and measures?*
      3. *Can you describe the extent to which you think ICT tools are important to your objective of preventing or mitigating such occurrences?*
      4. *Are you compelled by law to have these procedures, measures or methods in place or are they resultant from internally initiatives?*
      5. *Do currently measure and keep records of the emissions from your road transport distribution processes? And how do you achieve this?*
      6. *Do you feel the use of ICT has positively impacted your operations in this area of preventing negative occurrences like the Okobie incident?*
16. Do social and environmental issues like noise levels, carbon emissions, air pollution, and accidents come within the scope of negative issues that you seek to prevent or mitigate?
17. How do you balance the challenge of being socially and environmentally sustainable with being economically sustainable?
18. If you were evaluating your organisation’s approach to sustainability, would you describe it as very competent, competent or not competent (*where competence means that you have a very strategic and efficient plan in place*)
19. Back to the idea of ICT, I understand that your operations are very complex and involve a lot of coordination to deliver your operational objectives on a daily basis.
    * 1. *Do you use ICT devices and systems to aid the delivery of these objectives?*
      2. *How important is the use of ICT, in terms of your ability to meet your objectives? Would you say you couldn’t meet your operational objectives without the aid of ICT tools, devices, applications etc.?*
      3. *Can you give examples of ICT devices, software and applications that you use to achieve your operations objectives?*
20. Does the objective of being sustainable contribute to your decision to adopt ICT devices, tools, software and applications in your product distribution processes?
21. Bearing in mind that you also have other means of transporting products, e.g. water and pipelines,
    * 1. *How important would you say ICT is to your distribution of products via road?*
      2. *In what ways do you deploy ICT to aid the actual process of distributing your petroleum products*

* + 1. *Does the use of ICT any advantage over your competitors with regards to the distribution of petroleum products via road or would you consider it a basic threshold requirement of the industry sector? i.e. all the firms have it and it doesn’t create any significant profitability advantage.*
    2. *Can you share any ideas of how you think the use of ICT (as part of the product distribution process) can give your organisation an advantage or better advantage over the competition?*

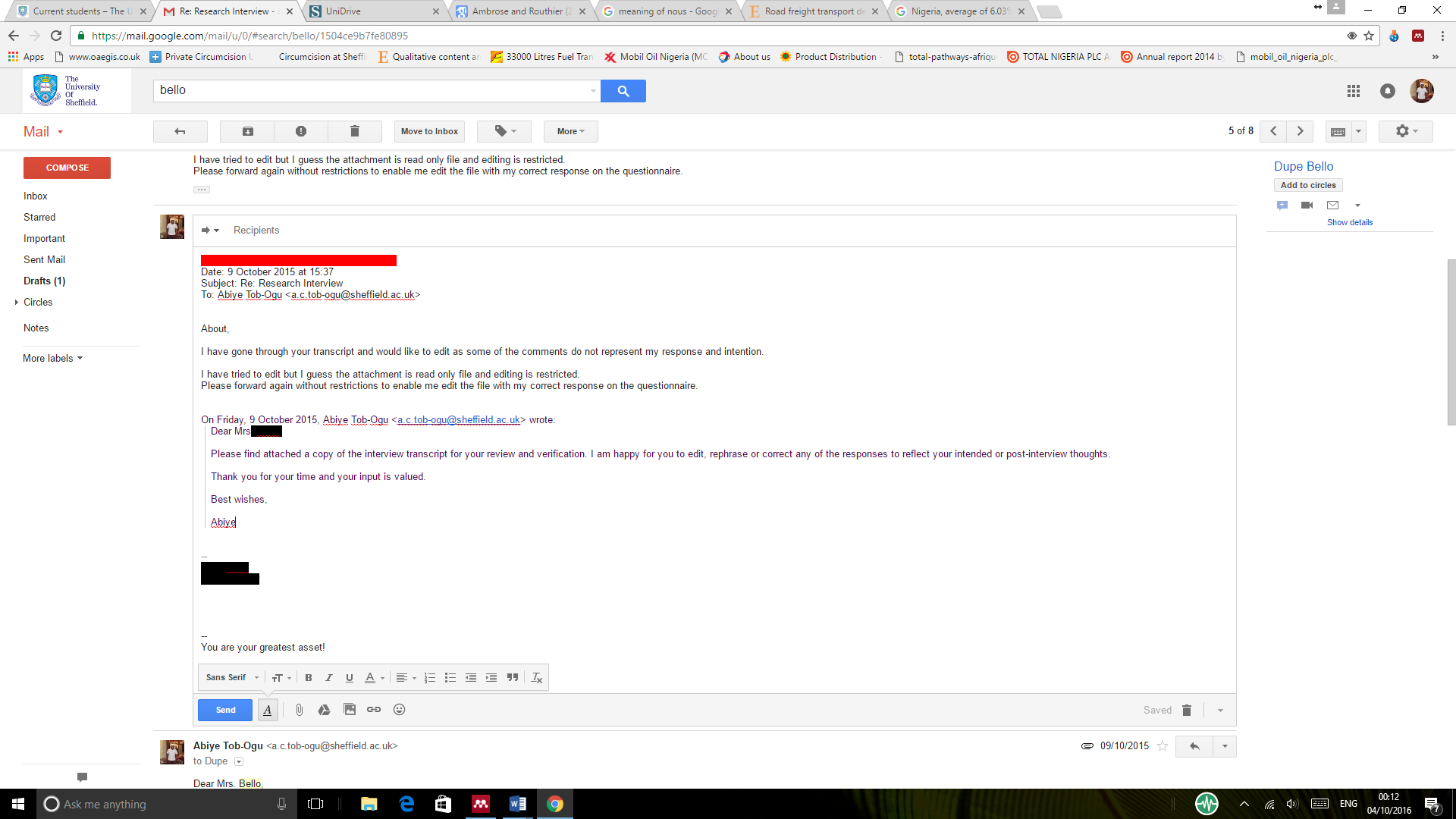
1. Does your organisation share information about the sustainability of your operations? If it does share with the public, where can such information be found?
2. Are there any issues which we haven’t highlighted but you think are important to discussing sustainability in your road freight operations?

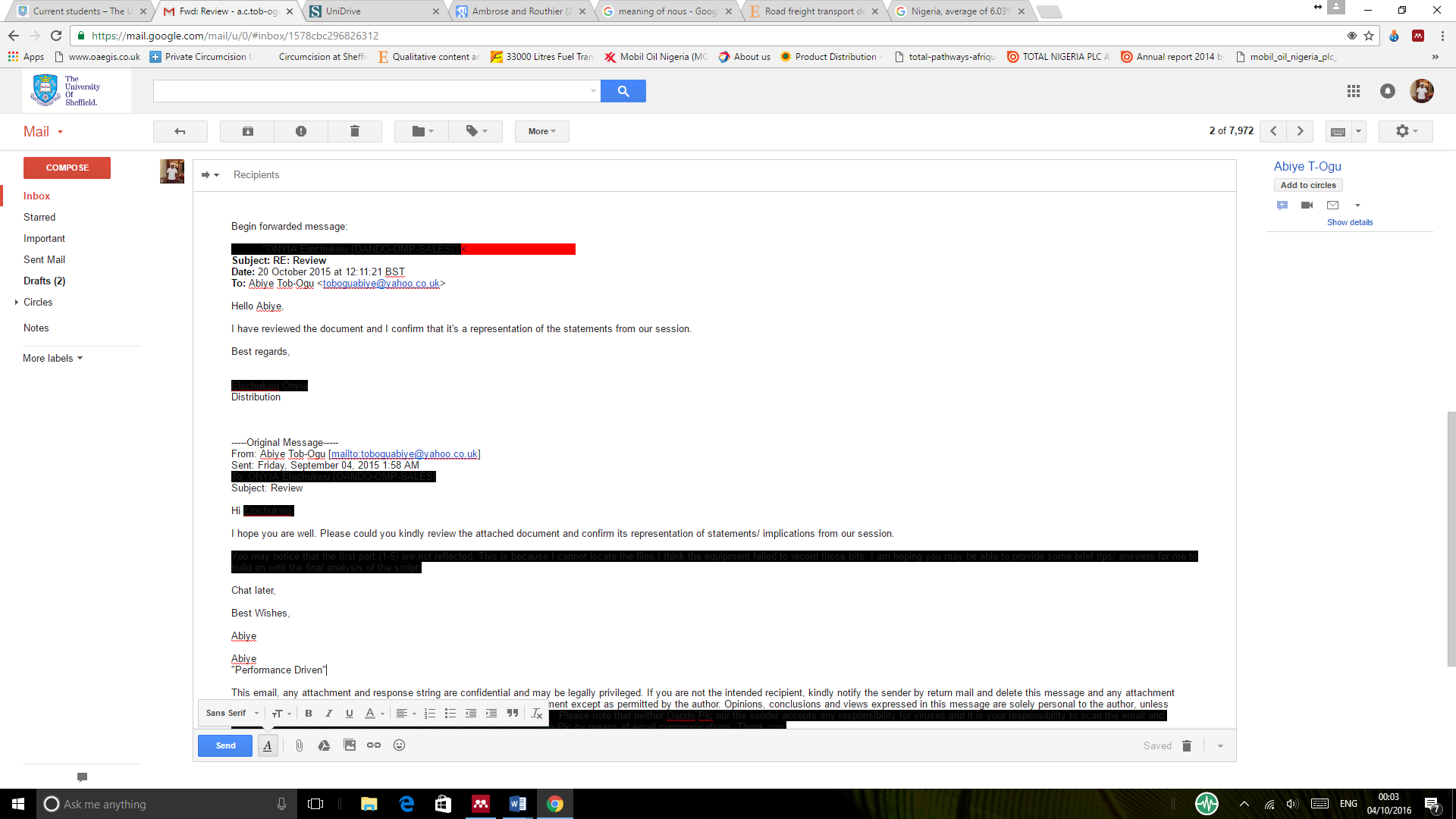
Thank you for your time and insight.

