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Green Supply Chain Management (GSCM) in the Oil and Gas Industry
A perspective from the Natural Resource-Based View (NRBV) and Stakeholder theory

Olajide, Olatunde

Award date:
2023

Awarding institution:
Coventry University

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Green Supply Chain Management (GSCM) in the Oil and Gas industry:

A perspective from the Natural Resource-Based View (NRBV) and stakeholder theory

By

Olatunde Adewole Olajide

A thesis submitted in partial fulfilment of the University's requirements for the Degree of Doctor of Philosophy

May 2022

Certificate of Ethical Approval

Applicant:

Olatunde Olajide

Project Title:

An Investigation of the sustainable supply chain management strategies in the oil and gas industry: A comparative case study of the UK and Nigerian Oil and Gas industry

This is to certify that the above named applicant has completed the Coventry University Ethical Approval process and their project has been confirmed and approved as Medium Risk

Date of approval:

19 March 2019

Project Reference Number:

P88708

Abstract

The O&G industry is predominantly implicated in environmental sustainability issues because of the polluting nature of its operations. Climate change and other environmental challenges are significantly linked to the hydrocarbon industry. Consequently, critical stakeholders continuously pressure O&G firms to implement green supply chain management (GSCM) practices to address environmental concerns. The extant literature suggests that GSCM implementation can improve firms' competitiveness. However, there is no empirical validation of the above in the Nigerian O&G industry. Therefore, this study combines stakeholder theory with the Natural Resource-Based View (NRBV) to examine how stakeholder pressures drive the Nigerian O&G firms to commit their strategic resources to GSCM implementation and the overall effect on firms' competitiveness.

A mixed-method research technique based on the pragmatism paradigm is adopted to address the research questions. A thematic analysis of twenty-nine semi-structured interviews conducted among relevant managers in the Nigerian O&G industry conceptualised GSCM practices within the strategic capabilities of pollution prevention, product stewardship and clean technology. The analysis further explored the critical strategic resources and stakeholder pressures that influence GSCM implementation in the industry. The subsequent confirmatory phase of the research adopted a Covariance-based structural equation modelling (CV-SEM) to analyse 214 questionnaire responses from relevant managers across the supply chain of the Nigerian O&G industry. This process examined the impact of GSCM practices on the environmental and economic competitiveness of the firms in the Nigerian O&G industry.

The results of the exploratory research validated the conceptualisation of GSCM practices as the strategic capabilities of pollution prevention, product stewardship and clean technology, drawn on NRBV. However, there is no empirical evidence of GSCM practices related to the base of the pyramid strategy in the industry. The qualitative analysis further identified seven strategic resources that influence GSCM adoption in the industry. The intangible resources of supply chain strategic collaboration and continuous innovations are highlighted as the most critical resources for GSCM implementation. Although six different stakeholders were found to influence firms' green practices, coercive pressure from government regulatory institutions is validated as the most compelling stakeholder pressure driving GSCM implementation in the industry. The SEM results indicate that government regulations negatively impact supply chain continuous innovations (as strategic resources) and have no statistically significant impact on GSCM strategies. However, supply chain continuous innovations positively impact GSCM. Also, GSCM practices positively influence environmental and economic competitiveness, except for clean technology with no statistically significant impact on economic competitiveness. Finally, environmental competitiveness has a positive impact on economic competitiveness.

This research provides empirical validation to the theoretical linkage between GSCM and NRBV, thereby extending the current level of knowledge in GSCM. It also informs the policymakers in the Nigerian O&G industry to rejig the current regulatory framework of the Nigerian O&G industry as it appears too weak to foster environmental sustainability. Finally, it encourages the Nigerian O&G firms to develop the necessary capabilities for GSCM as they positively impact the firm's competitiveness.

Dedication

"Now unto him, that is able to do exceeding abundantly above all we can ask or think, according to the power that worketh in us" (Ephesians 3:20 KJV).

In the first instance, this research is dedicated to the almighty God, the creator of the heavens and earth. It is also dedicated to the memory of my Dad, **HRH J.B.O Olajide, JP, Olusi of Usi-Ekiti** and my Mum, **Olori Grace Adejoke Olajide.** May your souls continue to rest in perfect peace.

Acknowledgement

My greatest appreciation goes to the almighty God and my Lord Jesus Christ for granting me divine health, wisdom, and direction to commence and complete this study. I cannot but acknowledge the support of my family, especially Olori Folakemi Catherine Adunni and my son, Treasure Ooreofeoluwa, who kept the home front while I embarked on this study. I also appreciate the Federal Republic of Nigeria, which sponsored this research through the Petroleum Technology Development Fund (PTDF). More importantly, and on a sad note, I remain eternally grateful to my late mum, Olori Grace Adejoke Olajide, who propagated my PhD vision and provided the motherly care and support, but unfortunately gave up the ghost on 11th June 2019. I also acknowledge the ever-reliable support of my life mentor, who is also my blood sister, Pastor (Mrs) Omobolanle Modupe Kehinde-Agboola and her husband, Hon. (Pastor) Kehinde Agboola, for their steadfast support and the conceptualisation of the idea that culminated in this research.

My sincere appreciation goes to the supervisory team led by Dr Muhammad Mustafa Kamal for the guidance, support, criticism and mentorship provided in this PhD journey. Particularly, I salute Dr Mustafa for his ability to successfully drive this research by providing the necessary support and offering constructive criticism when required. I must specially commend the significant efforts of my first Director of Studies (D.O.S), Dr Kwak Dong-Wook, who guided me in building a solid foundation for this study and mentored me in developing invaluable life skills. Of great importance is the mentorship, support and commitment of Professor Qile He in ensuring that this research comes to fruition. Equally important are the intellectual contributions of Professor Ming Lim, whose ideas have contributed significantly to shaping this research. The wealth of experience and the in-depth knowledge of these erudite scholars have effectively deepened my understanding of the fundamentals of academic research.

Finally, my sincere appreciation goes to all participants from the upstream and the downstream sectors of the Nigerian Oil and Gas industry who provided the empirical data that were analysed in this research. I must commend the regulators of the Nigerian O&G industry for introducing this research to the industry. Without you-the participants and the regulators, this research would have remained abstract. For this, I remain eternally grateful.

Declaration

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Research Outputs from this thesis

Olajide, O., (2020). The impact of supply chain innovations (SCI) on the sustainability of the Oil and Gas industry: The implications for entrepreneurship development and post COVID-19 strategy in the Oil and Gas industry, presented at the *1ST International Conference* on Entrepreneurship education, technology and sustainable development: COVID '19 and beyond, held at Federal Polytechnic Offa, Nigeria, between 28th and 30th September 2020.

Olajide, O., Kwak, D.W., He, Q. and Lim, M. (2019). A conceptual framework of environmental sustainability in the oil and gas supply chains: Natural Resource-Based View (NRBV) and institutional theory approaches, presented at the *24th International Symposium on Logistics* (pp. 95-103). Centre for Concurrent Enterprise, Nottingham University.

Olajide, O., Kwak, D.W. and He, Q. (2018). A comparison of the Nigerian oil and gas supply chains with the UK: Taking a sustainability perspective, presented at the a*nnual Logistics Research Network Conference 2018* (pp. 484-491) of the Chartered Institute of Logistics and Transport.

Other research output during PhD

Olajide, O.A. and Kwak, D.W. (2018). The impacts of logistics challenges on order management: the case of e-commerce firms in Nigeria, presented at the *annual Logistics Research Network Conference 2018*.

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List of Abbreviations

AGM	Assistant General Manager
CB-SEM	Covariance-Based Structural Equation Modelling
CFA	Confirmatory Factor Analysis
DPR	Department of Petroleum Resources
E&P	Exploration and Production
EFA	Exploratory Factor Analysis
GM	General Manager
GSCM	Green Supply Chain Management
HSE	Health, Safety and Environment
IPIECA	International Petroleum Industry Environmental Conservation Association
IOCs	International Oil Companies
NOCs	National Oil Companies
NRBV	Natural Resource-Based View
O&G	Oil and Gas
PLS-SEM	Partial Least Square Structural Equation Modelling
RBV	Resource-Based View
SC	Supply Chain
SCM	Supply Chain Management
SDG	Sustainable Development Goals
SEM	Structural Equation Modelling
SPDC	Shell Petroleum Development Company
SSCM	Sustainable Supply Chain Management
TBL	Triple Bottom Line

Chapter 1: Introduction

1.1 Chapter introduction

The oil and gas industry operates a complex and dynamic supply chain with far-reaching implications for safety, health, and the environment (Saad and Udin 2012). Owing to the high-risk nature of the industry, any small mistake in the system can have severe repercussions on all participating companies, personnel, the environment and society (Ahmad, de Brito and Tavasszy 2016). Unfortunately, due to the technical nature of the industry, supply chain management (SCM) in the industry was initially considered a ‘soft issue’ until the players in the industry realised that about 80% of their operating expenses are ‘burnt’ on SCM related activities (Mohammad 2008). Undoubtedly, the oil and gas industry plays a crucial role in human lives as a major energy source. Nevertheless, the negative impacts of its activities and products on lives and the environment remain a source of concern (Ahmad, de Brito and Tavasszy 2016). For example, environmental issues within the oil and gas industry, like California's Santa Babara oil spill in 1969 and the Deepwater Horizon disaster in the Gulf of Mexico in 2010, had devastating effects on terrestrial and aquatic creatures.

The Nigerian O&G industry has attracted substantial global attention fuelled by a series of unsustainable practices across its supply chain (Elenwo and Akankali 2014). Consistent gas flaring, oil spills, environmental pollution, and pipeline interdiction (Anifowose 2008; Dung, Bombom and Agusomu 2008; Ordinioha and Brisibe 2013) have led to socio-economic problems and severe conflicts between O&G firms and the host communities (Schneider et al. 2013). For instance, operational activities of SPDC in the Niger-delta area in the 1990s resulted in the pollution of rivers within Ogoni land. This eventually caused severe tension among the citizens of the host community (Schneider et al. 2013). Indeed, considering the high impacts of environmental destruction caused by the Nigerian oil and gas industry, Duffield (2010) describes Nigeria as the ‘*World oil pollution headquarters.’*

Although the above issues are noted in the upstream sector, the downstream sector is also a significant source of environmental problems. These include pipeline vandalism, economic sabotage, a high rate of oil tanker accidents, and the dangerous location of petrol stations within the residential areas. The above have reportedly resulted in conflagrations that caused loss of lives and properties worth millions of dollars across the country (Ambituuni, Amezaga and Emeseh 2014; Anifowose 2008). Therefore, it is argued that while the O&G industry presents a good case study to evaluate management sustainability strategies such as GSCM, the Nigerian O&G industry even provides a more significant platform for the same.

The concept of Green supply chain management (GSCM) is an effective management strategy for responding to firms' environmental concerns. GSCM is simply an infusion of environmental sustainability practices into the traditional SCM to reduce environmental impacts while improving economic benefits (Green et al. 2012; Zhu, Sarkis and Lai 2012). The literature suggests that companies integrating green practices into their SCM will likely attain enhanced competitiveness (Esfahbodi et al. 2017). Interestingly, scholars have focused research attention on GSCM in the manufacturing sector, while research focusing on sustainability in the supply chain of the O&G industry is scanty, despite its polluting nature (Ahmad et al. 2017). For instance, while research in sustainability has experienced considerable growth since 1987, the first scholarly article focusing on GSCM activities in the O&G industry was published in 2007 (Lhakal and Islam 2007). Indeed, Ansari and Kant (2017) found that only three GSCM studies published in top-rated journals between 2002 and 2016 specifically focused on the O&G industry.

A thematic analysis of the literature on sustainability in the supply chain of the O&G industry in section 2.7.4 reveals that the available few studies in this area mainly concentrate on three thematic areas. These are sustainability drivers and motivators (Yusuf et al. 2012; Modaress, Ansari and Thies 2016; Ahmed et al.; 2016; Ahmed et al. 2017; Raut, Narkhede and Ghadas 2017), sustainability strategies (Lhakal, Khan and Islam 2007; Lhakal, Khan and Islam 2009; Uricoli et al. 2014; Modinasab et al. 2017; Silvestre et al. 2017) and sustainability communication (Ahmad et al. 2016). Although some of the findings of these studies are revealing, there are still some areas of conflict that require further research investigation. For example, Ahmad et al. (2017) found that the regulatory factor is an essential driver of sustainability adoption in the O&G industry, while Thurner and Proskuryakova (2014) asserted that government regulations do not drive sustainability practices in the Russian O&G industry. Also, the literature to date has ignored the role of strategic resources and capabilities in implementing GSCM practices and the effect on firm competitiveness in the industry. Nevertheless, the O&G industry has remained under intense pressure to minimise its environmental impacts (Ghettas 2015; Lewis and Henkels 2014; McCarthy, Silvestre and Kietzmann 2013). Such pressures usually emanate from societal expectations, competitors' strategies, regulatory requirements and other stakeholders' activities. Perhaps the most cogent pressures for green practices adoption in the O& G industry emanate from government regulatory institutions. This is consistent with Ahmad et al. (2017), who portend that any regulation targeted at limiting carbon footprints in industrial activities, transportation, and energy generation is primarily targeted at the O&G industry since the industry's products are the root cause of the regulated environmental issues.

In this vein, this research adopts a holistic approach based on established management theories (Stakeholders theory and Natural Resource-Based View-NRBV) to examine the role of stakeholder pressures and strategic resources as the drivers of GSCM practices in the Nigerian O&G industry. The research further investigates how strategic resources activate specific strategic capabilities of pollution prevention, product stewardship, clean technology and the base of the pyramid for GSCM implementation. The impacts of GSCM practices (conceptualised as the capabilities above), commonly cited as NRBV strategic capabilities (Hart and Dowell 2011; Michalisin and Stinchfield 2010; Rodrigues et al. 2021), are assessed on the competitiveness of the Nigerian O&G industry.

This chapter is structured as indicated in figure 1.1.

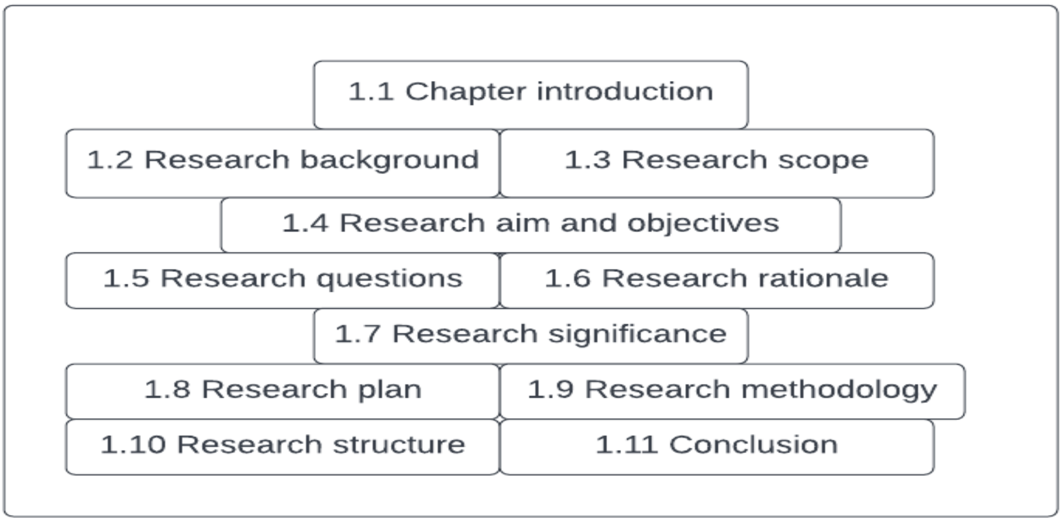

Figure 1.1: The structure of chapter one

1.2 Research background

The ability of firms to effectively manage their supply chain activities has been regarded as a source of competitive advantage. Against this backdrop, competition in today's business environment has moved beyond firms' level to the supply chain level (Bratić 2011; Carter and Ellram 2003). Consequently, supply chain management (SCM) has been receiving considerable attention among practitioners and academicians. Interestingly firms' dedication to improving their supply chain visibility has also mirrored increased environmental issues such as waste generation, resource depletion, greenhouse gas emissions, and other forms of pollution linked with supply chain activities (Giunipero et al. 2008). Therefore, global problems such as climate change, global warming, depletion of the ozone layers, deforestation, and many other vices that are inimical to our existence have been significantly linked to unsustainable production and consumption activities (Goodland 1995; Wheeler 2004). The above is arguably more profound in the O&G industry with its notoriety for environmental degradation (Ahmad et al. 2017). Thus, SCM is annexed with significant ecological issues since production and consumption activities occur within the supply chain

(Handfield et al. 2005). The literature suggests that an effective SCM can enable firms to minimise the overall environmental impacts of supply chain activities, thereby enhancing ecological protection (Ashby, Leat and Hudson-Smith 2012; Seuring and Müller 2008). Hence, SCM is pivotal to environmental management (Carter and Rodgers 2008).