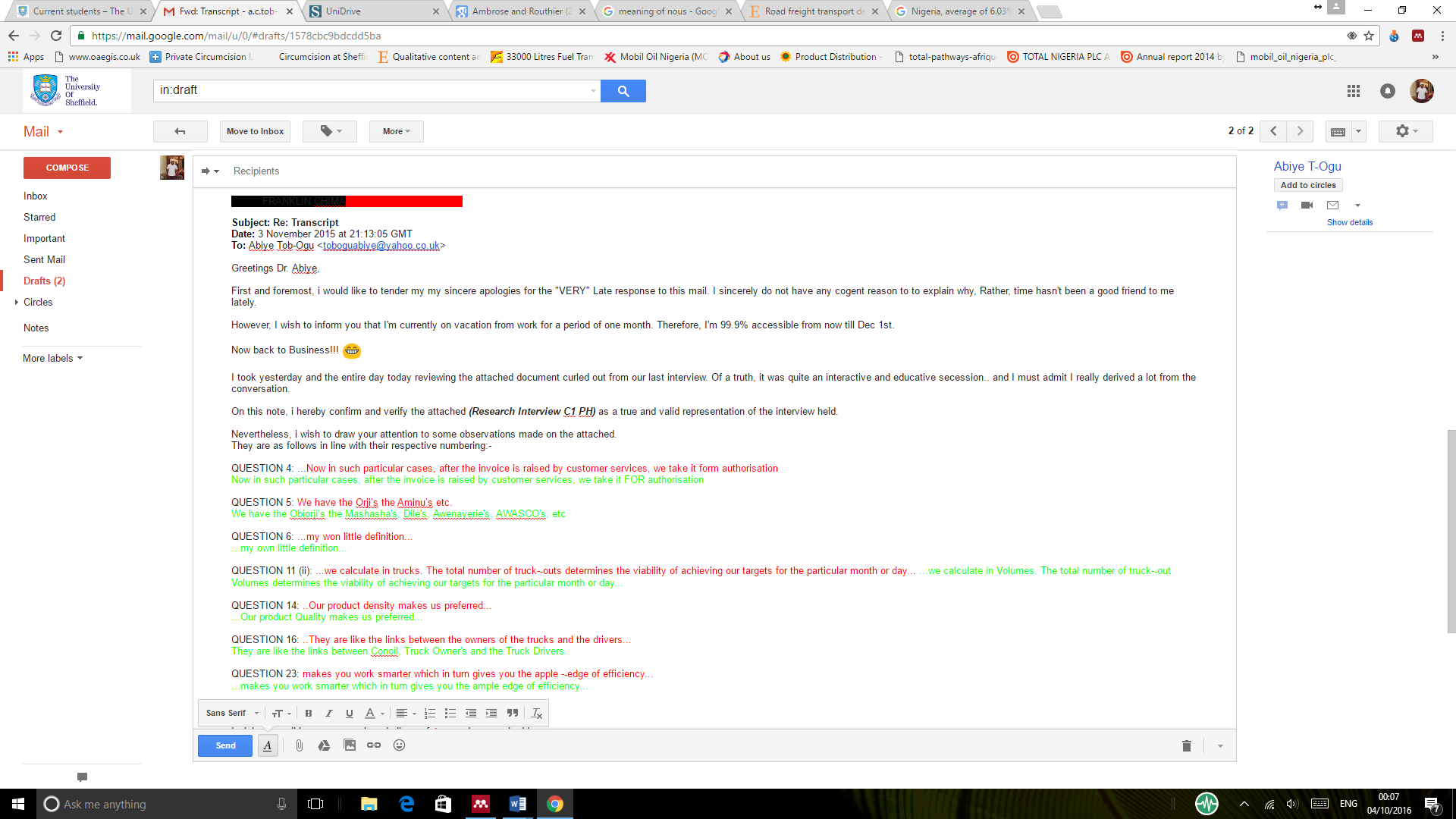
Your contribution to this research is of immeasurable value.

Start time: Conclusion time:

Appendix 3 – Transcript Validation (Email Samples)







Appendix 4 – Sample of Signed Consent Forms

Appendix 5 – Ethical Approval Form (Sample)

|  |  |  |
| --- | --- | --- |
| **Colour logo for print** | **University Research Ethics Application Form for Staff and PGRs** |  |

This form has been approved by the University Research Ethics Committee (UREC)

|  |  |
| --- | --- |
| **Date:** | 02 – August – 2014 |
| **Name of applicant:** | ABIYE TOB-OGU |
| **Research project title:** | **Investigating the Relationship between Sustainability and Information and Communications Technology in Road Freight Transportation** – A qualitative inquiry into the Nigerian Petroleum Downstream sector |

|  |  |
| --- | --- |
| **Complete this form if** you are a **member of staff or a postgraduate research student** who plans to undertake a research project which requires ethics approval via the University Ethics Review Procedure. | X |
| **or** |  |
| **Complete this form if** you plan to submit a **‘generic’ research ethics application (i.e. an application** that will cover several sufficiently similar research projects). Information on the ‘generic’ route is at: [www.sheffield.ac.uk/ris/other/gov-ethics/ethicspolicy/approval-procedure/review-procedure/generic-research-projects](http://www.sheffield.ac.uk/ris/other/gov-ethics/ethicspolicy/approval-procedure/review-procedure/generic-research-projects) |  |

If you are an undergraduate or a postgraduate-taught student, this is the wrong form.

PLEASE NOTE THAT YOUR DEPARTMENT MAY USE A VARIATION OF THIS FORM: PLEASE CHECK WITH THE ETHICS ADMINISTRATOR IN YOUR DEPARTMENT

**This form should be accompanied, where appropriate, by all Information Sheets/Covering Letters/Written Scripts which you propose to use to inform the prospective participants about the proposed research, and/or by a Consent Form where you need to use one.**

Further guidance on how to apply is at: [www.shef.ac.uk/ris/other/gov-ethics/ethicspolicy/approval-procedure/review-procedure](http://www.shef.ac.uk/ris/other/gov-ethics/ethicspolicy/approval-procedure/review-procedure)

Guidance on the possible routes for obtaining ethics approval (i.e. on the University Ethics Review Procedure, the NHS procedure and the Social Care Research Ethics Committee, and the Alternative procedure) is at: [www.shef.ac.uk/ris/other/gov-ethics/ethicspolicy/approval-procedure/ethics-approval](http://www.shef.ac.uk/ris/other/gov-ethics/ethicspolicy/approval-procedure/ethics-approval)

Once you have completed this research ethics application form in full, and other documents where appropriate, check that your name, the title of your research project and the date is contained in the footer of each page and email it to the Ethics Administrator of your academic department. Please note that the original signed and dated version of ‘Part B’ of the application form should also be provided to the Ethics Administrator in hard copy. Ethics Administrators are listed at:

[www.shef.ac.uk/polopoly\_fs/1.99105!/file/Ethics-Administrators.pdf](http://www.shef.ac.uk/polopoly_fs/1.99105!/file/Ethics-Administrators.pdf)

|  |  |
| --- | --- |
| **I confirm that I have read the current version of the University of Sheffield ‘Ethics Policy Governing Research Involving Human Participants, Personal Data and Human Tissue’, as shown on the University’s research ethics website at:** [**www.shef.ac.uk/ris/other/gov-ethics/ethicspolicy**](http://www.shef.ac.uk/ris/other/gov-ethics/ethicspolicy) | X |

**Part A**

A1. Title of Research Project: Investigating the relationship between sustainability and ICT in road freight transport

A2. Contact person (normally the Principal Investigator, in the case of staff-led research projects, or the student in the case of supervised-postgraduate researcher projects):

Title: MR

Post: DOCTORAL RESEARCHER

Email: A.C.TOB-OGU@SHEFFIELD.AC.UK

Name: ABIYE TOB-OGU

Department: MANAGEMENT SCHOOL

Telephone: 077 9239 5168

A2.1. Is this a postgraduate researcher project? If yes, please provide the Supervisor’s contact details:

Title: PROFESSOR

Post: SUPERVISOR

Email: JOHN.CULLEN@SHEFFIELD.AC.UK

Name: JOHN CULLEN

Department: MANAGEMENT SCHOOL

Telephone: +44 (0)114 222 3429

A2.2. Other key investigators/co-applicants (within/outside University), where applicable. Please list all (add more if necessary):

Title:

Post:

Email:

Name:

Department:

Telephone:

**A3. Proposed Project Duration:**

|  |  |
| --- | --- |
| Start date: OCTOBER, 2014 | End date: OCTOBER, 2016 |

**A4. Mark ‘X’ in one or more of the following boxes if your research:**

|  |  |  |
| --- | --- | --- |
|  |  | **involves adults with mental incapacity or mental illness** |
|  |  |  |
|  |  | **involves prisoners or others in custodial care (e.g. young offenders)** |
|  |  |  |
|  |  | **involves children or young people aged under 18 years** |
|  |  |  |
|  |  | **involves using samples of human biological material collected before for another purpose** |
|  |  |  |
|  |  | **involves taking new samples of human biological material (e.g. blood, tissue) \*** |
|  |  |  |
|  |  | **involves testing a medicinal product \*** |
|  |  |  |
|  |  | **involves taking new samples of human biological material (e.g. blood, tissue) \*** |
|  |  |  |
|  |  | **involves additional radiation above that required for clinical care \*** |
|  |  |  |
|  |  | **involves investigating a medical device \*** |

|  |  |  |
| --- | --- | --- |
|  |  | **is social care research** |

|  |  |  |
| --- | --- | --- |
|  |  | **is ESRC funded** |

|  |
| --- |
| \* If you have marked boxes marked **\*** then you also need to obtain confirmation that appropriate University insurance is in place. The procedure for doing so is entirely by email. Please send an email addressed to [insurance@shef.ac.uk](mailto:insurance@shef.ac.uk) and request a copy of the ‘Clinical Trial Insurance Application Form’. |