Based on the foregoing, corporate organisations are increasingly attracting pressure from stakeholders, such as regulatory authorities, Non-governmental organisations (NGOs), customers, and many others, to rethink and redesign their operational processes toward sustainability practices (Vezzoli et al. 2012). More than ever before, firms are being held accountable for unsustainable practices across their supply chains (Ekiugbo and Papanagnou 2017). Such an example is seen in the apparel industry, where famous brands such as Nike, Disney, Adidas, and many others have been held accountable for inhumane working conditions and environmental contamination across their entire supply chain (Seuring and Muller 2008). At the global level, Article 8 of the Rio declaration on environment and development (1992) articulates the need for states to collaborate with corporate institutions to reduce or possibly eliminate unsustainable production and consumption patterns (Vezzoli et al. 2012). In response to these pressures, many companies are inculcating sustainability initiatives into their traditional SCM to foster environmental and social responsibility (Ashby, Leat and Hudson-Smith 2012; Gimenez, Sierra and Rodon 2012; Matos and Hall 2007). Such initiatives may include reconfiguring the supply chain to produce eco-friendly products and services or completely exiting the environmentally damaging production line (Hart 1995; Sarkis, Gonzalez-Torre and Adenso-Diaz 2010).

Firms' inclusion of environmental sustainability strategies into their traditional SCM is termed *green supply chain management (GSCM).* It is a multidisciplinary concept that covers a wide range of disciplines such as sustainability, operations management, environmental management, law, production engineering, strategic management, and many others (Carter and Liane Easton 2011; Green et al. 2012; Linton, Klassen and Jayaraman 2007; Seuring and Müller 2008). Over the past few decades, GSCM has received a growing interest among practitioners, particularly in the manufacturing industries, to gain competitive performance by implementing green initiatives in SCM (Sarkis, Gonzalez-Torre and Adenso-Diaz 2010; Zhu, Sarkis and Lai 2012). The growing popularity of GSCM is not limited to the industry but also includes academia, where a considerable interest has been channelled to GSCM research. The above is evident in the increasing number of articles published on GSCM in top-rated journals over the past few decades. Interestingly, one clear notion from GSCM research is that the concept is multidimensional as scholars have adopted various approaches to examine the practices that constitute GSCM. Nevertheless, the extant literature reveals that some crucial aspects of GSCM still lack adequate empirical investigation.

First, despite the fundamental role of theory in the evolution of knowledge in any area of human endeavour (Handfield and Melnyk 1998), the extant literature on GSCM reveals that there is a general paucity of theory in GSCM research (Carter and Easton 2011; Sarkis, Zhu and Lai 2011). According to Carter and Liane Easton (2011), 87% of articles reviewed by them covering 1991-2000 are not theory-based. Although a more recent review reported that 40% of the articles under review applied some theories (Touboulic and Walker 2015), scholars have continued to demand the advancement of theory in GSCM research.

Second, previous studies have suggested that GSCM implementation has cost implications for firms (Rajeev et al. 2017; Yusuf et al. 2013). For example, companies may have to redesign their processes, train employees, acquire new resources and build new capabilities to implement sustainability practices successfully. Since many firms are profit-oriented, cost management is at the centre of their operational management (Hörisch, Freeman and Schaltegger 2014; Zhu, Sarkis and Geng 2005). Thus, unless it is evident that GSCM practices are beneficial, firms may be unwilling to voluntarily embark on such practices until certain pressure drives them (Esfahbodi et al. 2017; Sarkis, Gonzalez-Torre and Adenso-Diaz 2010; Varsei et al. 2014). In effect, firms' adoption of GSCM practices may be explained by stakeholder pressures on one hand and the belief that such adoption is beneficial to firms on the other hand.

Sequel to the above, many studies have investigated the impact of GSCM adoption on firms' competitive performance (Esfahbodi et al. 2017; Sarkis and Cordeiro 2001; Wang and Sarkis 2013; Zhu and Sarkis 2007). To a large extent, there is a significant consensus that GSCM implementation positively impacts environmental competitive performance (Esfahbodi et al. 2017; Rao, Rabinovich and Raju 2014; Vachon and Klassen 2006; Zhu and Sarkis 2007; Zhu, Sarkis and Geng 2005). However, mixed results have been recorded on the impacts of GSCM on economic competitive performance (Wang and Sarkis 2013; Zhu and Sarkis 2007). The above suggests the need for a further research investigation into the influence of GSCM practices on firms' competitive performance.

In the same vein, many scholars have investigated the factors that drive firms to adopt green practices in their supply chain. The current literature agrees that various stakeholder pressures can cause firms to adopt GSCM practices (Esfahbodi et al. 2017; Sarkis, Gonzalez-Torre and Adenso-Diaz 2010; Zhu and Sarkis 2007). However, some scholars have suggested that factors of GSCM adoption may vary across industries, organisations, and regions. Remarkably, studies that examined the critical drivers of GSCM in the O&G industry have yielded mixed results (Thurner and Proskuryakova 2014; Ahmed et al. 2017), thereby necessitating the need for a further empirical investigation.

Therefore, adopting established management theories to empirically examine the critical driving forces of GSCM adoption and the role of GSCM in enhancing firms' competitiveness cannot be overemphasised. This is more important in the O&G industry, reputable for adverse environmental impacts. While the stakeholder theory provides a veritable tool for understanding the effects of stakeholder pressures on firms' adoption of sustainability practices (Freeman 1999), the NRBV logic links firms' strategic resources with strategic sustainability capabilities and competitiveness (Hart 1995; Hart and Dowell 2011).

According to Freeman (2010), firms must consider the interest and expectations of a wide range of stakeholders in their strategic decisions. The requirements of various stakeholders can translate into pressures that influence firms' decisions to adopt environmental management strategies (Karra and Affes 2014; Sarkis, Gonzalez-Torre and Adenso-Diaz 2010; Wang, Li and Qi 2020). Empirical findings using the stakeholder theory to understand the drivers of green practices have also generated mixed results. For example, a body of literature suggests that when organisations are subjected to intense coercive pressures in terms of regulations from the government, they usually adopt various sustainability practices in their supply chains (Min and Galle 2001; Zhu and Sarkis 2007b). In contrast, Carter and Jennings (2004) found that regulatory pressures from the government are not a significant driver of GSCM adoption.

Furthermore, the degree of influence of stakeholder pressure on firms' strategic choices could also vary according to the country and industry of operations. For example, while Esfahbodi et al. (2017) found that coercive pressures in terms of government regulation are a crucial driver of sustainability practices in the UK manufacturing sector, Escobar and Vrendenburg (1999) asserted that pressures from government institutions do not drive the adoption of sustainability practices by the global O&G firms. The above suggests no *'one-size-fits-all'* approach exists to depict the stakeholder pressures behind GSCM. Adoption. Thereupon, the critical stakeholder driving forces of GSCM should inculcate the peculiarity of the country and industry context of the research.

Regarding the influence of GSCM on firms' competitive performance, Hart (1995) propounds that firms' competitiveness is dependent on their ability to utilise their specific strategic resources to develop and enhance specific strategic environmental capabilities. The original version of the NRBV recognises three strategic environmental capabilities of pollution prevention, product stewardship, and sustainable development as the catalysts of firms' competitiveness (Hart 1995). However, Hart and Dowell (2011) unbundled the sustainable development capability into clean technology and base of the pyramid capability. According to Touboulic and Walker (2015), NRBV is one of the most popular theories applied in GSCM research. Regardless, the specific strategic capabilities (pollution prevention, product stewardship, clean technology and base of the pyramid) lack empirical validation within the GSCM literature (McDougall, Wagner and MacBryde 2019).

Previous studies have suggested that the aforementioned strategic capabilities can be adopted as a proxy for GSCM practices because of their linkages (Guang Shi et al. 2012; McDougall, Wagner and MacBryde 2021; Yunus and Michalisin 2016). However, the hypothesised connections between the two concepts lack empiricism, leaving the GSCM-NRBV relationship in the abstract realm. Empirical validation of the theoretical link between both concepts will address an existing gap in the literature. Also, in response to the clamour for a theory-based approach to GSCM research (McDougall, Wagner and MacBryde 2021), examining GSCM through its linkage with the NRBV strategic capabilities could explore an alternative perspective in GSCM research. It will further advance the use of NRBV as a veritable tool for research investigation in operations management (Hart 1995; Hart and Dowell 2011).

Overall, this study argues that despite the growing developments in the GSCM literature, more empirical research is required to understand the effects of stakeholder pressures on firms' adoption of GSCM practices, particularly in the O&G industry. Furthermore, it is considered expedient to empirically validate the impact of GSCM on the competitiveness of the firms operating in the supply chain of the Nigerian O&G industry through the associated strategic capabilities of pollution prevention, clean technology, product stewardship and base of the pyramid. Arguably, such a comprehensive and integrated approach allows this research investigation to address an existing theory-practice gap, present a new perspective on GSCM and obtain more credible results that bridge currently mixed results on the impact of GSCM on firms' competitiveness.

1.3 Research scope

Upon presenting the background of this research in the previous section, the academic scope of this research is now discussed. Following the research gap identified within the extant literature as highlighted, this research attempts to:

(1) Determine the roles of stakeholder pressures and strategic resources in GSCM implementation by the firms in the Nigerian O&G industry supply chain.
(2) Investigate the outcome of GSCM practices conceptualised as pollution prevention, product stewardship, clean technology, and the base of the pyramid on the environmental and economic competitiveness of the Nigerian O&G industry.

In essence, this research examines the specific stakeholder pressures and strategic resources in the adoption of GSCM practices in the Nigerian O&G industry and whether these pressures and resources are sufficient to influence GSCM implementation. Further, it explores GSCM practices from the NRBV strategic capabilities, determining whether the firms in the Nigerian O&G industry derive economic and environmental competitiveness from GSCM adoption. Thus, the scope of this study covers the examination of the theoretical linkages between Stakeholder pressures, strategic resources, GSCM implementation and competitive advantage in the context of the O&G industry supply chain.

The theoretical lenses of stakeholder theory and NRBV are employed to examine these linkages effectively. Stakeholder theory provides insights into how the requirements and expectations of various stakeholders can constitute pressures that influence firms to pursue environmental management strategies. While these pressures can emanate from a wide range of stakeholders such as government, society, media, competition, customers, NGOs and many others, this research does not intend to evaluate the impacts of all stakeholders' pressures on GSCM implementation. The current study explores and identifies the most significant stakeholder pressures in the industry and examines the effects on GSCM adoption. On the other hand, the NRBV provides an understanding of the nature of strategic resources and how they can help organisations develop environmental management capabilities to generate competitive advantage. The four NRBV environmental strategies earlier discussed are interlinked with various GSCM practices to evaluate competitiveness in this research. The literature suggests that strategic resources are diverse across industries and can be classified as tangible and intangible. The current study does not examine all strategic resources in the Nigerian O&G industry. Rather, it explores the most critical strategic resources in the industry and investigates how they relate to the NRBV strategic capabilities and competitive advantage.

1.4 Research aim and objectives

The overarching aim of this research is ***'To explore the stakeholder pressures and the strategic resources that drive GSCM implementation while assessing the impact of GSCM practices on the competitiveness of the firms in the Nigerian O&G industry.*** In this study, GSCM is conceptualised as the NRBV strategic capabilities of pollution prevention, product stewardship, clean technology and the base of the pyramid. The above aim is broken down into achievable objectives as stated below:

(1) To explore and identify the specific GSCM practices that constitute the NRBV strategic capabilities of pollution prevention, product stewardship, clean technology and base of the pyramid in the Nigerian O&G industry.
(2) To explore and identify the critical strategic resources that enhance GSCM implementation in the Nigerian O&G industry.
(3) To explore and identify the critical stakeholder pressures that drive the implementation of GSCM practices in the Nigerian O&G industry.

(4) To develop and refine an integrative research model that links stakeholder pressure with strategic resources, GSCM and competitiveness for the Nigerian O&G industry's supply chain.
(5) To determine the impact of the conceptualised GSCM practices on the competitiveness of the firms operating across the supply chain of the Nigerian O&G industry by assessing the research model

1.5 Research questions

Despite the widespread adoption of resource-related theories such as NRBV in GSCM research (Touboulic and Walker 2015), it is contended that considerable gaps still exist concerning the specific resources required by firms to develop the capability for sustainability practices and competitiveness in SCM. Therefore, to put the objectives of this research in proper perspective, the main research questions of this study are stated below:

RQ1: What specific GSCM practices can be represented by the strategic capabilities of pollution prevention, product stewardship, clean technology and the base of the pyramid.
RQ2: What strategic resources enhance the implementation of GSCM practices in the Nigerian O&G industry?
RQ3: What stakeholder pressures drive GSCM adoption in the Nigerian O&G industry?
RQ4: What is the impact of GSCM practices (pollution prevention, product stewardship, clean technology and the base of the pyramid) on the competitiveness of the firms operating in the SC of the Nigerian O&G industry?

Reflecting on the research scope in section 1.3, this study posits that stakeholder pressures can influence firms to acquire strategic resources and capabilities for GSCM practices. These resources may yield consequences in terms of enhanced competitiveness. Reconciling these postulations with the research questions above, it can further be argued that the research question articulates and positions the research scope correctly. With this, researchable relationships can be established among the various concepts within the research scope.

1.6 Research rationale and Gap

The dearth of theory-based research in the GSCM literature has drawn the attention of scholars (Touboulic and Walker 2015; Carter and Easton 2011; Sarkis, Zhu and Lai 2011). In this vein, the current research identified NRBV and stakeholder theory as the compatible theoretical lenses with the aim of this study. While NRBV is a popular theory in operations management, empirical linkage of the embedded strategic environmental capabilities with GSCM practices is lacking (Guang Shi et al. 2012;

McDougall, Wagner and MacBryde 2021; Yunus and Michalisin 2016). In this regard, Guang Shi et al. (2012) propose the NRB-GSCM model that collapses the NRBV strategic capabilities into intra-organisational and inter-organisational GSCM practices. Similarly, Yunnus and Michalisin (2016) developed a theoretical model of GSCM and sustained competitive advantage that annexed the NRBV strategic capabilities with the upstream, internal and downstream GSCM practices. More recently, McDougall, Wagner and MacBryde (2021) presented dynamic Natural Resource-Based Capabilities frameworks that associate all the NRBV strategic capabilities with GSCM and dynamic capabilities. Despite attempting to validate the NRBV concept concerning GSCM, these models and frameworks lack confirmation empirically. Thus the reality of the NRBV logic in practice within the GSCM domain is yet to be established. Following the view of McDougall, Wagner and MacBryde (2021) that the usefulness of NRBV in GSCM literature should transcend beyond a mere offering of a theoretical tool, this study offers to empirically validate the conceptual link between GSCM and NRBV, using the O&G industry as a case study, to address this lacuna in the literature. Addressing this gap would contribute to theory-based research in GSCM as requested by scholars (Carter and Easton 2011; Sarkis, Zhu and Lai 2011). It would also deepen the applicability of NRBV as a practice-oriented concept against its current perception as a mere conceptual theory in GSCM (McDougall, Wagner and MacBryde 2019).

The logic that firms' development of environmental management capability depends on their ability to harness strategic resources is a vital component of the NRBV theory (Hart 1995; Hart and Dowell 2011). Despite the critical role of strategic resources in the NRBV literature, only a few research studies have conceptualised strategic resources in examining the NRBV strategic capabilities and firms' competitiveness. According to Lockett et al. (2009), the inability to properly conceptualise strategic resources for NRBV capabilities is a critical hindrance to the empiricism of the NRBV logic. Hart and Dowell (2011) clamour for a research investigation to identify the relevant strategic resources that drive the NRBV strategic capabilities across industries. Previous studies suggest that the bundle of resources that support strategic capabilities to achieve competitiveness could vary across firms and industries (Barney 1991; Grant 1991; Hart 1995). Considering that the role of strategic resources in developing the capability for environmental management by O&G firms has not been examined in the GSCM literature, the current study further addresses this gap by exploring the tangible and intangible resources that enable O&G firms' capabilities for GSCM practices implementation.

Also, one of the critical issues in the NRBV literature is that the extant literature is silent on the influence of external environmental factors in a firm's development of strategic environmental capabilities. Moreover, findings on the critical drivers of GSCM adoption in the O&G industry are mixed, as scholars have recorded conflicting results in this area (Thurner and Proskuryakova 2014; Ahmed et al. 2017). Similarly, scholars differ on the impacts of stakeholder pressures on firms' adoption of sustainability practices (Zhu 2013; Esfahbodi et al. 2017). The literature suggests that country impact factor and industry peculiarity can influence the specific stakeholder pressure that drives GSCM implementation. Therefore, since there is no current research on the role of stakeholder requirements in GSCM adoption by the firms in the Nigerian O&G industry, the need to address this gap cannot be overemphasised.

Furthermore, GSCM literature in O&G has not paid sufficient attention to the impact of GSCM practices on the competitive performance of O&G firms. Existing frameworks specific to the O&G industry focus on how GSCM strategies are implemented rather than how these strategies enhance competitiveness (Ahmad et al. 2017). Among others, Yusuf et al. (2013) examined the impact of GSCM practices on the performance of the UK O&G firms and found a real correlation. Although the study reported a positive association between green practices and firm performance in the industry, the results may not be adaptable to a developing economy like Nigeria, which is prone to weak regulations, low stakeholders' pressure and other operational laxities (Holt 2009; Silvestre 2015). Besides, the study is conceptually atheoretical.