**It is recommended that you familiarise yourself with the University’s Ethics Policy Governing Research Involving Human Participants, Personal Data and Human Tissue before completing the following questions. Please note that if you provide sufficient information about the research (what you intend to do, how it will be carried out and how you intend to minimise any risks), this will help the ethics reviewers to make an informed judgement quickly without having to ask for further details.**

**A5. Briefly summarise:**

1. **The project’s aims and objectives:**

(This must be in language comprehensible to a lay person)

|  |
| --- |
| Research Aim   * To explore and document the importance sustainable road freight transport within the Nigerian oil and gas industry * Bridging of the theory gaps on the relationship between ICT and sustainability in road freight transportation.   Research Objectives   * Design, collect and analyse empirical data using qualitative strategies to identify how the marketing and distribution companies construct sustainability and its importance to their transportation of products by road * Explore and document mechanisms adopted by firms to advance their sustainability, particularly ICT mechanisms. * Strengthen theoretical understanding of the ICT capabilities and their link to sustainable freight transportation. * Identify opportunities for future research in this area. |

1. **The project’s methodology:**

(This must be in language comprehensible to a lay person)

|  |
| --- |
| This study employs qualitative strategies underpinned by abduction to meet its objectives. This means that the philosophical assumptions are based on the views that knowledge in this area is best developed in the contexts of its application. Therefor literature exists to help identify contemporary knowledge but does not restrict the conduct of the study.  Data for this study will be collected in Nigeria, particularly from firms in the downstream sector of the oil and gas industry. This field work is scheduled to take 8 months from ethical approval, access through to the start of analysis.  Multiple case studies approach is used to facilitate data collection, using semi-structured interviews and non-participant observations as primary tools. Data analysis will be performed using the narrative analysis method to ensure that data meanings and nuances are preserved and reflective of the intent of the participants.  The overall research process is guided by the University of Sheffield ethical conformance requirements. |

**A6. What is the potential for physical and/or psychological harm/distress to participants?**

|  |
| --- |
| There is minimal potential for the psychological harm/ distress or physical harm for the participants of this study. It is probable that the data collection process may generate some personal or performance related data but this is anticipated to be covered by the principles of participant anonymity that this research is premised on. However, because of the iterative approach, it is intended that where any issues (which in the researcher’s judgement has the potential to cause any harm or distress) arises, immediate consultation with supervisors and the stakeholders will be initiated and managed in line with the University’s ethical guide. |

**A7. Does your research raise any issues of personal safety for you or other researchers involved in the project?** (Especially if taking place outside working hours or off University premises)

|  |
| --- |
| There is currently a health concern in Nigeria. A viral outbreak is causing severe health issues and leading to some difficulty in interpersonal relationships. However, the situation is under continuous monitoring and the authorities claim to be containing the outbreak. |

**If yes, explain how these issues will be managed.**

|  |
| --- |
| One will continue to observe the situation and make appropriate consultations with GPs and health experts prior to any travel. No other safety issues are envisaged for the conduct of the study.  Similarly, good personal hygiene is proffered as one of the preventative measures against the disease and good practices like hand-washing, minimal physical contact and frequent medical checks will help to minimise the risks of infection or harm. |

**A8. How will the potential participants in the project be?**

1. **Identified?**

|  |
| --- |
| Management contacts in some of the target organisations have indicated interest in this study. Informal discussions are underway to identify appropriate management personnel and locations for data collection. It is hoped that they will show good interest and give formal access and approval for the conduct of the study. |

1. **Approached?**

|  |
| --- |
| Organisation access request letters will be sent formally to the management staff. It is expected that discussions on access terms, restrictions, study benefits and data management will be made and agreed prior to formal access approval. This process will be aided through the snowballing technique where existing contacts in the industry will be used to gain appropriate management information and personnel access. |

1. **Recruited?**

|  |
| --- |
| There participants will be recruited through email and postal correspondence. |

**A9. Will informed consent be obtained from the participants?**

|  |  |  |  |
| --- | --- | --- | --- |
| Yes | X | No |  |

**If informed consent or consent is NOT to be obtained, please explain why.** Further guidance is at: [www.shef.ac.uk/ris/other/gov-ethics/ethicspolicy/policy-notes/consent](http://www.sheffield.ac.uk/ris/other/gov-ethics/ethicspolicy/policy-notes/consent)

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**A9.1.** This question is only applicable if you are planning to obtain informed consent:

**How do you plan to obtain informed consent? (i.e. the proposed process?):**

|  |
| --- |
| The participants will be informed of the general purpose of this study and the safeguards put in place by the University of Sheffield to promote ethical and integrity based research. The concept of voluntary participation will be made known to the participants and informed consent will be obtained via the semi-structured interview questions, which will be sent out to the participants prior to the interview sessions.  The question parks will include a session on the participant’s right to refuse participation and the need for informed consent, detailing the implications of consent and participation to the participants.  These pages will require a signature to show consent and will be collected prior to any interview or observation sessions. Observation sessions will be preceded by appropriate information by the line managers to the participants about the presence and objective of the researcher during the sessions. |

Remember to attach your consent form and information sheet (where appropriate)

**A10. What measures will be put in place to ensure confidentiality of personal data, where appropriate?**

|  |
| --- |
| Data confidentiality will be promoted through the following measures:   * Data will be collected and transcribed by the researcher alone. Data collection tools will be secured in a safe box. * All transcribed data will be stored on password protected computers. Password computers will be held in the name of Abiye Tob-Ogu only. * Names of participants will not be recorded rather sessional codes will be used to identify participants and guide subsequent analysis and presentation of data. * Strict conformance with the provisions of the data protection act, 1998. This will provide useful legal and practice guide for handling data. * Data held will be destroyed after 4 years from the date of collection. |

**A11. Will financial/in kind payments (other than reasonable expenses and compensation for time) be offered to participants?** (Indicate how much and on what basis this has been decided)

|  |
| --- |
| No financial or other kind of payment will be offered to any participant. |

**A12. Will the research involve the production of recorded media such as audio and/or video recordings?**

|  |  |  |  |
| --- | --- | --- | --- |
| YES | x | NO |  |

**A12.1.** This question is only applicable if you are planning to produce recorded media:

**How will you ensure that there is a clear agreement with participants as to how these recorded media may be stored, used and (if appropriate) destroyed?**

|  |
| --- |
| There is no plan to produce recorded media and whilst data collection will be aided through the use of audio devices, all audio data will be transferred from the recording equipment onto Abiye Tob-Ogu’s password protected computer device on a daily basis. Data will be wiped off immediately after transfer. |

Guidance on a range of ethical issues, including safety and well-being, consent and anonymity, confidentiality and data protection are available at: [www.shef.ac.uk/ris/other/gov-ethics/ethicspolicy/policy-notes](http://www.sheffield.ac.uk/ris/other/gov-ethics/ethicspolicy/policy-notes)

**University Research Ethics Application Form - Part B - The Signed Declaration**

|  |
| --- |
| Investigating the Relationship between Sustainability and Information and Communications Technology in Road Freight Transportation – A qualitative inquiry into the Nigerian Petroleum Downstream sector |

**Title of Research Project:**

I confirm my responsibility to deliver the research project in accordance with the University of Sheffield’s policies and procedures, which include the University’s ‘*Financial Regulations*’, ‘*Good Research Practice Standards’* and the ‘*Ethics Policy Governing Research Involving Human Participants, Personal Data and Human Tissue’* (Ethics Policy) and, where externally funded, with the terms and conditions of the research funder.

**In signing this research ethics application form I am also confirming that:**

* The form is accurate to the best of my knowledge and belief.
* The project will abide by the University’s Ethics Policy.
* There is no potential material interest that may, or may appear to, impair the independence and objectivity of researchers conducting this project.
* Subject to the research being approved, I undertake to adhere to the project protocol without unagreed deviation and to comply with any conditions set out in the letter from the University ethics reviewers notifying me of this.
* I undertake to inform the ethics reviewers of significant changes to the protocol

(by contacting my academic department’s Ethics Administrator in the first instance).

* I am aware of my responsibility to be up to date and comply with the requirements of the law and relevant guidelines relating to security and confidentiality of personal data, including the need to register when necessary with the appropriate Data Protection Officer (within the University the Data Protection Officer is based in CiCS).
* I understand that the project, including research records and data, may be subject to inspection for audit purposes, if required in future.
* I understand that personal data about me as a researcher in this form will be held by those involved in the ethics review procedure (e.g. the Ethics Administrator and/or ethics reviewers) and that this will be managed according to Data Protection Act principles.
* If this is an application for a ‘generic’ project, all the individual projects that fit under the generic project are compatible with this application.
* **I understand that this project cannot be submitted for ethics approval in more than one department, and that if I wish to appeal against the decision made, this must be done through the original department.**