Moreover, existing research models that investigate the impact of GSCM practices on organisations' competitiveness through the lens of the NRBV theory lack holistic consideration of all constructs of the NRBV framework (Shi et al. 2012). Therefore, developing and validating a comprehensive research model that examines the impact of GSCM practices on the competitiveness of the firms in a developing economy's O&G industry is an existing gap that requires research investigation in the GSCM literature. Consequently, the specific gaps addressed in this research are presented in table 1.1.

Table 1.1: Research objectives and relevant gaps

AIM: To explore the stakeholder pressures and the strategic resources that drive GSCM implementation while assessing the impact of GSCM practices on the competitiveness of the firms in the Nigerian O&G industry	
Research objectives	**Research gaps addressed**
To explore and identify the specific GSCM practices that constitute the NRBV strategic capabilities of pollution prevention, product stewardship, clean technology and base of the pyramid in the Nigerian O&G industry	• Lack of empirical evidence of the theoretical link between GSCM and NRBV strategic capabilities, despite previous conceptual frameworks (Shi et al. 2012; Yunus and Michalisin 2016; McDougall, Wagner and MacBryde 2021)
To explore and identify the critical strategic resources that enhance GSCM implementation in the Nigerian O&G industry	• Lack of dedicated attention to the role of strategic resources in developing environmental management capabilities by the firms in the O&G industry • Call for further investigation into industry-specific strategic resources that harness the NRBV based strategic environmental capabilities (Hart and Dowell 2011)
To explore and identify the critical stakeholder pressures that drive the implementation of GSCM practices in the Nigerian O&G industry	• Inconsistency in the findings of the critical stakeholder pressures driving GSCM implementation in the O&G industry (Thurner and Proskuryakova 2014; Ahmed et al. 2017).

To develop and refine an integrative research model that links stakeholder pressure with strategic resources, GSCM and competitiveness for the Nigerian O&G industry's supply chain	• Failure of previous models examining GSCM-NRBV impact on firms' competitiveness to consider all constructs of the NRBV (Shi et al. 2012).
To determine the impact of the conceptualised GSCM practices on the competitiveness of the firms operating across the supply chain of the Nigerian O&G industry by assessing the research model	• Lack of specific studies examining the impact of GSCM on the competitiveness of the Nigerian O&G industry. • Inconsistency of research findings on the impact of GSCM on the firms' competitiveness (Singh, Ma and Yang 2016; Esfahbodi et al. 2017)

1.7 Research Significance

This research aims to advance the knowledge of Green Supply Chain Management (GSCM) and the impact on the competitiveness of the oil and gas firms from the standpoint of the Natural Resource-Based View and stakeholder theory. In this vein, this thesis's theoretical and practical significance is presented below.

1.7.1 Theoretical significance

A plethora of studies examining the influence of GSCM strategies on the competitive performance of firms across industries (with less attention on the O&G industry) have suggested a positive correlation between GSCM practices and firms' competitiveness (Geffen and Rothenberg 2000; Zhu and Sarkis 2004; Rao and Holt 2005; Vachon and Klassen 2008; Lee et al. 2012). However, more recent studies have challenged the findings of the previous studies by offering mixed results on the relationship between the two variables (Walker and Jones 2012; Shi et al. 2012). This position indicates a lack of consensus and clarity in the literature concerning the impact of GSCM on the competitiveness of firms. Therefore, there is a need for further empirical investigation into these uncertainties and ambiguities to deepen the theoretical knowledge in this field of study.

Furthermore, the literature to date has not sufficiently conceptualised GSCM practices on established management theories. Generally, many studies have neglected the role of the exogenous stakeholder pressures and inter-organisational resources in examining the impact of GSCM on firm competitiveness. The stakeholder theory postulates that pressures from influential stakeholders can drive firms to implement GSCM practices (Freeman 1983). Also, the logic in NRBV dictates that the availability of strategic resources can help firms develop green strategies for enhanced competitiveness (Hart 1995). Therefore, this thesis argues that including the driving forces (of stakeholder pressure and strategic resources) in an integrative model will influence the relationship between GSCM and competitiveness in the proper theoretical perspective and vary the empirical outcomes of this relationship. Hence, the notable paucity of research investigating the relationships between GSCM implementation and competitiveness that integrate the influential role of the antecedent driving forces of stakeholder pressures and strategic resources motivated this study to pursue an empirical investigation.

One of this research's most important theoretical contributions is its ability to bring empiricism to the existing theoretical linkage between NRBV and GSCM. Whereas previous studies have merely adopted NRBV as a theoretical lens in GSCM literature, studies that precisely infuse NRBV strategic capabilities of pollution prevention, product stewardship and clean technology into GSCM are scant. Existing frameworks that consider the above are predominantly lacking in a holistic integration of NRBV green strategies into GSCM and empirical validation. The current study addresses this lacuna and sufficiently extends the NRBV framework with supply chain continuous innovations (SCCI) as strategic resources. This theoretical position has contributed to the ongoing debates on industry-specific strategic resources in the GSCM and NRBV literature.

1.7.2 Practical significance

Given the complexity of adopting GSCM practices and the uncertainties about the economic benefits, this research offers novel insights for practitioners, particularly in the O&G industry, on the GSCM agenda. In this regard, this study provides valuable insights for managers seeking to adopt GSCM practices. It also encourages policymakers and regulatory bodies to promote the GSCM agenda further. O&G producers are offered empirically validated processes to successfully integrate green initiatives across their supply chain. Furthermore, policymakers and regulators are given practical justification to motivate managers to embark upon GSCM implementation. Significantly, GSCM issues focusing on enhanced competitiveness in the O&G industry are unexplored. Indeed, there is a laxity of empirically validated research in the Nigerian O&G industry. The extant research in this area merely provides anecdotal evidence and theoretical postulations (Asaolu et al. 2012; Ukpabi et al. 2015; Ekiugbo and Papanagnou 2017). Therefore, this research is practically significant because it is one of the earliest attempts to empirically investigate the impacts of GSCM practices on the competitiveness of the Nigerian O&G industry, thereby providing managerial implications in this regard. Furthermore, this research provided a validated framework for assessing the synergistic impact of GSCM practices on the economic and environmental competitiveness of the O&G industry.

Although the context of the study is the Nigerian O&G industry, the research findings can be extended to the manufacturing industry of both developed and developing firms on how to transition from conventional supply chain management into green supply chains to reduce environmental damages and increase the level of competitiveness.

1.8 Research Plan

The research plan that guides the processes involved in undertaking this research is presented in figure 1.2. The logical steps depicted in this plan enable the researcher to execute the research work to the desired end effectively.

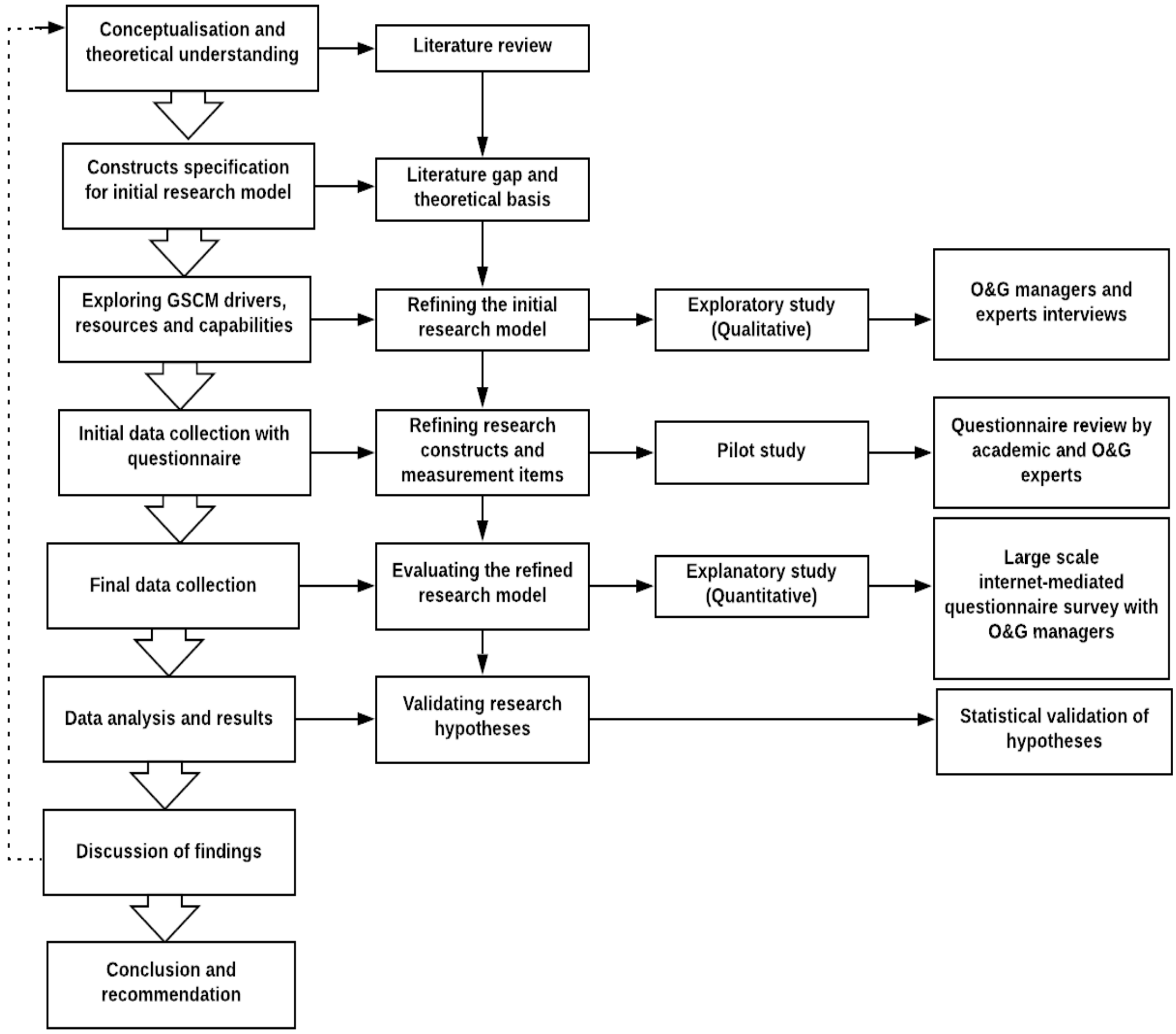

Figure 1.2: Research plan

1.9 Research Methodology

This research adopts the mixed-method approach, combining the qualitative and quantitative techniques to answer the research questions. Mixed-method research is invaluable in a situation where there is a need to deepen an understanding of a research phenomenon beyond the power of a single method (Greene, Caracelli and Graham 1989). This is because it confers the advantage of methodological triangulation, which enables a researcher to effectively benefit from the advantages of the two main research methods: qualitative and quantitative (Fidel 2008). In this research, the literature review reveals a dearth of research generally on sustainability issues in the supply chain of the O&G industry (Ahmad et al. 2016). More specifically, the role of strategic resources in enhancing the strategic capabilities of pollution prevention, product stewardship, clean technology and the base of the pyramid has not been examined. Hence, this study first adopts a qualitative technique to explore the specific strategic resources, strategic capabilities and stakeholder enablers of GSCM in the industry. Also, achieving the objective of determining the impacts of environmental capabilities on the competitiveness of O&G firms requires a quantitative approach. Therefore, this study utilises the mixed-method strategy to answer the research questions effectively.

Philosophically, this research is based on the paradigm of pragmatism. Pragmatism is a pluralistic paradigm that enables a researcher to provide solutions to real-world problems in a flexible manner that adapts to the prevailing circumstances of the research phenomenon (Bryman and Bell 2011; Yvonne Feilzer 2010). Pragmatism is a compatible paradigm with mixed-method research (Yvonne Feilzer 2009; Saunders Lewis and Thornhill 2009; Bryman and Bell 2011) as adopted in this research. In addition, the study adopts the abductive approach. The research also benefits from the inductive and deductive approaches (Bryman and Bell 2011; Creswell 2009).

Specifically, this research adopts an exploratory sequential mixed method research design. Hence, the qualitative study precedes the quantitative analysis (Ivankova, Creswell and Stick 2006), with the former informing the latter. Also, more emphasis is placed on the quantitative research element in this type of MMR design (Leech and Onwuegbuzie 2009). For this purpose, the qualitative data comprises twenty-nine semi-structured interviews conducted among selected top management staff of the firms across the supply chain of the Nigeria O&G industry. These interviews were interpreted using the thematic analysis technique.

On the other hand, the quantitative phase of the research is based on 214 questionnaire survey responses gathered among the management staff of firms operating across the supply chain of the Nigerian O&G industry. This data was analysed using structural equation modelling (SEM) in two stages: the Confirmatory Factor Analysis (CFA) and the structural modelling. This led to the acceptance and rejection of the relevant proposed hypotheses based on the findings. This methodology is justified because of its compatibility with the objectives of this study.

1.10 Research Structure

This research is structured into nine chapters: Introduction, literature review, initial conceptual framework, methodology, qualitative analysis and findings, refined conceptual model, analysis and results of quantitative study, discussion of findings, and conclusion with recommendations. In addition, each chapter is structured into various sections and subsections. The research structure of this study is presented in figure 1.3.

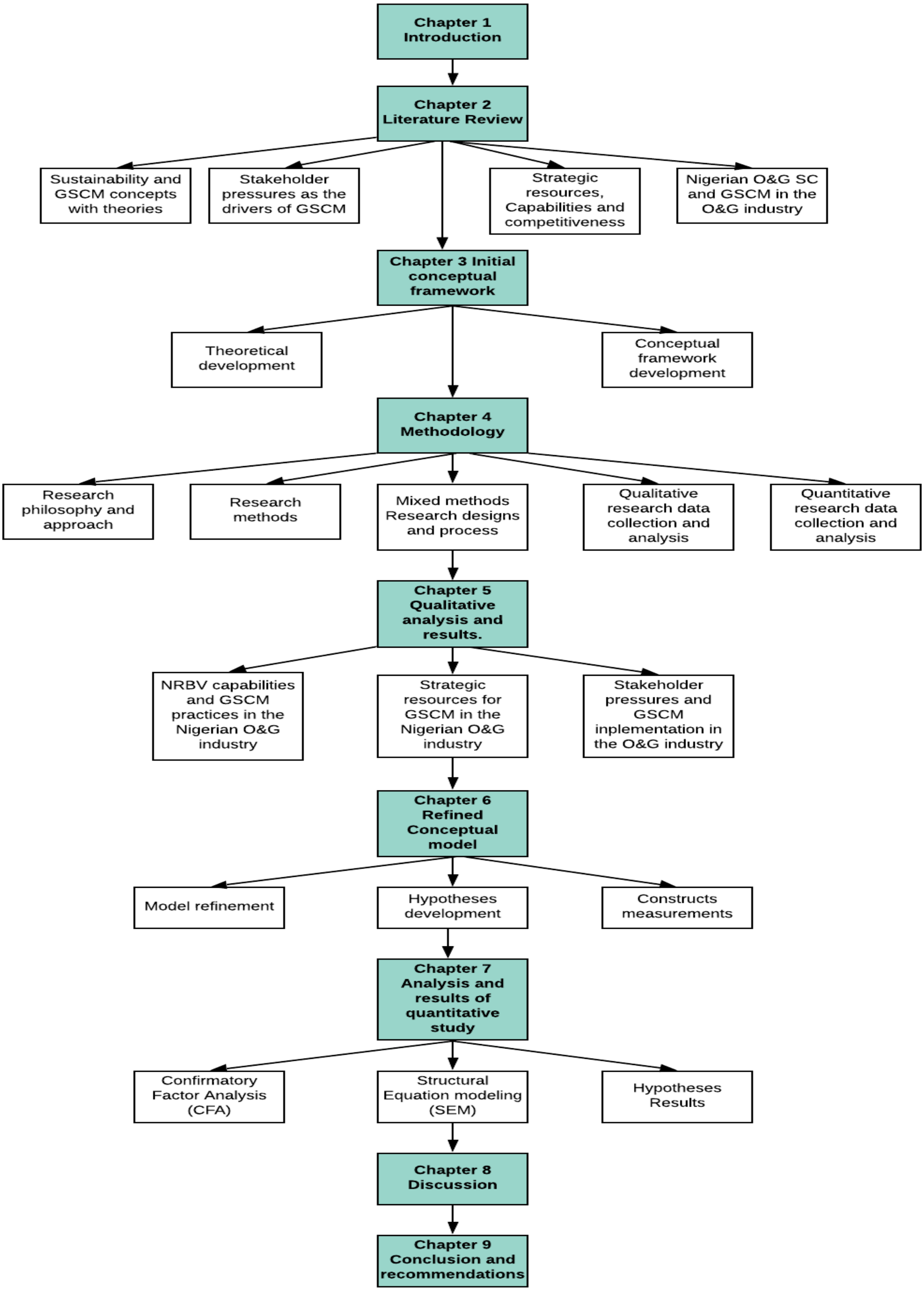

Figure 1.3: Research structure

It is pertinent to note that the items displayed under each chapter are general outlines meant to inform readers about what should be expected in each chapter.