**Name of the Principal Investigator (or the name of the Supervisor if this is a postgraduate researcher project):**

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| --- |
| **PROF. JOHN CULLEN, DR. NIRAJ KUMAR** |

|  |
| --- |
| **ABIYE TOB-OGU** |

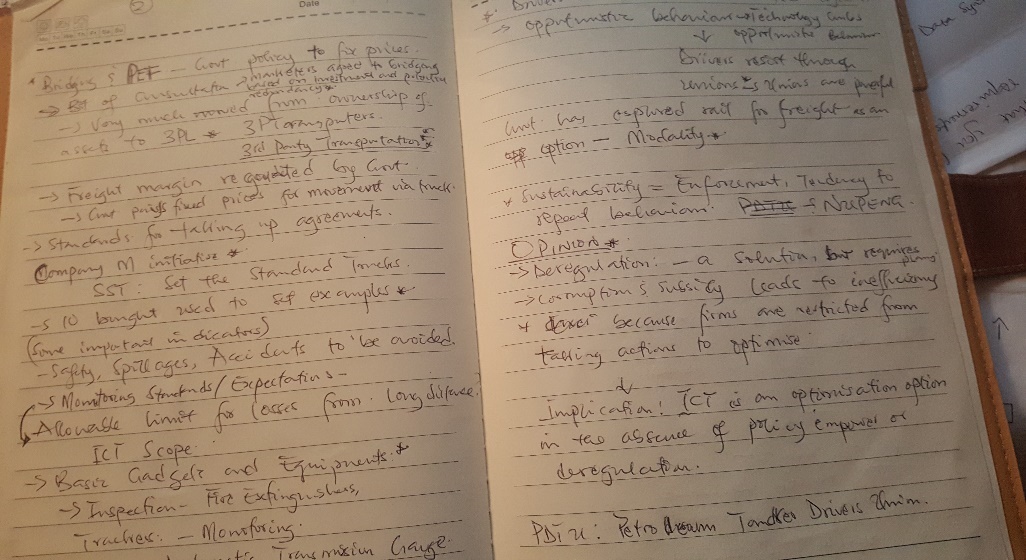
**If this is a postgraduate researcher project, insert the student’s name here:**

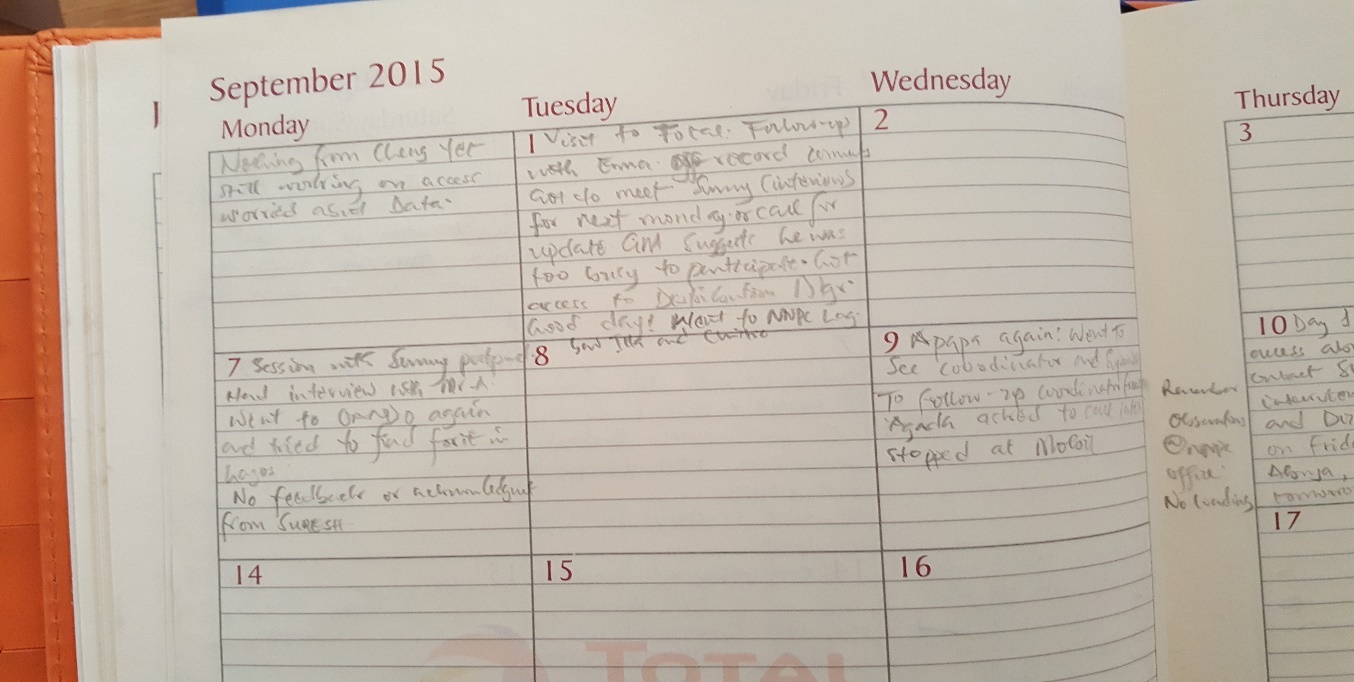
**Signature of Principal Investigator (or the Supervisor):**

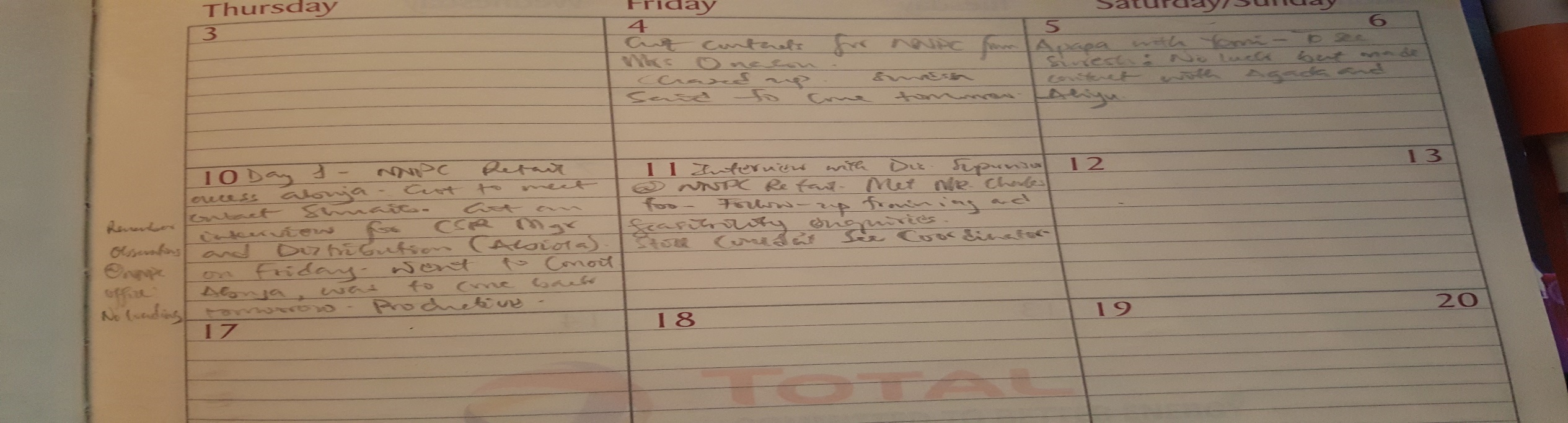
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|  | Date:01-09-2014 |

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| **Email the completed application form and provide a signed, hard copy of ‘Part B’ to the Ethics Administrator (also enclose, if relevant, other documents).** |

Appendix 6 – Field Diary Extracts







Appendix 7 - Contexts, thematic categories and outcome overview of articles in the systematic review