1.11 Chapter Conclusion

Sustainability issues across the supply chain of the O&G industry have put the responsibility on the managers in the O&G industry to adopt practices to minimise environmental impacts. Chiefly, GSCM has been adjudged as a practical management approach for managing sustainability issues. However, the extant literature reveals that GSCM in the O&G industry has been grossly under-researched. In addition, it is argued that a firm's adoption of GSCM practices may be influenced by stakeholder pressures or the potentiality of accruable benefits. Focusing on the Nigerian O&G industry, this research adopts the stakeholder theory and NRBV to investigate the critical stakeholder pressures that drive GSCM adoption and the required strategic resources that influence the strategic environmental capabilities for GSCM with their implications on competitiveness. This chapter presents the basic concepts of this study in terms of its background, scope, and methodology. Therefore, this chapter provides an introductory foundation to be developed in the subsequent chapters of this research.

Chapter 2: Literature Review

2.1 Chapter introduction

This chapter reviews the extant literature on GSCM from the perspective of sustainability, NRBV and stakeholder theory in the context of the O&G industry. The chapter is divided into two parts (A and B). Part A focuses on theoretical and conceptual review to understand the theoretical foundation of GSCM and how it could be driven by stakeholder pressures and strategic resources and its linkage with NRBV strategic capabilities and competitiveness. This part of the literature validated the choice of NRBV and stakeholder theory as the theoretical base of this research. It also explores how GSCM could be infused into NRBV capabilities to understand competitiveness. The second part of this review (Part B) is contextual. The literature in this area established the current state of environmental sustainability practices in the supply chain of the O&G industry. It also reviews the sustainability issues in the supply chain of the Nigerian O&G industry. These reviews create an opportunity to identify the existing gaps in the literature concerning the objectives of this study. For this purpose, this chapter is structured into various sections, as indicated in figure 2.1.

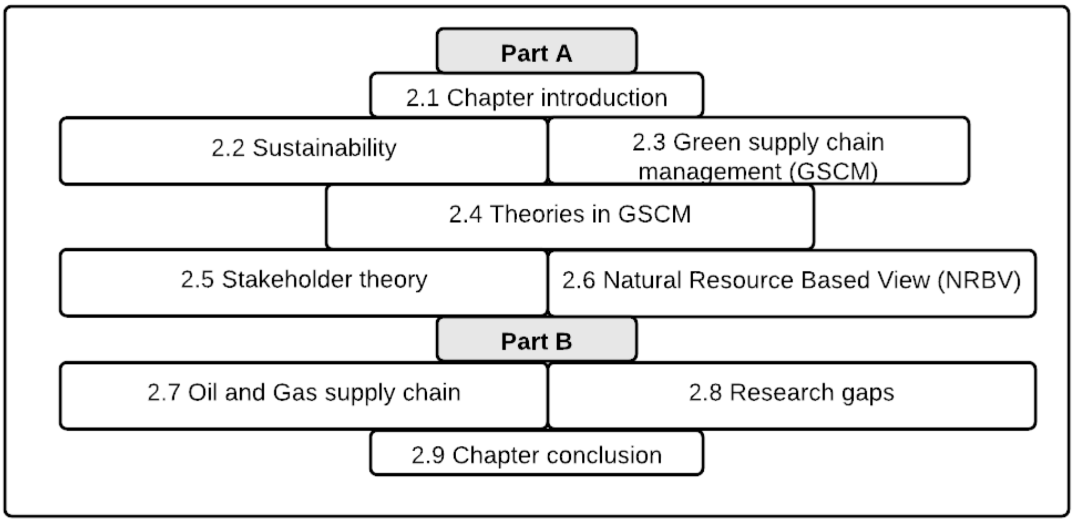

Figure 2.1: The structure of chapter 2

As indicated in Figure 2.1, this chapter begins by conceptualising GSCM from the general understanding of sustainability. This enables the study to understand how GSCM is located within the triple-bottom-line concept. To provide a theoretical background for GSCM, a critical approach was adopted to map out the specific theories in GSCM literature in section 2.3. In line with the aim of this research, section 2.4 and 2.5 discusses the stakeholder theory and NRBV as the underpinning theories of this research. These theories create the main research clusters of stakeholder pressures (GSCM drivers), strategic resources (GSCM antecedent), strategic capabilities (GSCM practices) and competitive advantage. An overlapping literature approach is adopted to synthesise these four literature clusters.

Thereafter, a systematised literature review approach is employed to understand the state of empirical research on GSCM practices from the perspective of the NRBV strategic capabilities. According to Grant and Booth (2009), a systematised review applies elements of systematic review, such as a predetermined search strategy with inclusion and exclusion criteria, while recognising resource limitations to attain a full-scale systematic review. For this purpose, the search strategy, including the exclusion and inclusion criteria, is presented in subsection 2.6.5. The above strategy led to identifying the empirical and theoretical gaps in the literature. The chapter later contextualised the research to the O&G industry by reviewing the literature on GSCM in the O&G industry in general and sustainability issues in the Nigerian O&G industry. The literature synthesis in this chapter forms the basis of the conceptual framework in the subsequent chapter.

2.2 Sustainability

Sustainability is a global phenomenon that has become a buzzword among academics and practitioners (Jones, Hillier and Daphne 2016). Over the years, the sustainability concept has attracted remarkable attention from scholars across academic disciplines (Rajeev et al. 2017). The extant literature suggests that the history of sustainability is dated to 1804 when forest reserve practitioners promoted sustainable forest reserves management to sensitise professionals on environmental management (Hassan and Lee 2015; Morgenstern 2007; Weisser 2017). However, sustainability was perceived as a loosely adopted concept applied to address particular issues in the industry during this period. Sustainability later became a central idea in 1946 when Lady Eve Balfour introduced sustainable farming in the British agricultural sector (Yusuf et al. 2013). Subsequently, sustainability has evolved into a global concept.

The globalisation of sustainability secured the endorsement of world leaders during the earth summit in Rio de Janeiro in 1992 (Dyllick and Hockerts 2002). Thereupon, governments and corporations have continuously advanced the sustainability concept to promote the *'safety of the earth'*. The above was further validated in 2015 when 195 countries forged the first universally binding agreement on climate change at the Paris Climate Conference (COP21). One of the significant features of this agreement is the resolution that nations of the world should initially reduce the current level of global emissions and eventually keep the global average temperature to 2ºC. Notwithstanding the above, one crucial issue is that the extant literature suggests ambiguity in sustainability interpretation among scholars. For example, John and Narayanamurthy (2015) argue that sustainability is a well-adopted concept lacking consensual definition among scholars and practitioners. Corroboratively, Jones, Hillier and Daphne (2016) observe that sustainability is a popular concept adopted in many walks of life that connotes 'all things to all people'. Consequently, scholars have attempted to conceptualise sustainability on the definition of sustainable development presented in the WCED of 1987 (Adams and McNicholas 2007; Dehghanian and Mansour 2009; Dresner 2002). In this report, sustainable development is defined as:

> *"A development that meets the needs of the present generation without compromising the ability of the future generation to meet their own needs"*

The above definition is also criticised for containing vague terminology, riddled with operationalisation difficulty, without practical implications (Adams and McNicholas 2007; Bartlett 1998; Robinson 2004; Wallner 1999). Regardless, the literature agrees that sustainability portrays positivity for society, despite its criticism. Therefore, the criticism and debates around sustainability relate to conceptualisation and operationalisation (Bell and Morse 2012). In this vein, Elkington (1998) proposed the Triple bottom line concept (TBL) to address these concerns. Thus, TBL was conceptualised by the author to help organisations operationalise sustainability practices by integrating the economic, environmental, and social dimensions into their operational frameworks. The concept of TBL of sustainability is presented below.

2.2.1 The triple bottom line

TBL operationalises the broad definition of sustainability by incorporating the social and environmental issues into the economic realities of organisations (Elkington 1998; Gimenez, Sierra and Rodon 2012). Traditionally, firms present their stewardships to stakeholders using financial accounting concepts and conventions that emphasise economic performance. In contrast, TBL emphasises that organisations' resources are not limited to monetary and financial investment but include environmental and societal inputs such as water, energy, and public infrastructures. Hence, reporting organisations' performances solely on the traditional accounting convention may not appropriately represent an accurate picture of firms' performance (Savitz 2014). Besides, evolving issues in the corporate world have continually pressured companies to present their performance reporting beyond the traditional financial boundaries and incorporate environmental and social indicators (Delai and Takahashi 2011). Therefore, the purpose of the TBL is to create an actionable basis whereby firms can successfully integrate the '*abstracts'* of environmental and social concerns into their accounting practices (Elkington 1998).

Hall (2011) describes TBL as an accounting framework predicated on successfully incorporating social and environmental dimensions into an organisation's traditional financial bottom line. For illustration, Table 2.1 presents a snapshot of some of the elements for consideration within the TBL framework.

Table 2.1: Representative measures of the triple bottom line (TBL). (Adapted from Savitz 2014).

Economic	Environmental	Social
Sales, Profits, ROI	Pollutants emitted	Health and safety record
Taxes paid	Carbon footprint	Community impacts
Monetary flows	Recycling and reuse	Human rights; privacy
Jobs created	Water and energy use	Product responsibility
Supplier relations	Product impacts	Employee relations

A cursory look at the table indicates that one of the critical challenges of TBL is how to integrate the three dimensions of sustainability effectively since the components are expressed in different denominators. For example, while the financial (economic) profits are usually measured in monetary values, environmental and social dimensions are generally represented in multi-various denominators. Therefore, finding a common basis for measuring social capital or ecological health related to the economic bottom-line can be very complex for a company (Hall 2011). Moreover, the above challenge becomes more pronounced in a supply-chain context where TBL must be integrated across the business relationships (Linton, Klassen and Jayaraman 2007; Sharma and Henriques 2005). To this end, Gopalakrishnan et al. (2012) argue that the realistic integration approach to TBL is grossly fragmented. Nevertheless, firms adopt various methodologies to integrate TBL into their reporting system (Wan Ahmad, de Brito and Tavasszy 2016). Various standard organisations and industry associations have designed frameworks that assist companies in integrating social and environmental issues into their economic realities. For example, the global reporting initiative (GRI) has issued a series of sustainability standards that help firms evaluate their operations' impacts on the social and environmental constructs (GRI 2016). Also, the IPECA's sustainability guidelines provide a framework by which O&G firms can report the impact of O&G operations on the relevant environmental and social variables of the TBL. Therefore, the three constituents of TBL are discussed below to situate the current study within the literature correctly.

(a) <u>The economic dimension of TBL</u>

The economic dimension of the TBL is focused on developing strategies to improve organisations' economic growth without degrading the environment or causing harm to people living within the society (Yusuf et al. 2013). This dimension of TBL explains firms' economic performance based on the concept of financial liquidity (cash flow generation) and profitability (shareholder's returns) (Dyllick and Hockerts 2002). Accordingly, Elkington (1998) represents the economic dimension of the TBL as the financial profit used for the computation of earnings attributable to shareholders.

Tsai, Chou and Hsu (2009) argue that economic sustainability transcends beyond mere positive returns on investment but incorporates corporate commitment into ensuring that activities generating profits do not harm the environment and the society. Thus, firms cannot claim to be economically sustainable by merely recording accounting profits, while their operations constitute threats to the environment and society. The above is hinged on the notion that making profits in the short run does not guarantee a firm's long-term survival or positive contributions to society (Doane and MacGillivray 2001). Therefore, the economic bottom line is focused on the principle of long-term orientation, which emphasises that the effective interaction of the social and environmental factors complements firms' financial performance and defines the overall and continuous survival of organisations' profitability (Tsai, Chou and Hsu 2009).

(b) The environmental dimension of the Triple bottom-line

Environmental sustainability places responsibility on firms and their supply chains to maintain the natural capital invested in production and consumption (Goodland 1995). According to Elkington (1998), the coverage of natural capital goes beyond merely counting the number of trees in the forest and similar activities. It is a concept that has a wide gamut that accounts for underlying natural wealth such as water regulation, greenhouse gases, and impacts of firms' activities on the terrestrial and aquatic habitats.

What constitutes the natural environment is divergent (Redclift 2005). For example, Wheeler (2004) limits the definition of the natural environment to physical things we can see in the world. In contrast, some other scholars adopt a more holistic definition by including critical elements such as natural resources, such as table and atmospheric water, fossil energy, oceans, and many more (see Elkington 1998, Goodland 1995). Regardless, the environment is consistently destroyed by human's unsustainable consumption and production activities (Walker and Jones 2012). The adverse effects of unstainable production and consumption manifest in the depletion of the ozone layers, climate change, global warming, and rising energy prices, which have remained matters of global concern (Goodland 1995, Wheeler 2004).

Similarly, the consistent growth in the global population continuously leads to increasing consumerism that pressurises the environment as a source of human survival (Gopalakrishnan et al. 2012). These activities have led to water, air, and land pollution, environmental carbonisation, flooding, drought, and famine (Bracho 2000; Wheeler 2004). Other studies have revealed that the atmospheric nature has been more seriously altered by activities relating to fossil fuel and deforestation in the past century than it has ever been in the previous eighteen thousand years (Graedel and Crutzen 1989; Markley and Davis 2007). To this end, Wilson (1989) portends that at the current consumption rate, there is a tendency that up to 50 per cent of the world's species would be extinct in fifty years. Accordingly, the sustainability of the current ecological practices (considering the possibility of the world's population doubling by 2030) is highly questionable (Shrivastava 1995). The above has placed responsibility on corporate organisations to rethink their production and consumption processes in line with the sustainable development goals (SDGs) requirements.

Furthermore, it is widely acclaimed that negative environmental issues can also affect firms' economic performance. Companies found culpable in ecological management are exposed to cash flow distortion (Klassen and McLaughlin 1996; Porter and Van der Linde 1995). They are also vulnerable to reputational risk (Karpoff, Lott and Wehrly 2005). Such occurrences can negatively affect the value of such companies in the stock market. For example, a sharp drop of over 50% was recorded in the share price of BP after the Deepwater Horizon oil spills in 2010 (Fodor and Stowe 2015).

Similarly, companies that failed to comply with national environmental laws in Korea have been subjected to a decline in market valuation (Dasgupta et al. 2006). In response to the above, many organisations realise the importance of improving their environmental bottom line to remain economically viable (Buyukozkan and Cifci 2010). The above indicates that organisations increasingly perceive investment and technology in environmental initiatives to improve their financial bottom line rather than just a way of gaining societal acceptance (Madu 1996).

(c) <u>Social (Equity) dimension of the Triple bottom-line</u>

The social dimension of TBL focuses on a holistic development that drives harmony in the evolution of humanitarian society (Elkington 1998). The above is fostered by creating a conducive environment that supports unity in social and cultural diversity, leading to improved quality of life for all populations (Polèse and Stren 2000). This dimension of TBL covers a wide range of social issues such as equity, social justice, human right, corporate power and environmental justice, global poverty, and corporate responsibility, among others (Blewitt 2008).

While creating economic profit, social sustainability orientation requires firms to improve society and people's lives without over-exploring the resources in the natural environment (Hoffman and Bazerman 2005). As such, socially sustainable organisations must uphold human values such as tolerance, compassion, and honesty (Townsend 2008). Social sustainability is based on the notion that organisations should voluntarily integrate CSR with environmental practices in their operations beyond regulatory requirements (Dyllick and Hockerts 2002). In essence, its adoption enables organisations to pursue business activities to improve the quality of life of most stakeholders (Kaynak and Montiel 2009; Labuschagne, Brent and Van Erck 2005).

The social dimension of sustainability has received the least research attention in the extant literature (Dempsey et al. 2011; Landorf 2011; Seuring and Müller 2008). One reason for this is the inconsistency in depicting the themes categorised as social factors, thereby creating ambiguity (Littig and Griessler 2005). Also, unlike the environmental and economic dimensions with well-established historical indicators, the social aspect is generally ridden with difficult-to-measure themes (Landford 2011).

Nevertheless, some scholars have attempted to study the social aspect of sustainability. For example, McKenzie (2004) conducted a singular examination of social sustainability. The author acknowledged a lack of low indicators in this area and highlighted the need to develop industry-specific social sustainability indicators. Azapagic (2004) attempted to develop sustainability indicators for the social dimension of sustainability in the mining and minerals industry. The author decried difficulty finding appropriate indicators that could express the depth of critical social issues.

2.3 Green Supply Chain Management (GSCM)

A firm's integration of the TBL concept into its supply chain management (SCM) is termed sustainable supply chain management (SSCM) (Seuring and Muller 2008; Carter and Rodger 208). Green Supply Chain Management (GSCM) is the aspect of SSCM that focuses on incorporating the economic and environmental dimensions of TBL into SCM (Mathivathanan, Kannan and Haq 2018). Thus, GSCM is not a departure from the conventional SCM principles (Gimenez and Tachizawa 2012) but a strategic modification of the underlining tenets (Taticchi et al., 2013; Govindan et al., 2016) to enhance overall business performance (Bag 2014). Following the above, the extant literature on SSCM cannot be divorced from GSCM. Indeed, many of the GSCM issues mildly consider the social aspect of TBL (Rettab and Ben Brik 2008).

Firms adopt green initiatives in SCM because activities inimical to the environment are often generated during supply chain operations (Rajeev et al., 2017). For example, freight and other logistics activities within the supply chain could cause noise pollution, accidents, and high greenhouse gas (GHG) emissions that harm the environment and the society (Dekker, Bloemhof and Mallidis 2012). In the past, the SCM approach was reactive to sustainability issues arising from supply chain activities (Yusuf et al. 2013) because of the strict focus of its orientation on the efficiency in managing organisations' economic activities, with limited attention to the environmental and social concerns (Das 2017). However, emerging factors, such as increasing stakeholders' expectations for firms to demonstrate ethical and ecological behaviour (Lozano 2008), are compelling supply chain managers to effect sustainability adjustment in their operations. To this end, focal companies in the supply chain are increasingly held responsible for their supply chain partners (Ekiugbo and Papanagnou 2017). Such examples are seen in the apparel industry, where organisations such as Nike, Disney, Levi, and Adidas, among others, have been blamed for inhumane working conditions and environmental contamination in their production process (Seuring and Muller 2008). Consequently, many organisations are developing strategies to adopt GSCM to integrate environmental objectives into their SCM without compromising their economic goals (Székely and Knirsch 2005).

Sequel to the above, academics have continuously witnessed a growing interest in the research that focuses on GSCM since the last decade. The above is more evident in the consistent growing numbers of literature review papers published in the field of supply chain sustainability in recent years (Ansari and Kant 2017; Bastas and Liyanage 2018; Burgess, Singh and Koroglu 2006; Carter and Liane Easton 2011; Carter and Rogers 2008; Centobelli, Cerchione and Esposito 2018; Miemczyk, Johnsen Thomas and Macquet 2012; Rajeev et al. 2017; Seuring and Müller 2008; Srivastava 2007).

It is pertinent to note that there is no generally accepted definition of GSCM as several terminologies and descriptions that fit into its conceptualisation abundantly exist in the literature (Eltantawy, Fox and Giunipero 2009; Miemczyk, Johnsen Thomas and Macquet 2012; Pagell and Shevchenko 2014; Spence and Bourlakis 2009). Nevertheless, some of the commonly cited definitions of GSCM are provided in table 2.2.

Table 2.2: Representative definitions of GSCM

S.No	Definition	Author/s
1	Application of environmental management principles to the entire set of activities across the whole customer order cycle, including design, procurement, manufacturing and assembly, packaging, logistics, and distribution	Handfield et al. (1997)
3	GSCM is the set of SCM policies held, actions taken and relationships formed in response to concerns related to the natural environment with regard to the design, acquisition, production, distribution, use, re-use and disposal of the firm's goods and services	Zsidisin and Siferd (2001)
4	GSCM is the summation of Green Purchasing, Green Manufacturing/Materials Management, Green Distribution/ Marketing and Reverse Logistics	
5	GSCM covers all phases of the product's life cycle from design, production and distribution phases to the use of products by the end-users and its disposal at the end of the product's life cycle	Zhu and Sarkis (2006)
6	GSCM is about integrating environmental thinking into SCM, including product design material sourcing and selection, manufacturing processes, delivery of the final product to the consumers and end-of-the-life management of the product after its useful life.	Srivastava (2007)
7	GSCM is an approach for improving the performance of the processes and products according to the requirements of the environmental regulations	Hsu and Hu (2008)
8	GSCM is a managerial approach that seeks to minimise a product or service's environmental and social impacts or footprint	Rettab and Ben Brik (2008)
9	Integrating environmental concerns into the inter-organizational practices of SCM, including reverse logistics	Sarkis, Zhu and Lai (2011)

While the above list is not exhaustive, it shows that GSCM has a wide gamut covering green practices such as green purchasing, eco-design, environmental policies, environmental cooperation, reverse logistics, and investment recovery. The current study adopts the definition offered by Rettab and Ben Brik (2008), who defined GSCM as:

> *"A managerial approach to minimise a product or service's environmental and social impacts or footprint."*

This definition is adopted in this study because the authors incorporate an element of the social aspect of TBL into their conceptualisation of GSCM. While GSCM is predominantly focused on the economic and environmental dimensions of TBL, environmental issues addressed by GSCM can also have implications on society. For instance, the environmental pollution of Ogoni land in Nigeria by SPDC raised issues of human rights, equity, and justice (Schneider et al. 2013), which are the focal points of the social dimension of sustainability (Elkington 1998). Also, adopting the above definition enables this research to apply a holistic approach to conceptualising GSCM from the relevant theoretical perspective, as indicated in section 1. 4.

Furthermore, firms may undertake various initiatives across their supply chain to minimise environmental impacts (Seuring and Muller). To this end, many studies have examined the scope of GSCM from different perspectives across industries. In this vein, Beamon (1999) conceptualises the scope of GSCM with various green practices such as recycling, reuse and remanufacturing. According to Zhu and Sarkis (2004), other aspects of GSCM include investment recovery and eco-design. From another perspective, Guang Shi et al. (2012) categorised GSCM into intra-organisational and inter-organisational environmental practices. Indeed, a study by Sharma and Gandhi (2016) on the linkage between GSCM and organisational performance identified hundreds of various components of GSCM practices in the literature. The literature suggests that GSCM practices may also vary across industries, organisations, and supply chain echelons (Meckenstock, Barbosa-Póvoa and Carvalho 2015). Considering the broad coverage of GSCM, Pullman, Maloni and Carter (2009) observe that authors find it challenging to develop an overarching framework for GSCM. Therefore, a proper conceptualisation of the scope of GSCM must reflect the peculiarity of the industry under consideration.

Another issue is that scholars have highlighted the dearth of theory-based research in GSCM (Carter and Liane Easton 2011; Touboulic and Walker 2015). Therefore, rather than adopting the conventional approach to examine GSCM, this study attempts to utilise existing theories to investigate GSCM in line with previous studies (Guang Shi et al. 2012; McDougall, Wagner and MacBryde 2021; Yunus and Michalisin 2016). Given the above, the theoretical perspective of GSCM is presented below.

2.4 Theories in GSCM

As earlier highlighted, GSCM is an aspect of SSCM that focuses on integrating environmental concerns into the traditional SCM. Therefore, applying theories in GSCM literature stems from the evaluation of theory-based literature in SSCM. The role of theory in deepening knowledge in any field of study cannot be overemphasised. According to Handfield and Melnyk (1998), a theory is a symbolic cornerstone of knowledge production and development. In essence, without the presence of a veritable tool of theory, it will be almost impossible for humanity to advance knowledge in any discipline. Following this notion, leading academic publishers in management sciences emphasise grounded theory as an essential criterion for selecting articles for publication (Carter and Liane Easton 2011; Colquitt and Zapata-Phelan 2007; Hambrick 2007). Indeed, the extant literature acknowledges that the validity of theoretical power is the bedrock of reliable empirical findings (Alvesson and Kärreman 2007; Colquitt and Zapata-Phelan 2007; Hambrick 2007; Maanen, Sørensen and Mitchell 2007). Specifically, Van Maanen, Sørensen and Mitchell (2007) portend that the beauty of the conceptual resides in the ability of the empirical to provide support for the theoretical, leading to an active engagement with practical problems that could lead to an emergence of good theories.

Like any other field of study, knowledge advancement in GSCM should be deepened by theories (Carters and Rodgers 2008). However, as a relatively new but growing field of study, many authors have raised concerns regarding the paucity of grounded theory in GSCM research (Carter and Easton 2011; Sarkis, Zhu and Lai 2011). Hence, a call for a broader theory application has been made. According to Carter and Easton (2011), 87% of all articles published on GSCM between 1991 and 2000 lack a theoretical basis. This position is corroborated by Touboulic and Walker (2015), who further revealed that the few theory-based research in GSCM applies four main theories: *Resource-Based View (and the Natural Resource-Based View), stakeholders' theory, institutional theory, and transaction cost theory (TCT).* An overview of these popular theories is presented in table 2.3.

Table 2.3: Popular theories in GSCM research (Adapted from Touboulic and Walker 2015)

Theories	Description	Application	Source	Sample References
Resource-Based View (RBV)	A firm's sustained competitive advantage is dependent on its valuable, rare, inimitable, and non-substitutable resources and capabilities.	To understand how strategic resources within the firm can be combined with strategic capabilities to enhance the supply chain's competitiveness.	(Barney 1991)	Gold, Seuring and Beske (2010); Mojumder and Singh (2021)
Natural Resource-Based View (NRBV)	**Beyond internal resources, the ability of firms to integrate environmental and social concerns into their strategic resources and capabilities is a source of sustained competitive advantage.**	**Utilises both firm-level and inter-organisation resources to develop strategic capabilities that enhance economic, social, and environmental competitiveness.**	**(Hart et al. 1995)**	**Guang Shi et al. (2012); McDougall, Wagner and MacBryde (2021)**
Stakeholders' Theory	**Firms are accountable and responsible to a wide range of external and internal stakeholders whose interests should be considered for the long-term survival of firms.**	**To depict how various SC stakeholders are integrated into a firm's GSCM/SSCM practices.**	**(Freeman, 1984)**	**Park-Poaps and Rees (2010); Huang, Borazon and Liu (2021)**
Institutional theory	Three external pressures (coercive, mimetic, and normative) can influence firms' strategic choices, including sustainability practices.	To understand critical institutional drivers of GSCM/SSCM such as consumer pressures, regulatory pressures, competitive pressures, etc.	(DiMaggio & Powell, 1983)	González, Sarkis and Adenso-Díaz (2008); Rezali et al. (2021)
Transaction Cost theory (TCT)	Following those costs and efforts are involved in business relationships between firms, organisations must clearly define the mode of governance to sustain business relationships in contractual agreements	To understand how supplying and buying companies govern relationships and recognise impacts of transaction costs about green practices.	(Williamson 1981)	Vachon and Klassen (2006a); Feng et al. (2022)

To select the relevant theories that align with the objectives of this study, there is a need to reflect on the main aim of this research stated in chapter one. Thus, this study aims:

> ***"To explore the stakeholder pressures and the strategic resources that drive GSCM implementation while assessing the impact of GSCM practices (conceptualised as pollution prevention, product stewardship, clean technology and base of the pyramid) on the competitiveness of the firms in the Nigerian O&G industry."***

First, this study identifies the most prevalent stakeholder pressures that drive GSCM practices adoption among firms in the Nigerian O&G industry. This objective aligns with Freeman's (1984) stakeholder theory, which states that firms must consider stakeholders' requirements and expectations in the decision-making process. However, it is essential to note that DiMaggio and Powell's (1983) institutional theory also complements the stakeholder theory in this research. This is because the pressures emanating from stakeholders can also translate into institutional isomorphism that influences firms' strategic decisions (Delmas and Toffel 2004; Sarkis, Gonzalez-Torre and Adenso-Diaz 2010;

Wang, Li and Qi 2020). For example, regulatory pressures emanating from the government as an essential stakeholder are also a significant source of coercive pressures within the institutional theory (Esfahbodi et al. 2017). Sarkis, Gonzalez-Torre and Adenso-Diaz (2010) conceptualise stakeholder pressures as forms of institutional pressures that trigger firms' adoption of GSCM practices. Also, Wang, Li and Qi (2020) assert that the neo-institutional approach could be adopted to examine the stakeholder pressures that drive firms' environmental management strategies,

Furthermore, this study examines the role of strategic resources and capabilities for GSCM practices on the competitiveness of the firms operating across the supply chain of the Nigerian O&G industry. Arguably, Barney's (1991) Resource-Based View (RBV) of firms, which stipulates that specific firms' resources and capabilities can enhance firms' competitive advantage, aligns with the aim of this study. However, one of the significant shortcomings of the RBV is that the theory fails to consider the role of the natural environment in sustaining organisations' competitiveness. Besides, it limits firms' capabilities and strategic resources within a firm's boundary, thereby excluding the possibility of inter-organisational resources required in SCM (Guang Shi et al. 2012). The above limits its direct application to the objective of this study as GSCM is predominantly concerned with environmental issues, which is often executed in collaboration with business partners

Hart's (1995) NRBV, a modification of the RBV, overcomes these shortcomings. In addition to integrating the natural environment into its conceptualisation, NRBV also recognises the role of inter-organisational resources in developing strategic capabilities for environmental management (Hart 1995; Hart and Dowell 2011). Therefore, this study combines stakeholder theory (from the neo-institutional perspective) with NRBV to examine how GSCM practices enhance the competitiveness of Nigerian O&G firms. The following section discusses the above theories in the context of this research.

2.5 Stakeholder theory

The term stakeholder became a particular point of interest in strategic management when Stanford Research Institute (SRI) published a business management report on the need to consider the requirements and expectations of various stakeholders in firms' decision-making process (Slinger 1999). The SRI report defines stakeholders as *"those groups without whose support the organisation would cease to exist"* (Freeman 1984: 13). Freeman (1984) argued that the existing management concept that lays credence solely on the supremacy of the shareholders' interest was inconsistent with the emerging changes and trends in the business world; hence, there is a need for a new conceptual framework for managerial practices. Therefore, the author propounded the stakeholder theory in 1984 as a framework with which firms can effectively explore their relationship with various individuals and groups of people who may influence or be influenced by firms' actions to the advantage of organisations. Organisations' activities can negatively or positively affect the positions of various stakeholders (McVea and Freeman 2005). Ansoff (2007) asserts that different adverse impacts of firms' activities, such as environmental pollution, monopolistic practices, manipulations, and many others, can trigger stakeholders' attention to firms' operations. Therefore, managers are requested to consider the interest of a wide range of stakeholders such as shareholders, employees, customers, creditors and the society upon which companies depend in decision making.

The proposition of stakeholder theory has led to increased stakeholder pressure requesting organisations to address the negative impact of operations on the environment (Hart 1995). In response, firms are compelled to reconfigure their strategic capabilities to accommodate environmental issues (Kassinis and Vafeas 2006). Thus, stakeholder theory underscores the notion that firms usually adopt green practices to meet the expectations and requirements of critical stakeholders. Green stakeholders are those with the power to influence an organisation's environmental strategies like GSCM. Many authors have attempted to identify and categorise the essential stakeholders that drive firms' green practices based on their power and relationship with the firm. A taxonomy of green stakeholders based on previous studies is provided in table 2.4.

Table 2.4: Taxonomy of green stakeholders

Authors	Taxonomy of stakeholder	Associated stakeholders
Fineman and Clarke (1996)	Regulatory stakeholders	Local and national governments
	Internal stakeholders	Chief executive officers and top managers
	Stakeholders with indirect interest	financial shareholders, customers, suppliers and media
	Stakeholders with a focus on global sustainability	Green pressure groups, high-profile individuals championing environmental protection
Henriques and Sardosky (1999)	Regulatory stakeholders	Government, trade associations
	Organisational stakeholders	Customers, suppliers, employees, shareholders
	Community stakeholders	Community groups, environmental organisations, other potential lobbies
	Media	Local and international media
Buysee and Verbeke (2003)	Regulatory stakeholders	National and regional Governments, local public agencies
	External primary stakeholders	Domestic and international customers and suppliers
	Internal primary stakeholders	Employees, shareholders and financial institutions
	Secondary stakeholders	Domestic and international competitors, international agreements, NGOs, media
Murillo-Luna, Garcés-Ayerbe and Rivera-Torres (2008)	Regulatory stakeholder	Environmental legislation, administration and control
	Corporate governance stakeholder	Managers, shareholders, owners
	Internal economic stakeholder	Employees, labour union
	External economic stakeholder	Customers, suppliers, financial institutions, insurance companies, competitors

	Social external stakeholders	Media, communities, ecologists' organisations
Darnall, Henriques and Sadorsky (2010)	Primary stakeholders	Value chain participants-customers and suppliers
	Internal stakeholders	Management and non-management employees
	Secondary stakeholders	Environmental and community organisations, labour unions, industry associations
	Environmental regulators	Government institutions

Some of the classifications above, particularly the taxonomy presented by Henriques and Sadorsky (1999), have been applied by other scholars. It is pertinent to note that the impact of individual stakeholders on a firm's environmental policy is determined by the power and the importance of the classified stakeholders (Garcés-Ayerbe, Rivera-Torres and Murillo-Luna 2012). Mitchell, Agle and Wood (1997) suggest that conflict of interest may arise in meeting the expectations of a wide range of stakeholders of a company. Thus, firms tend to prioritise stakeholders' interests based on their impact on organisations.

In prioritising the importance of stakeholders, managers apply their perceptions of the cumulative impact of three intrinsic features: power, legitimacy and urgency. Power is defined as the ability of stakeholders to impose their expectations on firms. Legitimacy is the influence to determine the validation of normative conduct, which defines standards for corporate decisions. Finally, urgency underscores the promptness with which companies must address a particular stakeholder's requirements (Mitchell, Agle and Wood 1997). Many studies have classified stakeholders' importance using the theoretical foundation of power, legitimacy and urgency (Agle, Mitchell and Sonnenfeld 1999; Eesley and Lenox 2006; Harvey and Schaefer 2001).