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No** | **Author** | **Year** | **Title** | | **Journal** | | | **Methodology** | **Instrumentation** | | **Theory** | | **Context** | | **Theme (Intervention Mechanism** | | **Outcomes** | |
| 1 | Sternberg et al., | 2014 | The efficiency potential of ICT in haulier operations | | Computers in Industry | | | Mixed | Case Studies | | Unstated | | Europe: Germany, Sweden, Switzerland | | ICT (Information and Communications Technology) | | IC beneﬁts on individual transportation unit levels (drivers’ working time) in terms of reduced work hours in the administration and waiting times associated with administration. Identifies driver’s working time saving as credible ICT adoption propositions for managers to look to, in addition to fuel savings. | |
| 2 | Marchet et al., | 2009 | An exploratory study of ICT adoption in the Italian freight transportation industry | | International Journal of Physical Distribution & Logistics Management | | | Qualitative | Case Studies | | Unstated | | Italy | | ICT (Information and Communications Technology) | | Only operational routines are ICT supported. Even lower adoption levels for innovative applications and integrating IT platforms. Affirms the influence of size on adoption tendencies amongst firm. Lack of awareness and fragmentation inhibits integration | |
| 3 | Marchet et al., | 2012 | Modelling the impacts of ICT adoption for inter-modal transportation | | International Journal of Physical Distribution & Logistics Management | | | Mixed | Modelling/ Case Studies | | Unstated | | Italy | | ICT (Information and Communications Technology) | | ICT extends to gains across economic and environmental benefits for the adopting firms. ICT can improve all companies and help logistics and transport companies to improve their effectiveness and efficiencies. Important considerations extend to integration and terminal size for intermodal operations. | |
| 4 | Davies et al., | 2007 | Assessing the impact of ICT on UK general haulage companies | | International Journal of Production Economics | | | Quantitative | Survey | | Unstated | | UK | | ICT (Information and Communications Technology) | | ICT is important and has a positive effect on haulage operations, enabling efficiencies, back-loading and planning. Size is instrumental to adoption with smaller firms missing out on benefits | |
| 5 | Walker and Manson | 2014 | Telematics, urban freight logistics and low carbon road networks | | Journal of Transport Geography | | | Quantitative | Simulation | | Unstated | | UK | | ICT (Information and Communications Technology) | | Telematics does not always lead to more efﬁcient urban logistics. Indeed, in many cases the same outcomes can be achieved with 0% telematics as it can with 100%. Policy enforcers have important roles to play and topography is important for the application of telematics to urban freight | |
| No | Author | Year | Title | | Journal | | | Methodology | Instrumentation | | Theory | | Context | | Theme (Intervention Mechanism | | Outcomes | |
| 6 | Harris et al., | 2015 | ICT in multimodal transport and technological trends: Unleashing potential for the future | | International Journal of Production Economics | | | Qualitative | Conceptual Review | | Unstated | | EU | | ICT (Information and Communications Technology) | | Reviews 33 EU framework projects and links ICT trends to future outcomes. Paper identifies policy, user and technology barriers to ICT use for multimodal transport. Cloud computing, wireless technologies, social networking and interface technologies determined as crucial ICT modifiers for increased use in intermodal freight, helping to lower adoption barriers. | |
| 7 | Wang et al., | 2015 | The use of ICT in road freight transport for CO2 reduction - An exploratory study of the UK's grocery retail industry | | The International Journal of Logistics Management | | | Qualitative | Case Studies | | Unstated | | UK | | ICT (Information and Communications Technology) | | Study identifies positive correlations between ICT and CO2 emissions reduction. ICT contributes to improved energy efficiencies; better routing and scheduling at different levels. ICT also improves collaborative transport arrangements | |
| 8 | Button et al., | 2001 | Intelligent transport systems in commercial fleet management: a study of short term economic benefits | | Transportation Planning and Technology | | | Mixed | Case Studies/ Surveys | | Unstated | | USA | | ICT (Information and Communications Technology) | | ICT improves productivity of freight transport drivers and also reduces stress in despatchers due to improved efficiencies. Software use for congestion mitigation is still very limited and unhelpful. | |
| 9 | Crainic et al., | 2009 | Intelligent freight-transportation systems: Assessment and the contribution of operations research | | Transportation Research Part C: Emerging Technologies | | | Qualitative | Conceptual Review | | Unstated | | Generic | | ICT (Information and Communications Technology) | | Paper focuses on and assesses the main technological issues affecting freight transport, emphasizing the role of operations based DS software for improving freight ITS performance. The importance of DS software has both policy and industry implications for ITS uptake and performance | |
| 10 | Islam et al., | 2013 | Performance evaluation of an online benchmarking tool for European freight transport chains | | Benchmarking: An International Journal | | | Mixed | Survey/ interview | | Unstated | | EU | | Other | | Cost is the most important indicator in evaluating freight transport performance. Use of information technology for planning and benchmarking still not prevalent in the road freight industry | |
| No | Author | Year | Title | | Journal | | | Methodology | Instrumentation | | Theory | | Context | | Theme (Intervention Mechanism | | Outcomes | |
| 11 | Demir et al., | 2014 | A review of recent research on green road freight transportation | | European Journal of Operational Research | | | Qualitative | Review | | Unstated | | Generic | | Other | | Other factors besides routing and travel minimisation affect energy consumption in road freight. Speed, load weight and road gradient also determine consumption. Driver working hours may impact efficiencies and sustainability. | |
| 12 | Pan et al., | 2013 | The reduction of greenhouse gas emissions from freight transport by pooling supply chains | | International Journal of Production Economics | | | Quantitative | Modelling/ Case Studies | | Unstated | | France | | Other | | Joint road and rail transport is a signiﬁcant way to reduce CO2 emissions, provided the electrically powered train generates low emissions in France. Alternatively, the study affirms that a single transport mode can yield similar emission reduction and cost savings through the consolidation of supply network | |
| 13 | Kinnear et al., | 2015 | Emissions Reporting in the Australian Road Freight Transport Sector: Is There a Better Method than the Default Option? | | International Journal of Sustainable Transportation | | | Quantitative | Modelling/ Case Studies | | Unstated | | Australia | | Other | | Makes case for the migration from default reporting methodologies to NGERS reporting as a means of reducing emissions. | |
| 14 | Khorheh et al., | 2015 | Socio-environmental performance of transport systems | | Management of Environmental Quality: An International Journal | | | Quantitative | Survey | | Unstated | | Australia | | Other | | Logistics perceptions have gone beyond economic considerations. Political, soci0-ecnomic, infrastructure and technological solutions impact road freight transport but technology has the most significant impact on environmental and social performance | |
| 15 | Alho, and de Abreu e Silva | 2014 | Analysing the relation between land-use/urban freight operations and the need for dedicated infrastructure/enforcement - Application to the city of Lisbon | | Research in Transportation Business and Management | | | Mixed | Modelling/ Case Studies | | Unstated | | Portugal | | Other | | Illegal parking by non-freight vehicles impacts road freight performance. Better planning and enforcement will improve congestion and aid efficiency in urban freight deliveries | |
| 16 | Pérez-Martínez and Vassallo-Magro | 2013 | Changes in the external costs of freight surface transport in Spain | | Research in Transportation Economics | | | Quantitative | Modelling | | Unstated | | Spain | | Other | | Policy measures driving modality, vehicle load distribution and fuel efficiencies are helping to address external cost from road freight in Spain. Also highlights some difficulties with predictions from existing data structures. | |
| No | Author | Year | Title | | Journal | | | Methodology | Instrumentation | | Theory | | Context | | Theme (Intervention Mechanism | | Outcomes | |
| 17 | Carballo-Penela et al., | 2012 | From the motorways of the sea to the green corridors' carbon footprint: the case of a port in Spain | | Journal of Environmental Planning and Management | | | Quantitative |  | | Unstated | | Spain | | Other (Green Corridors) | | Carbon strategies built around various stakeholders are vital to the success of green corridor initiatives. Indirect emissions have to be taken into account in emissions management. | |
| 18 | Figliozzi, M. A | 2011 | The impacts of congestion on time-definitive urban freight distribution networks CO2 emission levels: Results from a case study in Portland, Oregon | | Transportation Research Part C: Emerging Technologies | | | Quantitative | Modelling/ Case Studies | | Unstated | | USA | | Other | | Uncongested travel reduces emissions, although the impact of congestion on freight vehicle emissions is difficult to forecast. | |
| 19 | Marchet, Gino; Melacini, Marco; Sara, Perotti | 2014 | Environmental Sustainability in Logistics and freight transportation: A literature review and research agenda | | Journal of Manufacturing Technology Management | | | Qualitative | Conceptual Review | | Unstated | | Generic | | Other | | Although researchers have started to examine the decision-making process involved in environmental sustainability adoption in recent years, many themes, such as sustainability evaluation and measurement, and the level of adoption of sustainability initiatives in the context of the third-party logistics (3PL) industry are under-represented in the literature. articles are either conceptual papers or empirical studies (i.e. mostly based on surveys or case studies), while simulation and analytical modelling have rarely been addressed. | |
| 20 | Alises et al., | 2014 | Road freight transport decoupling: A comparative analysis between the United Kingdom and Spain | | Transport Policy | | | Quantitative | Decomposition analysis | | Unstated | | UK and Spain | | Decoupling | | Explores the stagnation of freight transport growth using decomposition analysis to identify and explain determining variables in the UK and Spain. Construction sector growth in Spain is found to be influencing slower decoupling rates compared to the UK, accounting for the higher road freight transport intensity measurements. | |
| 21 | Liimatainen and Pollanen | 2013 | The impact of sectoral economic development on the energy efficiency and CO2 emissions of road freight transport | | Transport Policy | | | Quantitative | Quantitative Modelling | | Unstated | | Finland | | Decoupling | | Examines decreasing road freight transport in Finland. The study provides a 2016 forecast update for the Finnish road freight transport sector; highlighting an 8% increase on the previous forecast levels. Fuel consumption increases are cited as a factor influencing the emissions increase and evidence points to little or no decoupling taking place within the Finnish economy. | |
| No | Author | Year | Title | | Journal | | | Methodology | Instrumentation | | Theory | | Context | | Theme (Intervention Mechanism | | Outcomes | |