Moreover, the degree of interdependence between stakeholders and firms can determine the importance and prioritisation of stakeholders (Sharma and Henriques 2005). Depending on their power, legitimacy and urgency, important stakeholders can pressure firms to adopt environmental initiatives. Previous studies conceptualised stakeholders' pressures from a neo-institutional perspective. For instance, Wang, Li and Qi (2020) classified stakeholder pressures into internal pressures, market pressures, coercive pressures and normative (societal pressures). Internal pressures arise from the internal stakeholders such as top management, shareholders and employees. Market pressures are exerted by supply chain members (suppliers and customers) and market competition (industry associations and competition). Government is the source of coercive pressure through the enactment of regulations. Finally, normative pressures come from various societal stakeholders such as NGOs, Media and the public. This classification will be adopted in this research to identify the stakeholder pressures that drive the adoption of GSCM in the Nigerian O&G industry.

The extant literature empirically validates the role of stakeholder pressures in firms’ implementation of green practices. Some scholars suggest that proactive strategies are developed to respond to pressures emanating from critical stakeholders (Buysse and Verbeke 2003; Henriques and Sadorsky 1999; Sharma and Henriques 2005). Also, different stakeholder pressures are addressed by different green practices ranging from preliminary operational procedures such as pollution control and eco-efficiency to advanced decisions that involve a complete reconfiguration of operational processes (Sharma and Henriques, 2005). Other studies have also empirically verified a positive impact of stakeholder pressures on proactive environmental strategies such as GSCM. These studies suggest that a higher level of stakeholder pressure increases firms' proactive environmental strategy capabilities. From the perspective of stakeholder theory, the commonly cited drivers of GSCM are presented below.

2.5.1 Drivers of GSCM

Many studies have adopted the stakeholder theory in exploring GSCM practices and the development of an organisation’s environmental management capabilities (Geng and Dai 2018; Sarkis, Gonzalez-Torre and Adenso-Diaz 2010: Wang, Li and Qi 2020). One key reason for this could be the ability of the theory to explain why firms adopt certain practices beyond economic benefits (Berrone, Cruz and Gomez-Mejia 2014; DiMaggio and Powell 1983; Meyer and Rowan 1977). Nonetheless, organisational theories such as stakeholder theory in GSCM research is still at their infancy stage (Kitchen and Hult 2007). In GSCM, the stakeholder theory is mainly used to explain how various stakeholders' expectations and requirements influence firms’ proactive environmental management strategies (Geng and Dai 2018). Other scholars conceptualised stakeholder expectations as the pressures that influence firms’ environmental management decisions (Geng and Dai 2018; Sarkis, Gonzalez-Torre and Adenso-Diaz 2010; Wang et al. 2020; Wang, Li and Qi 2020). Specifically, researchers have examined the impact of different stakeholder pressures on firms’ adoption of green practices in the supply chain context. Interestingly, the findings in this direction have shown mixed results, even in research in the same regions and countries.

From a neo-institutional perspective, Zhu, Sarkis and Lai (2013) examined the effects of stakeholder pressures on green practices among Chinese manufacturers. The study reveals that stakeholder requirements positively influence the Chinese manufacturers' internal and external GSCM practices. These findings are similar to Esfahbodi et al. (2017), who found that regulatory pressures from government institutions are positively associated with proactive environmental strategies in the UK manufacturing sector. Zhu and Geng (2013) examined the impacts of stakeholder influence on Chinese manufacturers' energy savings and emission reduction. The author found that while government requirements do not motivate firms to reduce emissions and safe energy consumption, mimetic factors from successful competitors promote sustainable purchasing and consumer cooperation. Their findings conflict with Esfahbodi et al. (2017), who found that government requirements are the critical driver of sustainability practices in the UK manufacturing sector. In their study conducted in the Ghanaian mining industry, Famiyeh et al. (2021) found that government requirements constitute potent drivers for adopting TBL principles in SCM, while the impact of competitive pressures is limited. In contrast, Rentizelas et al. (2020) found that coercive pressures from the government are insufficient to drive social sustainability practices in the supply chain of the Omar O&G upstream sector.

Following the above, the literature suggests that various industries and countries may be subjected to a different degree of any of the three stakeholder pressures (Zeng et al. 2017). Thus, the peculiarity of the sector and country of operations, among other factors, may influence the type of stakeholder that drive firms to implement GSCM practices. Consequently, there is a need for the current study to understand the specific stakeholder pressures that drive the Nigerian O&G firms to implement GSCM practices, in line with the objective of this study. The commonly cited stakeholder drivers of GSCM adoption are discussed below.

- **Government regulatory institutions**

Governments protect the environment and society by holding organisations responsible for their activities' social and environmental impacts across the supply chain (Zailani et al. 2012). Consumption of resources and ecological pollution majorly linked with the operations of manufacturing corporations is one of the reasons for the enactment of various environmental regulations by governmental institutions, both at the national and international levels (Zhu, Sarkis and Lai 2013). Governments are responsible for ensuring that the society becomes a more sustainable habitat, leading to their exertion of coercive pressures on polluting corporations (such as O&G firms) through stringent environmental legislation (Boström et al. 2015).

In practice, regulatory institutions are reputed as powerful forces that exert significant influence on the action of corporations through the execution of enacted environmental regulations, leading to the implementation of sustainability practices by firms across their supply chains. As a form of coercive pressure, regulatory forces are rooted in legal backing, leading to conformity by firms (Esfahbodi et al. 2017). According to Sarkis, Gonzalez-Torre and Adenso-Diaz (2010), government regulatory institutions are the most potent stakeholders that drive firms to adopt GSCM initiatives because of the linkage with the authoritative capacity of the people in power. The above may be particularly true in the developed nations where the regulatory compliance rate is considered high, with higher regulatory enforcement capacity by the government. For example, the UK government has continually enacted stringent environmental laws that restrict the use of non-renewable resources such as diesel and petrol in the distribution process (Taylor and Taylor 2013). This has recorded a high rate of compliance, leading to the adoption of GSCM practices by manufacturing firms and the O&G industry in the UK, has been recorded (Esfahbodi et al. 2017; Yusuf et al. 2013).

Nevertheless, pressures emanating from government regulatory institutions may not necessarily drive GSCM implementation in developing countries with weak legislative and enforcement frameworks (Silvestre, Gimenes and Neto 2017). In these countries, environmental regulations may be flouted without severe consequences, as seen in Nigeria, where a massive project like Bonny LNG was executed without any EIA certification (as mandated by law) without sanction (Emeseh 2006). Nevertheless, empirical findings have suggested that regulatory pressures may function as the critical drivers of green initiatives in some developing countries. For example, Gardas et al. (2019) combined interpretive structural model (ISM) with structural equation modelling (SEM) to examine the driving forces of GSCM in the Indian O&G industry and the impact on operational and business performance (OPR). The authors found that regulatory pressures have the highest driving power for adopting GSCM practices in the industry. Similarly, Famiyeh et al. (2021) empirically established that government regulatory pressures are critical drivers of GSCM practices in the Ghanaian mining industry.

By and large, national and international environmental regulations and their compliance burdens have driven most manufacturing corporations, including O&G firms, to implement sustainability practices in their supply chains (Esfahbodi et al. 2017; Ford, Steen and Verreynne 2014). In essence, the requirements of government regulatory institutions are a critical driver for GSCM practices implementation, considering the associated legal backing for driving environmental initiatives (Sarkis, Gonzalez-Torre and Adenso-Diaz 2010b)

- **Shareholders and top management**

Shareholders and top management are vital internal stakeholders with a vested interest in firms' economic, social and environmental sustainability (Karra and Affes 2014). Therefore, the interest of this group of persons has been identified as a cogent driver of GSCM adoption by firms. Generally, the extant literature suggests that organisations cannot effectively implement GSCM practices without the internal commitment and participation of various internal stakeholders, such as the shareholders, top management, and even the employees, within different organisational structures (Diabat and Govindan 2011; Seuring and Müller 2008).

Shareholders dictate their expectations, including sustainability expectations, to the top management of corporations (Paloviita and Luoma-aho 2010). Subsequently, top management may incorporate the shareholders' agenda into the firm's vision and deploy the needed support and commitment to implement GSCM practices (Green et al., 2012). Thus, the sustainability vision of shareholders can combine with the support of the top management to galvanise internal commitment to the implementation of GSCM practices (Green et al. 2012; Sarkis, Gonzalez-Torre and Adenso-Diaz 2010). Therefore, shareholders' sustainability requirements and top management commitment are critical complementary forces that trigger firms' adoption of GSCM practices (Karra and Affes, 2014).

- **Customers**

Organisations exist to provide values and satisfaction to their customers through supply chain activities (Handfield and Nichols 1999). This is because the whole essence of a supply chain is to effectively and timely deliver products and services that meet consumers' satisfaction (Christopher 2016). Therefore, the customers' interests represent crucial driving forces influencing firms' sustainability decisions (Handfield et al. 2005). Recently, a growing environmental concern and awareness made consumers of products and services across industries demand more environment-friendly products and services (Seuring and Muller 2008). Consequently, customers are increasingly becoming more environmentally conscious, thereby gravitating toward products and services with evidence of compliance with high environmental and social standards (Diabat and Govindan 2011; Luthra et al. 2015).

Customers' expectations may compel firms to adopt environmental initiatives to avoid their products and services being boycotted by customers due to unsustainable practices. This may lead to reputational damages and financial loss (Sarkis, Gonzalez-Torre and Adenso-Diaz 2010b). This position is reiterated by Hsu et al. (2013), who asserted that firms that suffer reputation damages owing to environmental and social issues in their supply chains are likely to witness declined customer patronage. Therefore, it is established that pressures from the customers are crucial drivers of GSCM adoption.

- **Competitors**

Another stakeholder influence that may drive firms' adoption of sustainability practices in their supply chain is the activities of the competitors. Considering that competition has moved beyond firm-level to the supply chain level in today's global market (Hult, Ketchen and Arrfelt 2007; Vokurka, Zank and Lund Iii 2002), firms may wish to respond to competitive pressures by implementing environmental initiatives in the context of their supply chain management (Giunipero et al. 2012; Giunipero et al. 2008).

Competitor driving forces are highlighted in a situation where corporations adapt and mimic the actions and the operational policies of the leading and successful organisations in an industry (Rivera 2004). This gives rise to the concept of ‘competitive benchmarking,’ which is defined as a firm’s adoption and replication of the success stories of its competitors (Vachon and Klassen 2008). The above explains why many leading organisations implement GSCM practices to gain a higher competitive advantage in the market (Zhu et al. 2010). Therefore, the competition pressure is a mimetic market pressure that may drive firms to adopt sustainability practices.

Given the fierce competition in the global market, organisations continually experience pressures from successful competitors determined to snatch away market share by targeting environmental-conscious customers with eco-friendly products and services (Hsu et al. 2013). As a survival strategy, firms, which may not ordinarily consider implementing sustainability initiatives, are pushed by competitive pressures to develop capabilities for implementing proactive environmental practices, such as GSCM. In effect, successful and leading organisations that gain market share by implementing green initiatives motivate other companies in the industry to copy and execute similar actions (Sarkis, Zhu and Lai 2011).

Notwithstanding the foregoing, other studies have suggested that while competitive pressures may motivate GSCM adoption, they may not be sufficient as powerful triggers (Hsu et al., 2013). In this regard, Zhu, Sarkis and Lai (2012) found that competitive pressures have no significant influence on GSCM adoption by manufacturing firms.

2.6 Natural resource Based View (NRBV) of firm

The theorisation of the NRBV concept is premised on the principles of the Resource-Based View theory (RBV) (Hart and Dowell 2011). The RBV theory argues that a firm’s superior competitive advantage is interlinked with its valuable, rare, inimitable, and non-substitutable resources and capabilities (Barney 1991; Grant 2016). Succinctly, the theory examines the linkage between a firm’s internal characteristics and organisational performance, emphasising tacit and socially complex resources (Teece, Pisano and Shuen 1997), which are specific and unique to an organisation without being shared with others (Grant, 2016).

RBV is prone to various limitations, including the non-recognition of environmental strategies and inter-organisational resources in its conceptualisation (Hart and Dowell, 2011). Hart (1995) developed the NRBV to address these shortcomings with the proposition that firms’ future competitive advantage depends on their ability to tactically manage their relationship with the natural environment using internal and external resources (Chan 2005). According to Hart (1995), natural environmental factors at the risk of explosion are crucial to organisations' strategic management. Thus, organisations' competitiveness does not solely depend on internal factors (resources and capabilities) as postulated by the traditional RBV theory but involves effective management of the natural environment (Hart and Dowell 2011).

The natural environment is inundated with multi-dimensional challenges impacting firms (Hart and Dowell, 2011). These challenges are also predicted to become more complicated in the years ahead (Keyfitz 1989). For example, the human population grew astronomically from 2 billion people, after World War II, to over 5 billion in the last decade (Keyfitz 1989). The current population has been predicted to double by 2030 (Shrivastava 1995). Similarly, climate change issues continually threaten humanity and firms, leading to increased ocean levels and desertification (Schneider 1989). Hence, Hart (1995) postulated the NRBV theory to incorporate and internalise the challenges of the natural environment into the RBV framework.

Hart (1995) proposes three interdependent strategies: pollution prevention, product stewardship, and sustainable development, as the strategic capabilities for competitive advantage. These capabilities are built on the concept of valuable, rare, inimitable, and non-substitutable (VRIN) principles of the traditional RBV (Grant 1991). Hart (1995) asserts that these capabilities are activated by specific strategic resources (based on the VRIN principle) to generate a competitive advantage. Based on the foregoing, figure 2.2 depicts the central idea behind NRBV.

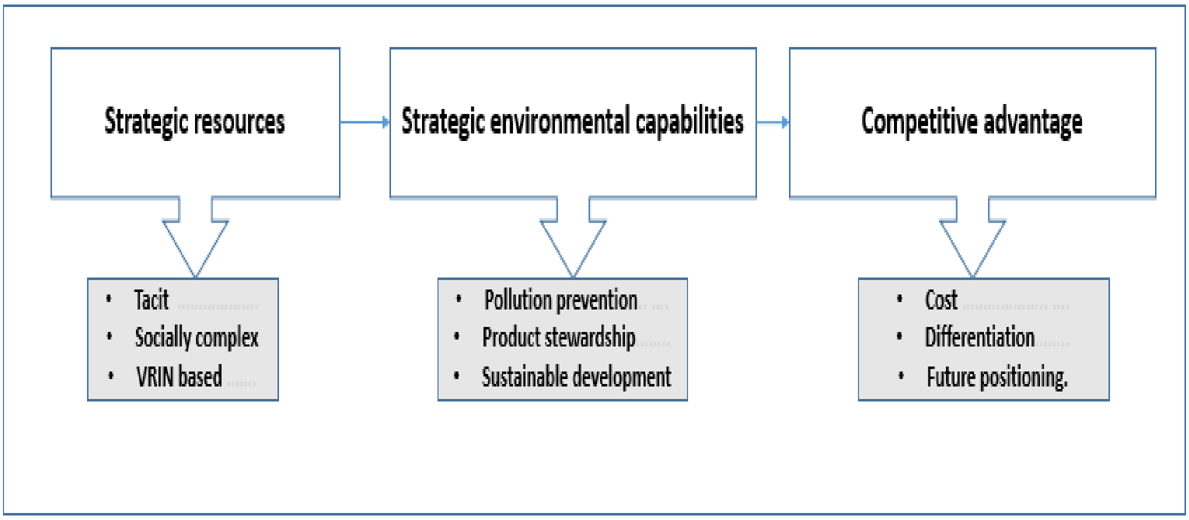

Figure 2.2: The conceptual idea of NRBV

Considering that the original NRBV presented three strategic environmental capabilities earlier discussed, the remaining parts of this section focused on NRBV strategic environmental capabilities, strategic resources, and competitive advantage.

2.6.1 NRBV strategic capabilities

The environmental strategies presented in NRBV are perceived as strategic capabilities. They are also known as proactive sustainability strategies (Aragón-Correa and Rubio-Lopez 2007; Aragón-Correa and Sharma 2003; Mishra and Yadav 2021), dependent on specific and identifiable processes (Eisenhardt and Martin 2000). According to Hart and Dowell (2011), the NRBV strategies are dynamic capabilities that must be continually integrated, built, and reconfigured to channel the internal and external competencies to address the rapidly changing business environments (Teece, Pisano and Shuen 1997). On this note, each of these strategic capabilities is discussed below:

2.6.1.1 Pollution Prevention

According to Hart (1995), the idea behind pollution prevention transcends beyond a mere development of 'end-of-pipe' strategies that control pollution and emission (which are often very expensive and seldom effective). It majorly focuses on the adoption of pollution management strategies targeted at clearly defined environmental objectives for reducing emissions through continuous improvement. Handfield et al. (2002) observe that organisations' approaches to pollution management can either be reactive or proactive. Environmentally reactive firms are prone to poor environmental performance, while proactive firms tailor their policies towards maximising the benefit of cost minimisation through waste reduction and environmental management systems (Klassen and McLaughlin 1996). Thus, one of the key aims of an effective pollution prevention strategy is to proactively minimise emissions, effluent, and wastes at the source (Menguc and Ozanne 2005). According to Hart (1995), pollution prevention strategy is linked with total quality environmental management, which posits that collaboration with internal stakeholders is necessary for pollution prevention strategies.