| 22 | McKinnon, A. C. | 2007 | Decoupling of Road Freight Transport and Economic Growth Trends in the UK: An Exploratory Analysis | | Transport Reviews | | | Qualitative | Explorative (decomposition) analysis | | Unstated | | UK | | Decoupling | | Paper reviews research on decoupling strategies and identifies decline in road share, offshoring, growth of service sector and decentralisation as drivers of decoupling within the UK. Advances the proposition that environmental gains from decoupling are modest at best, unless supported with other modal, policy and operational mechanisms. | |
| 23 | Macharis et al., | 2011 | A decision support framework for intermodal transport policy | | European Transport Research Review | | | Quantitative | Modelling | | Unstated | | Belgium | | Modality (Inter and Co-modality) | | Inter-modality as a cost, policy and efficiency construct. DSS are critical to optimising intermodal operations. Demonstrates the viability of DSS for intermodal freight transport efficiencies. | |
| 24 | Banomyong and Beresford | 2001 | Multimodal transport: The case of Laotian garment exporters | | International Journal of Physical Distribution & Logistics Management | | | Qualitative | Modelling | | Unstated | | Lao (South East Asia) | | Modality (Inter and Co-modality) | | Inter-modality offers competitive gains and increased awareness and accessibility to exporters may offer Laotian garment exporters. | |
| 25 | Winebrake et al., | 2008 | Assessing Energy, Environmental, and Economic Trade-offs in Intermodal Freight Transportation | | Journal of the Air & Waste Management Association | | | Quantitative | Modelling/ Case Studies | | Unstated | | USA | | Modality (Inter and Co-modality) | | Trucking holds significant time advantage over other modes of freight transport. Routing also creates emission trade-offs between CO2 and PM10 emission. | |
| 26 | Rich et al., | 2011 | On structural inelasticity of modal substitution in freight transport | | Journal of Transport Geography | | | Quantitative | Modelling | | Aggregation | | EU/ Scandinavia | | Modality (Inter and Co-modality) | | Strong inelasticity for modal shift from trucks in the freight market. The structural inelasticity is also strongly connected to the ‘‘last-mile problem” of freight transport. | |
| 27 | Ruiz-Garcia et al., | 2007 | Review. Monitoring the intermodal, refrigerated transport of fruit using sensor networks | | Spanish Journal of Agricultural Research | | | Qualitative | Conceptual Review | | Unstated | | Generic | | Modality (Inter-modality and ICT) | | Efficiencies are critical to intermodal freight operations and the combination of available information technologies can provide useful efficiencies for food freight, reducing costs, improving integration and mobility | |
|  |  |  |  |  | |  |  | | |  | |  | |  | |  | |
| 28 | Woxenius, J | 2007 | Generic Framework for Transport Network Designs: Applications and Treatment in Intermodal Freight Transport Literature | | Transport Reviews | | | Qualitative | Review/ Conceptual | | Unstated | | EU/ Generic | | Modality (Inter-modality) | | Intermodal studies are still fragmented across countries, references and even meanings attached to terminologies. Convergence is essential for progressive learning. | |
| No | Author | Year | Title | | Journal | | | Methodology | Instrumentation | | Theory | | Context | | Theme (Intervention Mechanism | | Outcomes | |
| 29 | Wiegmans, B. W | 2010 | The Freight Transport Portfolio: A New Way to Analyse Intermodal Freight Transport as Compared to Single-Mode Road Transport | | Transportation Journal | | | Quantitative | Modelling | | Equity Portfolio Management | | Europe | | Modality (Inter-modality) | | Reliability of rail and inland waterways as alternatives to road is still very low and the development of policies that improve reliability and cost efficiencies is crucial to intermodal arrangements | |
| 30 | Kim, and Van Wee | 2009 | Assessment of CO2 emissions for truck-only and rail-based intermodal freight systems in Europe | | Transportation Planning and Technology | | | Quantitative | Life Cycle Assessment Modelling | | Unstated | | Europe | | Modality (Inter and Co-modality) | | Fuel production in engines only account for between 10-12.5% of emission. Also intermodal freight isn’t always more sustainable than road freight and drayage distance affects inter-modality. | |
| 31 | Bontekoning and Priemus | 2004 | Breakthrough innovations in intermodal freight transport | | Transportation Planning and Technology | | | Qualitative | Review | | Unstated | | EU/ Generic | | Modality (Inter and Co-modality) | | Technological and management breakthroughs are critical to intermodal freight transport. Although ICT is a viable breakthrough, uncertainties, risks and benefit perceptions limit ICT integration and intermodal freight growth. Advocates the simultaneous or early involvement of all stakeholders at the early stages of innovation to overcome these perceptive limitations. | |
| 32 | Caris et al., | 2008 | Planning Problems in Intermodal Freight Transport: Accomplishments and Prospects | | Transportation Planning and Technology | | | Qualitative | Review | | Unstated | | Generic | | Modality (Inter and Co-modality) | | Reviews papers on inter-modality from a STO (Strategic, Tactical and Operational) framework. Terminal design and infrastructure configuration for network are the 2 most critical planning elements for intermodal operations | |
| 33 | Li et al., | 2015 | Intermodal freight transport planning – A receding horizon control approach | | Transportation Research Part C: Emerging Technologies | | | Quantitative | Modelling/ Simulation | | Systems and Control theory | | Netherlands | | Modality (Inter-modality) | | Dynamic models for addressing modality in freight transport have significant limitations. RIFC models help provide time, control and cost scenarios for accurately modelling intermodal transport | |
| 34 | Nealer et al., | 2011 | Modal freight transport required for production of US goods and services | | Transportation Research Part E: Logistics and Transportation Review | | | Quantitative | Modelling | | Unstated | | USA | | Modality (Inter and Co-modality) | | International shipping is the dominant method of freight transport, followed by trucks and rail. Decomposition strategies that help to identify trucking emissions by sectors will afford better options for targeted implementation of modal changes. | |
| No | Author | Year | Title | | Journal | | | Methodology | Instrumentation | | Theory | | Context | | Theme (Intervention Mechanism | | Outcomes | |
| 35 | Arnold et al., | 2004 | Modelling a rail/road intermodal transportation system | | Transportation Research Part E: Logistics and Transportation Review | | | Quantitative | Modelling | | Location theory | | Europe: Iberian Peninsula | | Modality (Inter and Co-modality) | | International freight traffic is more cost sensitive to modal share variations than national traffic. Intermodal transport provides significant advantage over unimodal road, rail or water systems. | |
| 36 | Newnam and Goode | 2015 | Do not blame the driver: A systems analysis of the causes of road freight crashes | | Accident Analysis and Prevention | | | Qualitative | ACCIMAP | | Systems theory | | Australia | | Operations (Design and Process) | | Socio-technical perspective to road freight transport externalities. Administrative faults and management faults as key causes of HGV accidents. | |
| 37 | Pérez-Martínez, P. J. | 2009 | The vehicle approach for freight road transport energy and environmental analysis in Spain | | European Transport Research Review | | | Quantitative | Surveys/ PRFSS | | Unstated | | Spain | | Operations (Design and Process) | | Paper reviews some key indicators of efficiency in road freight performance in Spain. Identifies a 0.2% increase in energy and environmental efficiencies using the PRFSS model to analyse data between 1997 and 2003. Also short and medium distances, 9–112 km, are critical as small increments within this distance range produce high increments on transport content and therefore high environmental impacts. It asserts that internalisation of external costs can lead to energy savings and CO2 reductions. | |
| 38 | Li, et al., | 2015 | Oil-saving pathways until 2030 for road freight transportation in China based on a cost-optimization model | | Energy | | | Quantitative | Modelling | | Unstated | | China | | Operations (Design and Process) | | The cost-effective GHG emission reduction target of developing alternative fuels should be set below the turn point for road freight transport. diesel and gasoline will remain the dominant fuels over the planning horizon, because the deployment scale of biofuel and natural gas was constrained by resource supply and construction speed of ﬁlling station respectively | |
| 39 | Liimatainen, et al., | 2014 | Energy efficiency of road freight hauliers-A Nordic comparison | | Energy Policy | | | Quantitative | Survey | | Unstated | | Europe (Nordic Region) | | Operations (Design and Process) | | Examined decarbonisation EEI practices of hauliers in 4 Nordic countries, replicating an earlier study in Finland. EEI reporting helps to improve environmental performance and the effect of EEI as a tool for comparison revealed very similar trends across all four counties. | |
| 40 | Ozen and Tuydes-Yaman | 2013 | Evaluation of emission cost of inefficiency in road freight transportation in turkey | | Energy Policy | | | Quantitative | Survey | | Unstated | | Turkey | | Operations (Design and Process) | | 22.3% of empty running in 2009, accounting for over 42% of emissions. Emission reduction savings could be gained from policy initiatives that address empty running. Additional implementation of Euro IV standards could drive down GHG by up to 40% in some cases. | |
| No | Author | Year | Title | | Journal | | | Methodology | Instrumentation | | Theory | | Context | | Theme (Intervention Mechanism | | Outcomes | |
| 41 | Wang, et al., | 2014 | Operational transportation planning of freight forwarding companies in horizontal coalitions | | European Journal of Operational Research | | | Quantitative | Modelling | | Unstated | | Germany | | Operations (Design and Process) | | To improve operational efﬁciencies, forwarders have to reorganize their internal processes for better management of external relations to partners in both vertical and horizontal cooperation. Systematic considerations that combine routing, computational simulation can help reduce cost of subcontracting by up to 10%. | |
| 42 | Ehmke, et al., | 2016 | Vehicle Routing to Minimize Time-Dependent Emissions in Urban Areas | | European Journal of Operational Research | | | Quantitative | Modelling/ Experiment | | Unstated | | Germany | | Operations (Design and Process) | | Paper focuses on the problem of minimizing CO2 emissions in the routing of vehicles in urban areas. Study adopts a methodology that identifies emissions minimizing path and shows savings in emissions are proportion ally larger than the associated increases in duration, indicating improved emissions are achievable at a low cost. Sizes of trucks are important in the addressing emissions reductions. | |
| 43 | Sanchez-Rodrigues, et al., | 2014 | Developing “Extra Distance” as a measure for the evaluation of road freight transport performance | | International Journal of Productivity and Performance Management | | | Qualitative | Case Studies (Workshops) | | Unstated | | UK/ South Africa | | Operations (Design and Process) | | The “Extra Distance” measure was applied to quantify the effects of disruptions that can occur in road freight transport networks with adverse effect on profit margins. Late notification of deliveries, size, loading schedules, congestion and road restrictions were highlighted as main sources of extra distance costs, Operations integration is identified as a viable means of reducing extra distance incidents, mitigating losses by 80% in one instance, with energy and emissions implications | |
| 44 | Sternberg et al., | 2013 | Who controls the fleet? Initial insights into road freight transport planning and control from an industrial network perspective | | International Journal of Logistics Research and Applications | | | Qualitative | Case Study | | Network theory | | Switzerland | | Operations (Design and Process) | | Discusses road haulage as a complex operation with implications for control and coordination. Integration of planning and control through ICT needs to overcome fragmented barriers within the industry. | |
| 45 | Palsson and Kovács, | 2014 | Reducing transport emissions: A reaction to stakeholder pressure or a strategy to increase competitive advantage | | International Journal of Physical Distribution & Logistics Management | | | Quantitative | Survey | | RBV/ Stakeholder | | Sweden | | Operations (Design and Process) | | Greening freight transportation is both a response to external pressure and internal management strategy. Stakeholder pressure sets the minimal acceptance levels whilst RBV explains the competitive factors of sustainability | |
| No | Author | Year | Title | | Journal | | | Methodology | Instrumentation | | Theory | | Context | | Theme (Intervention Mechanism | | Outcomes | |
| 46 | McKinnon and Ge | 2006 | The potential for reducing the empty running by trucks; a retrospective analysis | | International Journal of Physical Distribution & Logistics Management | | | Quantitative | Survey | | Unstated | | UK | | Operations (Design and Process) | | This analysis suggests that, across the 29 vehicle ﬂeets sampled, there was very limited potential for reducing the distance that the trucks ran empty. It highlights the effects of operational constraints on back-loading, particularly, where the average length of haul is short, the scheduling is tight and a large proportion of freight requires refrigeration. | |
| 47 | Gilpin et al., | 2014 | Biodiesel's and advanced exhaust after treatment’s combined effect on global warming and air pollution in EU road-freight transport | | Journal of Cleaner Production | | | Quantitative | Survey | | Unstated | | EU | | Operations (Design and Process) | | The independent implementation of  RME biodiesel and advanced exhaust after treatment SCR and DPF in road-freight transport results in the reduction of their targeted emissions GWP100 and the life-cycle emissions of NOx, PM, CO, and NMHC, respectively. Perceived beneﬁts associated with reduction may vary when measured independently. | |
| 48 | Furst and Oberhofer | 2012 | Greening road freight transport: Evidence from an empirical project in Austria | | Journal of Cleaner Production | | | Quantitative | Survey | | Environmental Management/ Theory of Planned Behaviour | | Austria | | Operations (Design and Process) | | Company structure and inclination to implement environmental sustainability in road freight transport. Higher number of companies do not actively practice environmental management and size and environmental management have some relationship | |
| 49 | Allen et al., | 2012 | Investigating relationships between road freight transport, facility location, logistics management and urban form | | Journal of Transport Geography | | | Quantitative | Survey | | Unstated | | UK | | Operations (Design and Process) | | HGV freight loads in urban areas vary according to size of the urban areas. Geographical, spatial and land use factors have influences on freight activity in urban. Also urban land use patterns affect freight intensity, impacting the balance of trade. | |
| 50 | Ando and Taniguchi | 2006 | Travel time reliability in vehicle routing and scheduling with time windows | | Networks and Spatial Economics | | | Quantitative | Case Study/ Experiments | | Unstated | | Japan | | Operations (Design and Process) | | Vehicle routing and scheduling can yield favourable emissions savings. VRPTW-P model reduced negative emissions in terms of CO2, NOx and PM in addition to cost savings | |
| 51 | Olsson and Woxenius | 2014 | Localisation of freight consolidation centres serving small road hauliers in a wider urban area: Barriers for more efficient freight deliveries in Gothenburg | | Journal of Transport Geography | | | Quantitative | Case study/ Surveys | | Unstated | | Sweden | | Operations (Design and Process) | | Time is more important than cost in urban freight planning and clustering FCCs close to freight providers can improve efficiencies, helping to address congestion queries within urban centres. By clustering or consolidating around FCCs, shippers can also reduce vehicle kms and corresponding emissions. | |
| No | Author | Year | Title | | Journal | | | Methodology | Instrumentation | | Theory | | Context | | Theme (Intervention Mechanism | | Outcomes | |
| 52 | Ubogu et al., | 2011 | Port-hinterland trucking constraints in Nigeria | | Journal of Transport Geography | | | Quantitative | Survey | | Unstated | | Nigeria | | Operations (Design and Process) | | Operational issues in the Nigeria context. Nuances of security, policy bottlenecks, infrastructure etc. as key limitations to sustainability within road freight operations | |
| 53 | Morrison et al., | 2013 | Effects of longer heavy vehicles on traffic congestion | | Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science | | | Quantitative | Simulation | | Unstated | | UK | | Operations (Design and Process) | | The study indicates that the introduction of LHVs to UK roads would have very little eﬀect on motorway traﬃc congestion, with potential of very little decrease in congestion although LHVs would significantly reduce energy consumption compared to HGVs | |
| 54 | Midgley and Cebon | 2015 | Control of a hydraulic regenerative braking system for a heavy goods vehicle | | Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering | | | Quantitative | Secondary Data | | Unstated | | UK | | Operations (Design and Process) | | Three global optimisation techniques for breaking systems in HGVs were investigated over four standard driving cycles. The greedy algorithm was identified as the only algorithm that can operate in real time, yielding an EIv decrease of 9–17%, depending on the driving cycle. Also highlights problems with accurate data for predictive controllers. | |
| 55 | Midgley et al., | 2013 | Modelling of hydraulic regenerative braking systems for heavy vehicles | | Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering | | | Quantitative |  | | Unstated | | UK | | Operations (Design and Process) | | Examines breaking systems in HGVs, finding gain efficiencies from simulation, with corresponding fuel and energy savings. Gains on fuel consumption could be as high as 29.4%. | |
| 56 | Lammgård and Andersson | 2014 | Environmental considerations and trade-offs in purchasing of transportation services | | Research in Transportation Business and Management | | | Quantitative | Survey | | \*Process | | Sweden | | Operations (Design and Process) | | Reliability, Quality and Price are at the apex of the decision-making agenda for logistics managers in the selection of transport providers. Market coverage is equally important but environmental importance has little and unchanged significance over 9 years (2003-2012). | |
| 57 | Allen et al., | 2012 | The Role of Urban Consolidation Centres in Sustainable Freight Transport | | Transport Reviews | | | Qualitative | Reviews | | Unstated | | Generic | | Operations (Design and Process) | | Improving load factor of goods vehicles through UCCs can provide km savings, reducing GHG and air quality. Public funding is required to promote UCCs, however the UCCs can become self-sustaining. | |
| No | Author | Year | Title | | Journal | | | Methodology | Instrumentation | | Theory | | Context | | Theme (Intervention Mechanism | | Outcomes | |
| 58 | Crainic et al., | 2004 | Advanced freight transportation systems for congested urban areas | | Transportation Research Part C: Emerging Technologies | | | Quantitative | Case Study/ Experiments | | Unstated | | Italy | | Operations (Design and Process) | | Modelling problems and scenarios on improving urban freight efficiencies within urban spaces. Finding a compromise of views and methods is vital to planning for and controlling road freight without eliminating service. Integration a key success factor | |
| 59 | Demir et al., | 2011 | A comparative analysis of several vehicle emission models for road freight transportation | | Transportation Research Part D: Transport and Environment | | | Quantitative | Simulation | | Unstated | | Generic | | Operations (Design and Process) | | Compares and models fuel consumption and GHG emissions. Fuel consumption varies with the size of vehicle, road gradient and speed of travel. Measurement models still vary. | |
| 60 | Velázquez-Martínez et al., | 2016 | A new statistical method of assigning vehicles to delivery areas for CO2 emissions reduction | | Transportation Research Part D: Transport and Environment | | | Quantitative | Modelling/ Experiment | | Unstated | | Mexico | | Operations (Design and Process) | | Evaluates the effect of delivery conditions on freight vehicle performance. Empirical findings from Mexico suggest matching vehicle to environment topography can reduce emissions from delivery. Fleet design choices affect emissions savings from road freight transport. | |
| 61 | Galos et al., | 2015 | Reducing the energy consumption of heavy goods vehicles through the application of lightweight trailers: Fleet case studies | | Transportation Research Part D: Transport and Environment | | | Qualitative | Modelling | | Unstated | | UK | | Operations (Design and Process) | | Single deck trailers have better mass energy performance compared to existing double deck fleets. Reducing the empty weight of HGV trailers used in mass-limited operations can impact energy consumption  savings which will lead to a reduction in both operation costs and carbon footprint | |
| 62 | Moreno-Quintero et al., | 2013 | Modelling planner-carrier interactions in road freight transport: Optimisation of road maintenance costs via overloading control | | Transportation Research Part E: Logistics and Transportation Review | | | Quantitative | Modelling | | Unstated | | Mexico | | Operations (Design and Process) | | Extends methods for modelling multi-actor approaches in freight transport from a policy perspective. The bi-level approach allows for hierarchical designations within the model with significant outcomes for different actors, thereby enabling policy planners achieve better and more acceptable policies | |
| 63 | Haughton, M. A. | 2002 | Route re-optimization's impact on delivery efficiency | | Transportation Research Part E: Logistics and Transportation Review | | | Quantitative | Experiment/ Simulation | | Probability | | West Indies/ Generic | | Operations (Design and Process) | | Increased driver learning is critical to routing efficiencies, especially where disruptions are unpredictable. High staff retention helps to improve driver learning and invariably helps to improve routing optimisation | |
| 64 | Fleischmann et al., | 2004 | Dynamic Vehicle Routing Based on Online Traffic Information | | Transportation Science | | | Quantitative | Modelling | | Unstated | | Germany | | Operations (Design and Process) | | Dynamic planning for routing and travel for freight, Flexible assignments yield better performance based on optimal AP solutions, accounting for time, empty loads and routing variations | |
| No | Author | Year | Title | | Journal | | | Methodology | Instrumentation | | Theory | | Context | | Theme (Intervention Mechanism | | Outcomes | |
| 65 | McKinnon, A. C. | 2009 | Benchmarking road freight transport: Review of a government-sponsored programme | | Benchmarking: An International Journal | | | Qualitative | Review | | Unstated | | UK | | Policy | | Benchmarking SRFT from a government perspective. Policy impetus and convergence with industry benchmarking outcomes | |