Within the supply chain management domain, attempts have been made to integrate environmental protection issues (including pollution prevention) into the concept of green supply chain management (Rao and Holt 2005; Zhu, Sarkis and Geng 2005). Whereas many of the earliest studies were fundamentally generic, the later studies appear to be specifically focused on critical aspects of GSCM practices. For example, Vachon and Klassen (2006) examined the impacts of collaborative environmental activities on supply chain performance using the NRBV lens and propose that logistical integration, technological integration, and supply reduction are critical factors of effective supplier collaboration. Also, Guang Shi et al. (2012) proposed a framework that fussed internal and external GSCM practices into the NRBV strategic capabilities. More recently, McDougall, Wagner and MacBryde (2021) developed a framework linking various sustainability practices with NRBV strategies conceptualised as dynamic capabilities. Nevertheless, the previous studies linking GSCM with NRBV capabilities lack empirical verification (Guang Shi et al. 2012; McDougall, Wagner and MacBryde

2021). Also, the postulations of the existing frameworks have not been applied and tested in the O&G industry.

2.6.1.2 Product stewardship

The objective of the product stewardship strategy is to incorporate an environmental perspective into the entire life cycle Analysis (LCA) of a product through effective stakeholders' engagement (Hart 1995). Thus, product stewardship's spectrum is beyond mere control of pollution at the manufacturing base but focuses on minimising the product's environmental impacts throughout its life cycle. (Hart 1997). The NRBV product stewardship strategy emphasises the pursuit of the low ecological cost of a product from 'cradle to grave.' This may involve several activities, such as substituting non-renewable and toxic materials mined from the earth's crust with renewable resources at a rate consistent with their replenishment (Keoleian and Menerey 1993).

Product stewardship capability is pivotal to effective product management through strategic collaboration (Bhupendra and Sangle 2017; Guang Shi et al. 2012). As a proactive environmental management strategy, environmentally conscious producers voluntarily design a collaborative approach to minimise adverse effects of products (Wagner 2013). Such voluntary implementation of a product stewardship strategy is dependent on a firm's level of absorptive capabilities (Bhuependra and Sangle 2017). For this purpose, an absorptive capability is defined as a firm's capacity to retrieve information outside of its boundary and apply it for business decision-making (Cohen and Levinthal 1990). Also, the extant regulations may drive firms to implement product stewardship strategies. An example of such regulations is the German 'take-back' law that enables customers to return spent products to manufacturers at no cost and prevents manufacturers from disposing of them as junk. According to Hart (1995), this law motivates German companies to develop the necessary capability to design reusable and recyclable products to avoid disposal costs.

To achieve the above, organisations collaborate with a wide range of external and internal stakeholders, such as the environmentalists, community leaders, the media, internal marketers (employees), and customers, to integrate the 'voice of the environment' into decisions on product design and development (Hunt and Auster 1990; Welford 1993). Hence, stakeholder engagement is the centre of an effective product stewardship strategy.

A few studies have confirmed some of the theory's propositions about product stewardship. For example, Sharma and Vredenburg (1998) studied the link between proactive corporate environmental strategy and the competitive capability of the firms in the Canadian oil and gas industry. They found that firms that incorporate product stewardship into their environmental strategy tend to be more proactive and exhibit greater stakeholder integration than those with no product stewardship strategies. Notwithstanding the importance of product stewardship in enhancing firms' environmental sustainability, Hart and Dowell (2011) found that the NRBV product stewardship capability is under-researched. This position is crucial to the current study as its conceptualisation is related to the link between GSCM, strategic capabilities and competitive advantage within the context of the O&G industry.

2.6.1.3 Sustainable development

Sustainable development as a strategic capability in the NRBV theory focuses on the need for organisations to reduce the negative impacts of their operations globally (Hart 1995). Its notion could be linked with sustainability principles entrenched in the 1987 Brundtland Report. It also contemplates Elkington's (1998) TBL concept earlier discussed in section 2.2.1. Its conceptualisation is based on the idea that organisations operating in the developed world (which accounts for over 80% of the world's economic and industrial activities, but 20% of the world population) should adopt strategies that foster development also in the developing world, with the larger share of the world population and consumption (Hart 1995).

Fundamentally, NRBV's sustainable development strategy is informed by the need for firms to realise that production and consumption activities could trigger environmental and social problems globally (Hart and Dowell 2011). For instance, supplying every household in China and India with cars and refrigerators produced with conventional technology (prone to high GHG emissions) can permanently distort the earth's atmosphere. Hence, firms need to acquire cleaner technology that minimises the impacts of their products and operations on the entire globe (Hart 1995). To this end, Hart and Dowell (2011) argue that sustainable development strategy at the firm level transcends beyond merely minimising environmental damages but emphasises the need for organisations to focus on strategies that help to reduce the negative impacts of the current and future production indefinitely. Interestingly, a review of the applicability of NRBV after its fifteen years of existence suggests that the strategy of Sustainable development within its framework has not been included in any empirical research (Hart and Dowell 2011). Also, the NRBV sustainable development strategy is reclassified into two new strategic environmental management capabilities: clean technology and base of the pyramid capabilities, as depicted in figure 2.3.

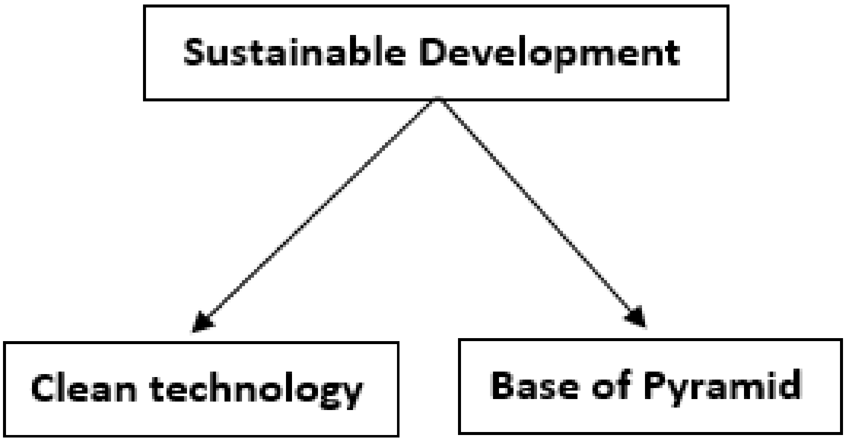

Figure 2.3: New elements of the NRBV sustainable development capability

The emergent strategic capabilities associated with the sustainable development strategy of NRBV are discussed below.

2.6.1.3.1 Clean technology

According to Hart (1997), clean technology, which is the advanced stage of pollution prevention and product stewardship, is targeted at firms' development of strategic capabilities that enhance their ability to pursue positive impact of operations on the entire global environment. Thus, while pollution prevention and product stewardship capabilities help firms minimise operational effects from the internal operations and product management perspectives, clean technology focuses on applying radical innovations to eliminate the global environmental impact of a company's products and operations (Hart and Dowell 2011). Therefore, firms targeting clean technology capabilities must proactively invest in future technological innovations to enjoy the competitive advantage of future positioning (Hart 1997; Hart and Dowell 2011). For example, since decarbonisation through the use of renewables is the focus of today's research in the energy industry, firms committed to developing capabilities for clean technology should begin to seek technological innovations for the adoption and commercialisation of non-renewables. In essence, the idea behind clean technology capabilities is to transition from traditional routines and processes to support the creative redesign of conventional industries so that sustainability practices are optimised in a global context (Hart and Milstein 1999). In this wise, Pernick and Wilder (2007: 2) define clean technologies as:

'Any product, service or process that delivers value using limited or zero non-renewable resources or creates significantly less waste than traditional offerings'

The above definition suggests that firms should continuously seek a paradigm shift in their products, processes, and service offerings to develop innovative ways of doing things to eliminate damaging traditional practices. Consequently, several areas of clean technologies have been explored in the extant literature. However, research on clean technology is highly fragmented, with a limited link to GSCM and SSCM practices (McDougall, Wagner and MacBryde 2019) by researchers. One of the earliest attempts is Hart and Dowell (2011), who discussed the prioritisation of biotechnologies and bioengineering as a conventional clean technology among manufacturers. Similarly, Bjornali and Ellingsen (2014) focused on firms' adoption and commercialisation of solar, wind, hydropower energy, sustainable transportation, and green buildings. Pernick and Wilder (2007) categorised clean technologies into four different classes. These are energy technologies comprising solar and wind energy; smart grid and mobile applications; transportation technologies in the form of hybrid and electric cars; water technologies including water filtration, desalination technology, and nanotechnologies; and material technologies comprising green construction, biofuels, and biomaterials.

Regardless of the clean technology taxonomy, clean technology capabilities largely depend on firms' vision, entrepreneurship, and innovativeness (Hart and Milstein, 1999; Hart and Dowell, 2011). This is because the execution of an effective clean technology strategy is not a mere development of incremental innovations needed for pollution prevention and product stewardship capabilities (Hart and Dowell, 2011). Clean technology deployment capability entails the ability of firms to develop radical innovations that activate a complete metamorphosis in processes and product offerings (De Stefano, Montes-Sancho and Busch 2016; McDougall, Wagner and MacBryde 2021). Therefore, the development of clean technology capabilities is linked to many factors in an organisational context. These include a clear vision and the ability to manage and create disruptive changes in the form of creative destruction (Hart and Milstein 1999). It also involves organisational-wide future positioning and technology cannibalisation strategies (Hart and Dowell 2011). In addition, firms targeting clean technology capability are required to demonstrate the political acumen to overcome policy, legislative and regulatory roadblocks (Bjornali and Ellingsen 2014). However, the degree of empiricism of clean technology in NRBV is still under-researched, even in the face of the 21st-century drive for energy transition and clean-tech revolution (Pernick and Wilder, 2007). This has therefore constituted an area of research interest in the current study.

2.6.1.3.2 The base of the Pyramid

As earlier highlighted, the base of the pyramid is the second sub-categorisation of sustainable development NRBV strategic environmental capabilities (Hart and Dowell 2011). Unlike clean technology, the base of the pyramid capability highlights corporations' responsibility to alleviate social ills, global poverty and stimulate economic development in emerging markets (Hart and Christensen 2002; Hart and Dowell 2011). The argument behind the base of pyramid capabilities is that firms can remain profitable despite focusing on transacting business with the world's underprivileged to reduce global poverty (Hart and Milstein, 1999). This is based on the premise that the market existing in the developing world may present the opportunity for significant growth for firms (London and Hart 2004). It may also create an opportunity to explore innovations with a lower degree of risk (Hart and Christensen, 2002). After that, working innovations in the emerging markets can be adapted to the domestic and existing markets, thereby minimising operational and market disruptions (Hart, Sharma and Halme 2016; Hart and Dowell 2011; Prahalad and Hart 2002). Therefore, it can be logically deduced that the base of the pyramid strategy is complementary to the clean technology capabilities because firms can experiment with clean technology innovations at the base of the pyramid markets with a high degree of environmental and social degradation (Prahalad and Hart, 2002; Hart and Dowell 2011). This can also reduce poverty through enhanced living standards in emerging markets (Arnold and Valentin 2013).

Notwithstanding the above, the applicability of the NRBV base of the pyramid concept has remained under-researched in the extant literature. For example, a study by McDougall, Wagner and MacBryde (2019) cannot empirically confirm elements of the Base of pyramid strategies in the UK Agri-food industry, despite the presence of other NRBV strategic environmental capabilities. The above has constituted the need to conduct further research into the base of pyramid strategy in different industries and countries. Having discussed the NRBV strategic environmental capabilities in this sub-section, the following subsection reviews literature around strategic resources as the antecedents of the NRBV strategic environmental capabilities as conceptualised in the original framework (Hart 1995).

2.6.2 Strategic resources

The concept of resources and capabilities concerning competitive advantage is the epicentre of the RBV and the NRBV (Barney 1991; Hart 1995). The theoretical links between these variables date back to the 1959's works of Penrose (Penrose and Penrose 2009), which suggest that an organisation's success and growth are based on its ability to manage its resources effectively. Later, Rubin (1973) portends that a group of resources needs to be well-aligned for the organisation's success. Rooted on these principles, Wernerfelt (1984) theorised the resource-based view (RBV) of the firm, arguing that firms can derive sustainable competitive advantage from specific resources and capabilities which firms have developed over time.

Interestingly, the boundary between resources and capabilities in the original conceptualisation of RBV is not clearly demarcated (Andersen and Kheam 1998). Specifically, Barney (1991) considers resources as all assets and *capabilities* at the disposal of firms to conceive and implement strategies for enhancing the effectiveness and efficiency of operations. This, in effect, suggests that Barney's (1991) conceptualisation of '*resources'* also includes capabilities. Such examples are also seen in Bartlett and Ghoshal (1991), who depict marketing competence and management capability as critical resources for firms' strategic pursuits. To address this, Grant (1991) contends that there is a need to distinguish between resources and capabilities in an organisation clearly. Therefore, Grant (1991) argues that while resources are firms' production inputs such as 'capital equipment, finance, skills of individual employees, patents, brand names finance, etc., capabilities are the abilities of a combination of resources to accomplish tasks for firms.

Having established a difference but the interrelated relationship between firms' resources and capabilities above, it is also essential to state that firms cannot derive a competitive advantage from all available resources (Barney 1991). According to Powell (1992), firms sustained competitive advantage is tied explicitly to those strategic resources that are scarce, difficult to copy, non-substitutable, and not readily available to the competitors. More concisely, Barney (1991) portends that strategic resources that would confer a sustainable competitive advantage on firms must be valuable, rare, inimitable, and non-substitutable. This is usually termed the VRIN concept in strategic management. For this purpose, valuable resources enable firms to take advantage of opportunities while neutralising threats in external environments. Also, rare resources are generally limited in supply, while inimitable resources are difficult to copy by competitors because they are socially complex and causally ambiguous. Finally, non-substitutable resources are irreplaceable by other resources (Lockett, Thompson and Morgenstern 2009).

Although the competitive outcome of resource utilisation could vary (Collis and Montgomery 1995), the extant literature has focused significantly on the economic gains attributable to resource utilisation (Grant, 1991; Powell, 1992; Priem and Butler 2001), generally providing academic support for the theoretical position. Nevertheless, other scholars, for example, Lockett et al. (2009), have also criticised the nexus between resources and competitiveness, hinging their arguments based on tautology and ambiguity noted in the RBV theory. Furthermore, the critics of RBV have decried the impracticability of the theory on the ground that the tacit nature of strategic resources and their conceptual focus on scarcity, inimitability and non-substitutability is practically unattainable (Lockett, Thompson and Morgenstern 2009; Priem and Butler 2001).

Notwithstanding the foregoing, the position of the RBV on the relationship between resources and competitiveness is strengthened by the scholarly argument that such a relationship is based on complexity (Barney 2001; Peteraf and Barney 2003). In effect, the utilisation of heterogeneous resources can also result in heterogeneous competitive results (Hitt, Xu and Carnes 2016), derived through the relevant capabilities, but with no guarantee that firms will always realise such gains (Amit and Schoemaker 1993). Therefore, it is argued that even though the proper deployment of the right combination of resources may enhance competitiveness (Peteraf and Barney 2003; Hitt, Xu and Carnes 2015), such a result is not automatic and can significantly vary across firms (Lockett et al. 2009).

Resources are of various types, such as capital equipment, financial resources, employees' skills and knowledge, brand name, and so on (Grant 1991). Essentially, resources can both be tangible and intangible. However, the NRBV seems to emphasise intangible resources (Hart 1995; Hart and Dowell 2011). Specifically, Hart (1995) stated that continuous improvement drives pollution prevention capabilities, while the resources of stakeholder integration drive the attainment of product stewardship capabilities. Furthermore, Hart and Dowell (2011) assert that the resources of disruptive change and embedded innovation enhance the strategic capabilities of clean technology and the base of the pyramid, respectively. Arguably, continuous innovation and stakeholder collaboration are critical resources in NRBV (McDougall, Wagner and MacBryde 2019), as they appear to be interwoven with other resources. For example, for disruptive change to occur, firms require collaboration with stakeholders to generate innovations. This is more important considering that the NRBV strategic capabilities are dynamic capabilities that need continuous and proactive modification to align with constant changes in the business environment (Hart and Dowell 2011; Teece, Pisano and Shuen 1997).

2.6.3 Competitive advantage

Competitive advantage reflects how a firm can defensively position itself above the competition in the market (McGinnis and Vallopra 1999; Porter 1985). Predominantly, it is rooted in the ability of firms to capitalize on economic values created to dominate and control the market to their advantage (Helfat et al. 2009). Focusing on competitive advantage, firms can combine capabilities with critical management decisions to differentiate themselves from the competitors in the market (Tracey, Vonderembse and Lim 1999). From the extant literature, competitive advantage has been studied from various perspectives. Porter (1985) studied the factors that drive competitive advantage in industries. He proposed his *'five competitive forces model,* which includes the threat of new entrants, bargaining power of suppliers, threat of substitute products and services, bargaining power of buyers, and rivalry among existing firms to evaluate an industry's competitiveness.

Further, Porter (1985) argues that a firm's competitive advantage is rooted in two factors: *cost and differentiation*. The ability of a firm to provide an above-average performance through low cost (cost leadership) and unique products (product differentiation) will lead to a sustained competitive advantage. Also, from the Resource-based point of view (RBV), Barney (1991) delineates competitive advantage as benefits to a firm from implementing a value-generating strategy that is not available to any current or potential competitor. Thus, the ability of resources and capabilities to confer a competitive advantage on a firm is dependent on the uniqueness of the value created (Porter 1985) through such resources and capabilities.