| 66 | Matos and Silva |  | The rebound effect on road freight transport: Empirical evidence from Portugal | | Energy Policy | | | Quantitative | Modelling | | Unstated | | Portugal | | Policy | | Discusses the rebound effect syndrome and the potential implications for energy consumption and road freight intensity. Findings suggest that operators are more likely to adopt operational objectives over technological efficiencies. Estimated 24.1% rebound effect identified in some case. Implications can extend to overestimated energy consumption savings. | |
| 67 | M’raïhi et al., | 2014 | Road Freight Transport and Carbon Dioxide Emissions: Policy Options for Tunisia | | Energy and Environment | | | Quantitative | Modelling | | Unstated | | Tunisia | | Policy | | Decomposes the CO2 emissions in the Tunisian road freight transport system, identifying fossil fuel as a main factor. Advocates the combination of various policy, operational and decoupling mechanisms for address the emissions problems. Extends a caveat on the limitations of decoupling strategies in the face of infrastructural and intermodal deficiencies. | |
| 68 | Mattila and Antikainen | 2011 | Back casting sustainable freight transport systems for Europe in 2050 | | Energy Policy | | | Quantitative | Modelling/ Back casting | | Unstated | | Europe | | Policy | | Adopts a back casting technique to model freight transport over long distances. Model identified gaps and short comings in current trends and the authors advocate complimentary strategies as critical to achieving sustainable road freight transport by 2050. Study also identifies the need for specific technology road maps that balance costs and benefit distributions | |
| 69 | Zanni and Bristow | 2010 | Emissions of CO2 from road freight transport in London: Trends and policies for long run reductions | | Energy Policy | | | Quantitative | Survey | | Unstated | | UK | | Policy | | Examines the trends and projections for freight transport in the city of London. Raises concerns about the viability of policy and logistics solutions to curb the emissions problems in London by 2050. Analysis of historical emissions shows that from 1996 to 2005 emissions from HGVs and LGVs in London increased by around 18%. Projections show that without further policy interventions these CO2 emissions may increase by an additional 109% by 2050. A combination of behavioural, technology and policy interventions are commended to aid performance. | |
| No | Author | Year | Title | | Journal | | | Methodology | Instrumentation | | Theory | | Context | | Theme (Intervention Mechanism | | Outcomes | |
| 70 | Liimatainen et al., | 2012 | Energy efficiency practices among road freight hauliers | | Energy Policy | | | Quantitative | Survey | | Unstated | | Finland | | Policy | | Examines energy efficiency practices amongst road hauliers within the Finnish haulage industry. Common actions include speed limitation, vehicle monitoring and effective deployment. Size is highlighted as a determining factor in energy efficiency amongst firms. Also it provides evidence that voluntary environmental agreements need to be complemented with rethinking the institutional settings that the agreements ﬁt in, in order to overcome barriers of the technological lock-in. | |
| 71 | Winebrake et al., | 2012 | Estimating the direct rebound effect for on-road freight transportation | | Energy Policy | | | Qualitative | Review | | Unstated | | USA | | Policy | | Paper provides a critical review of the literature related to the HDV rebound effect. Results reveal gaps in terms of focused studies in this area. The combination of this gap, the variability and heterogeneity of the trucking sector serve to limit understanding of the rebound effect in the HDV operations | |
| 72 | McKinnon and Piecyk | 2009 | Measurement of CO2 emissions from road freight transport: A review of UK experience | | Energy Policy | | | Quantitative | Survey/ Secondary Data | | Unstated | | UK | | Policy | | Paper highlights some key considerations for improving CO2 measurement using the UK experience as a point of reference. They advocate for greater transparency, common measurement values and data consistency. | |
| 73 | Li et al., | 2013 | Trends in road freight transportation carbon dioxide emissions and policies in China | | Energy Policy | | | Quantitative | Modelling/ Decomposition analysis | | Unstated | | China | | Policy | | Used decomposition analysis to estimate freight transport and economic relationships, with a highlight of policy measures around vehicle specification, modal infrastructure and tolling charges as instrumentation for addressing road freight externalities | |
| 74 | Eom et al., | 2012 | We keep on truckin': Trends in freight energy use and carbon emissions in 11 IEA countries | | Energy Policy | | | Quantitative | Modelling | | Unstated | | IEA Countries (11) | | Policy | | Analyses trends in freight CO2 emissions in 11 IEA countries from the earliest year of data availability to 2007–2010. Presents counter evidence for coupling as opposed to decoupling. Identifies policy driven intermodal measures as more viable means for decarbonising freight. | |
| No | Author | Year | Title | | Journal | | | Methodology | Instrumentation | | Theory | | Context | | Theme (Intervention Mechanism | | Outcomes | |
| 75 | Piecyk and McKinnon | 2010 | Forecasting the carbon footprint of road freight transport in 2020 | | International Journal of Production Economics | | | Quantitative | Survey/ Delphi | | Unstated | | UK | | Policy | | Paper presents research undertaken to determine the baseline trends in LSCM and associated environmental effects up to 2020. Factors affecting freight transport demand, truck fuel consumption and related CO2 emissions are classiﬁed into six categories in relation to different levels of logistical decision- making. These complexities in the decision-making process and perceptions amongst practitioners lead to different BAU scenarios where the mid-range BAU scenario indicates that the most likely outcome is a marginal reduction in CO2 emissions from road freight transport of around 10% against a 20% increase on road freight intensity from a 2006 base. | |
| 76 | Cristea et al., | 2013 | Trade and the greenhouse gas emissions from international freight transport | | Journal of Environmental Economics and Management | | | Quantitative | Modelling | | Unstated | | Worldwide | | Policy | | Extensive world trade data is used to model international output and transport comparisons. Study identifies international transport as responsible for 33% of emissions. Strengthens the body of work on coupling between economic growth, freight transport and emissions with some important considerations for policy makers. | |
| 77 | Massara, V.M | 2012 | Brief Synopsis of the Brazilian Freight Transport and Future Development | | Journal of Infrastructure Development | | | Qualitative | Review | | Unstated | | Brazil | | Policy | | Regulation, Inter-modality and Infrastructure directions for advancing the Brazilian freight transport system | |
| 78 | Ballantyne et al., | 2013 | A comparative study of urban freight transport planning: Addressing stakeholder needs | | Journal of Transport Geography | | | Qualitative | Survey/ interview | | Stakeholder Theory | | Europe | | Policy | | Local council awareness of urban freight issues and the capacity to regulate urban freight as actors or just stakeholders. | |
| 79 | Stelling, P. | 2014 | Policy instruments for reducing CO2 emissions from the Swedish freight transport sector | | Research in Transportation Business and Management | | | Qualitative | Review | | Unstated | | Sweden | | Policy | | Analyses policy instruments for reducing CO2 in Sweden’s logistics and freight sector. Economic, Legal, Knowledge and Societal instruments are reviewed with different time implications and relevance for economic and legal (short term), knowledge and societal (long term) | |
| No | Author | Year | Title | | Journal | | | Methodology | Instrumentation | | Theory | | Context | | Theme (Intervention Mechanism | | Outcomes | |
| 80 | Liimatainen et al., | 2014 | Decarbonizing road freight in the future - Detailed scenarios of the carbon emissions of Finnish road freight transport in 2030 using a Delphi method approach | | Technological Forecasting and Social Change | | | Mixed | Delphi Technique | | Unstated | | Finland | | Policy | | Delphi method is used to forecast the changes of GDP and seven indicators, which determine the CO2 emissions of road freight. Scenarios are used to forecast demand and reductions with the most positive results yielding 74% decline in CO2 emissions and at least 26% reduction in the worst case; base year is 2010 and projections were for 2030. | |
| 81 | M'raihi et al., | 2015 | Carbon emissions growth and road freight: Analysis of the influencing factors in Tunisia | | Transport Policy | | | Quantitative | Decomposition Analysis | | Unstated | | Tunisia | | Policy | | Uses decomposition analysis to examine the driving factors of CO2 emissions in Tunisia. Identifies economic growth as a main driver of CO2 growth with emphasis on limitations of decoupling as a viable strategy due to the fall out the 2010 revolution. Modality, technology and incentivizing are presented as more viable mechanisms | |
| 82 | Dablanc, L. | 2007 | Goods transport in large European cities: Difficult to organize, difficult to modernize | | Transportation Research Part A: Policy and Practice | | | Qualitative | Observation/ Review | | Unstated | | Europe | | Policy | | Slowdown in logistics infrastructure and facilities is attributed to cost considerations, further exacerbating the logistics urban distribution problem. Two principal administrative policy recommendations are made; simplification of planning process for city access and practitioner focused approach to policy development for urban freight. | |
| 83 | Léonardi, Jacques; Baumgartner, Michael | 2004 | CO2 efficiency in road freight transportation: Status quo, measures and potential | | Transportation Research Part D: Transport and Environment | | | Mixed | Survey | | Unstated | | Germany | | Policy | | Survey of trucking in Germany in spring 2003, found the mean CO2 eﬃciency (E) is 10.4tkm/ kg CO2. Emission eﬃciency shows a large variation between 0.8 and 26tkm for 1kg CO2. Identifies deficiencies in implementation measures for improving transport efficiency and makes a case for policy driven information dissemination as well as OBCs for monitoring the success of other operational efficiency measures | |
| 84 | Steenhof, Paul; Woudsma, Clarence; Sparling, Erik | 2006 | Greenhouse gas emissions and the surface transport of freight in Canada | | Transportation Research Part D: Transport and Environment | | | Quantitative | Survey/ Decomposition Analysis | | Unstated | | Canada | | Policy | | A decomposition analysis framework is applied to the Canadian freight sector to better understand processes leading to changes in GHG emissions. The framework demonstrates that GHG emissions increase was driven by road freight intensity and countered by multimodality between 1990 and 2003. Policy augmentation for modal shift is advanced | |

End.

1. Please see Appendix1 for a sample copy of Review Protocol [↑](#footnote-ref-1)
2. Elv – Exposure Limit value [↑](#footnote-ref-2)
3. See Ethical Approval Form (Appendix 5) [↑](#footnote-ref-3)
4. See Research Protocol Pack (Appendix 2) [↑](#footnote-ref-4)
5. See Appendix 6 (Field Diary Note Extracts) [↑](#footnote-ref-5)
6. Sample of informed consent sheet attached in Appendix 2. [↑](#footnote-ref-6)
7. See Appendix 3 for a sample of transcript validation email and responses. [↑](#footnote-ref-7)
8. \*All cases have been anonymised to protect identities and promote confidentiality of the participants [↑](#footnote-ref-8)
9. AQUILA is a government agency regulated inventory system under the management of the petroleum equalisation fund (PEF) agency. [↑](#footnote-ref-9)