Sequel to globalization and increasing customization, competition among firms (Vokurka, Zank and Lund Iii 2002), especially in the manufacturing sector, has witnessed continuous growth over the years (Vokurka, Zank and Lund Iii 2002). Consequently, firms' approach to competition has moved beyond inter-organizational strategy to the involvement of supply chains in competitive strategies (Hult, Ketchen and Arrfelt 2007; Vokurka, Zank and Lund Iii 2002). To this end, organizations are capitalizing on their supply chain activities as excellent sources of value and competitive advantage for business continuity (Burgess, Singh and Koroglu 2006). One way the supply chain could be activated for competitive advantage is by the infusion of sustainability practices into the concept of SCM, as earlier reiterated. Therefore, considerable efforts have been dedicated to studying the nexus between sustainability and organizational performance to identify sources of competitive advantages in harnessing environmental and social deliverables with business capabilities (Hart 1995, Hart and Milstein 2003). For example, Markley and Davis (2007) investigated the link between organizational performance and GSCM by using the combination of the NRBV and the TBL. The authors suggest that strategic integration of stakeholders' perspectives within the sustainability dimensions across a supply chain can enhance firms' competitive advantage. Similarly, Hsu, Tan and Mohamad Zailani (2016) portend that reverse logistics can culminate into a competitive advantage by enhancing firms' goodwill through customers' loyalty.

A plethora of studies have identified various sources of competitive advantage (Handfield and Pannesi 1995; Kessler and Chakrabarti 1996; Koufteros, Vonderembse and Doll 2002; Li et al. 2006; Skinner 1985; Stalk 1988; Tracey, Vonderembse and Lim 1999; Vesey 1991; Zhang and Lado 2001). These include a wide range of factors such as price/cost, quality, delivery dependability, product innovation, time to market, flexibility, and customization. The commonly cited sources of competitive advantage are presented in table 2.5.

Table 2.5: Commonly cited sources of Competitive advantage.

Element of CA	Definition/perception	Sample References
Cost/Price	Using low-cost position/aggressive pricing strategy	Porter (1985); Day (1994); Hart (1995); Le and Lei (2018); Liberman (2021);
Quality	Capability to firms to produce value that fulfil consumers expectation	Tracy et al (1999); Li et al (2006); Richardson and Shaddon (2011); Le and Lei (2018); Ding et al. (2019)
Delivery dependability	Unique focus on an effective correct, complete and timely delivery of customers' orders	Slack (1991); Harrison and Van-Hoek (2008); Hsu, Tan and Mohamad Zailani (2016); Siahaan and Nazaruddin (2020)
Innovativeness	Ability to rapidly meet changing customers' expectation with innovative products	Koufteras et al (2002); Bonnet et al (2007); Pagell and Wu (2009); Chen 2018; Hossain, Kannan and Raman (2021)
Time to market	Shortening product development process, time-mover advantage	Vessey (1991); Li et al. (2006); Peng et al. (2011); Rekilitis et al. (2021)
Flexibility	Ability to quickly adapt strategies to rapid changes in the environment	Gutpa and Goyal (1989); Palandeg et al. (2018); Makhloufi et al. (2021)
Customization	An idea fuelled by increasing individualism of customers creating opportunity for personalised products and delivery	Gunasekaran and Ngai (2005); Hendry (2010); Adamik (2019); Madhavaram (2021)

Whereas the above list is not exhaustive, one exciting notion in the literature is that other studies have related GSCM to dynamic capability for competitive advantage within the NRBV theory concept (Beske 2012; Beske, Land and Seuring 2014). The NRBV and GSCM concerning this have been previously discussed.

2.6.4 Linking GSCM with NRBV strategic capabilities

The extant literature suggests that both NRBV and GSCM are in perfect alignment, as such attempts have been made to establish the meeting points between the two concepts (Guang Shi et al. 2012; McDougall, Wagner and MacBryde 2021; Yunus and Michalisin 2016). This is because sustainability through collaboration is the focal point of both GSCM and NRBV. Thus, it can also be argued that GSCM is contemplated throughout the NRBV literature (Hart 1995; Matopoulos, Kovács and Hayes 2014; Johnsen, Howard and Miemczyk 2014). This can be logically inferred from the notion that sustainability falls within the supply chain domain (Nishat Faisal 2010). Thus, attaining sustainability depends on each partner's ability in a supply chain to make meaningful contributions (Abbasi and Nilsson 2012; Gimenez and Tachizawa 2012; Miemczyk, Johnsen and Macquet 2012; Seuring and Müller 2008). This is further supported by the argument that supply chain management should be fashioned as a strategy to protect the environment and conserve natural resources (Matopoulos, Kovács and Hayes 2014). Therefore, some researchers have attempted to establish a direct linkage between GSCM practices and NRBV strategic capabilities.

Guang Shi et al. (2012) conceptualised the GSCM-NRBV structural model linking the NRBV to GSCM, where all the elements of GSCM were categorized into intra-organizational and inter-organizational environmental practices. Accordingly, Intra-organisational practices are described as tacit internal GSCM practices linked with the NRBV pollution prevention capabilities. On the other hand, inter-organizational environmental practices comprise the socially complex GSCM practices of green purchasing, green distribution, and design for the environment, linked with the NRBV product stewardship capabilities. As an integrative framework, Guang Shi et al. (2012) expressed causal relationships between the environmental practices and performances in terms of operational, financial, and ecological measures. Furthermore, the authors conceptualized stakeholder pressure factors as the key drivers of the GSCM-NRBV practices. Although the arguments behind the framework appear compelling, the study lacks empirical evidence. Also, the framework sufficiently ignored the sustainable development element of the NRBV.

Yunus and Michalisin (2016) also attempted to align NRBV capabilities with GSCM practices. Following the works of Hsu and Hu (2008), the authors identified a wide range of GSCM practices, which were later categorized under three GSCM investments, namely upstream supply chain, internal supply chain, and downstream supply chain investment. Elements under each category were linked with the NRBV pollution prevention, product stewardship, and sustainable development capabilities, leading to developing a theoretical model of GSCM-NRBV and sustained competitive advantage. While this is perceived as another great attempt to find the meeting points between SSCM/GSCM and NRBV, the proposed framework failed to incorporate the strategic resources that enhance the impact of GSCM-NRBV relationships on sustained competitive advantage. Also, the framework does not include the NRBV clean technology and the base of pyramid capabilities. Furthermore, the framework lacks empirical validation, putting it in the theoretical realm.

McDougall, Wagner and MacBryde (2021) took a more holistic approach to relating GSCM/SSCM with NRBV. Unlike the previous attempts (Guang Shi et al. 2012; Yunus and Michalisin 2016), the authors specifically identified sustainability practices related to the NRBV and pollution prevention, product stewardship, clean technology and base of pyramid capabilities. In addition, the authors successfully linked NRBV and SSCM relationships with Teece, Pisano, and Shuen's (1997) dynamic capabilities of sensing, seizing and transforming. However, one of the shortcomings of this study is that the relationships between the NRBV capabilities and SSCM are not linked with a competitive advantage as contemplated in NRBV and GSCM literature (Barney 1991; Grant 1991; Hart 1995; Hart and Dowell 2011). Also, the framework proposed in the study has not been empirically validated, just like in the previous studies. Nevertheless, the framework presented in this study provides a reasonable basis for addressing some of the research objectives of the current study.

Based on the extant literature, the specific areas of alignment between GSCM and the four NRBV strategic capabilities are presented below.

2.6.4.1 Pollution prevention and GSCM practices

Implementing advanced waste management techniques to improve efficiency, quality, and environmental performance while reducing operating costs is a critical alignment between GSCM and pollution prevention capabilities (McDougall, Wagner and MacBryde 2021). In GSCM literature, various practices related to waste management, resulting in a possible derivation of financial rewards, are commonly researched (Markley and Davis 2007; Miemczyk, 2012). Consistent with Hart (1995), Sarkis, Zhu and Lai (2011) argue that pollution and waste management are internal GSCM operations. This is also contemplated by Guang Shi et al. (2012), who depicted pollution prevention as the only NRBV strategic capability aligned with their conceptualized intra-organizational environmental practices. This view is without prejudice to other studies that suggest that firms may collaborate with external stakeholders to enhance their pollution prevention capabilities (Sharma and Vredenburg 1998b). More specifically, figure 2.4 depicts that GSCM is interlinked with NRBV pollution prevention capability in three significant areas: intra-organizational practices, environmental management system (EMS), and lean practices (Guang Shi et al. 2012; McDougall, Wagner and MacBryde 2021). These are discussed below:

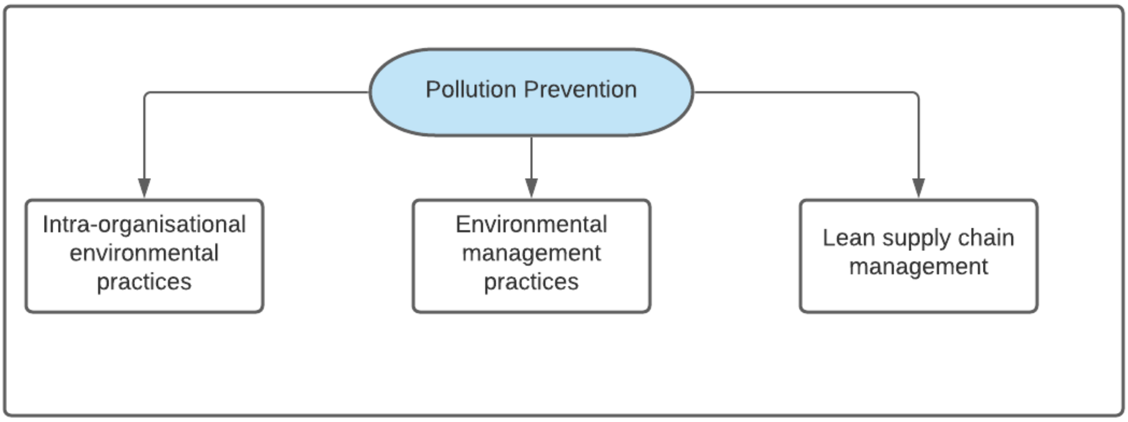

Figure 2.4: A framework of NRBV pollution prevention and GSCM linkage

- **Intra-organizational environmental practices (Intra-OEPs)**

Guang Shi et al. (2012:56) define Intra-OEPs as *"proactive environmental practices that account for all energy, material consumption, and waste related to an organization's in-house processes".* This definition aligns with the conceptualization of pollution prevention as a capability that relies on internal resources such as employees' support and total quality management (TQM) to proactively reduce effluent and emissions from operations (Hart 1995). Guang Shi et al. (2012:56) linked NRBV pollution prevention with Intra-OEPs. Based on their definition, several GSCM practices are related to Intra-OEPs. For example, internal environmental policies, specific enterprise-wide recycling techniques, and similar practices linked with Intra-OEPs have been examined in the literature (Zhu, Sarkis and Lai 2008). Indeed, Luthra et al. (2014) corroborate the Intra-OEPs categorization by establishing that GSCM literature emphasizes the significance of internal operational practices such as eco-friendly materials, the substitution of hazardous materials, and recyclability. These are also found to be compatible with NRBV.

- **Environmental management systems (EMS)**

Hart (1995) emphasizes that pollution prevention is linked with the concept of Total quality management. Furthermore, total quality environmental management features prominently in the NRBV literature (Aragón-Correa and Sharma 2003; Guang Shi et al. 2012). These environmental management systems are also well discussed in the GSCM literature in relation to waste reduction and cost minimization (Seuring and Muller 2008), thereby creating a verifiable linkage between EMS and pollution prevention (Guang Shi et al. 2012; Hajmohammad et al. 2013). Notably, ISO 14001 certification on EMS features prominently in GSCM concerning pollution prevention (Guang Shi et al. 2012; Hajmohammad et al. 2013). Indeed, a wide range of practices on EMS is also recorded in the literature concerning GSCM and NRBV (McDougall, Wagner and MacBryde 2021). While the current study does not intend to reproduce these practices, it is considered expedient to empirically establish the extent of EMS in the Nigerian O&G industry in relation to pollution prevention.

- **Lean practices**

Lean is defined as *"inter-related, complementary and mutually reinforcing operating practices, often referred to as bundles, that aim at reducing or eliminating non-value adding activities throughout a product's entire value stream, within an organization and along with its supply network'* (Hajmohammad et al. 2013). This definition is also consistent with Hart's (1995) NRBV pollution prevention strategy because both concepts (lean and NRBV) focus on firms' capabilities for pollution and inefficiency reduction. Similarly, the lean orientation is arguably complementary and extensive to GSCM (Hajmohammad et al. 2013). Studies have equally suggested that lean and GSCM are complementary and inseparable (Galeazzo, Furlan and Vinelli 2013; Pagell and Shevchenko 2014; Wiese et al. 2015). Notwithstanding the above, other studies have also suggested that the relationship between 'greening' and 'lean' is complex and conflictive (Miemczyk 2012). Despite the above, lean is found to feature prominently in the relationship between NRBV pollution prevention and GSCM in waste and effluents reduction (Miemczyk, Johnsen and Macquet 2012; Sarkis, Zhu and Lai 2011).

2.6.4.2 Product stewardship and GSCM practices

Arguably, the link between NRBV and GSCM is most profound concerning product stewardship. This is because NRBV product stewardship capability is based on the need for firms to shift towards lifecycle environmentalism in collaboration with external stakeholders such as supply chain partners (Hart 1995; Miemczyk, Johnsen and Macquet, 2012) in product impact management. The NRBV literature suggests that product stewardship is premediated by supply chain strategies (Vachon and Klassen 2008; Ashby et al. 2012; Shi et al. 2012; Wu, 2013). General SSCM/GSCM practices such as green purchasing, green distribution, and design for the environment have been conceptualized as the elements of product stewardship under the inter-organizational environmental practices (Guang Shi et al. 2012). Also, critical supply chain concepts such as sustainable supply chain collaboration (Vachon and Klassen 2008; Johnsen et al. 2014; Miemczyk, Howard and Johnsen 2016) and closed-loop supply chain management (Hart and Milstein 1999; Vachon and Klassen 2008; Ashby et al. 2012; Golicic and Smith 2013; Matopoulos, Kovács and Hayes 2014) are linked with NRBV product stewardship capabilities. The established points of linkages between NRBV and GSCM are presented in figure 2.5, followed by a discussion on these.

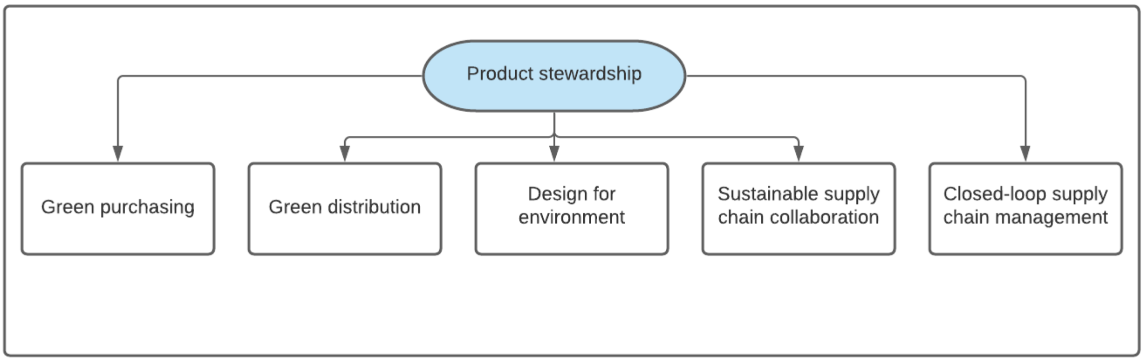

Figure 2.5: A framework of NRBV product stewardship and GSCM linkage

- **Green purchasing**

In their linkage of inter-organisational environmental practices (Inter-OEPs) with NRBV, Guang Shi et al. (2012) depict green purchasing as the first meeting point between GSCM and NRBV product stewardship. The above is also significant for realizing firms' environmental operations (Luthra et al. 2014). In SCM, purchasing and procurement activities are pivotal in organizations' orientation to sustainability and green practices infusion (Markley and Davis 2007). It has also been established that integrating green and sustainability practices into purchasing activities can enhance firms' competitive advantage (Esfahbodi et al. 2017; Vazifehdoust et al. 2013). Particularly, Vazifehdoust et al. (2013) stated that green purchasing activities' objective is to minimize the lifecycle impact of products on the environment. This position is also consistent with Hart's (1995) depiction of product stewardship based on firms' ability to collaborate with stakeholders to minimize the environmental impacts of products. Nevertheless, green purchasing must be integrated with other NRBV capabilities to explain product stewardship capabilities (McDougall, Wagner and MacBryde 2021). Guang Shi et al. (2012) acknowledge this position by depicting other Intra-OEPs as the elements of product stewardship capabilities.

- **Green distribution**

According to Guang Shi et al. (2012), the gamut of green distribution covers a wide range of sustainability practices such as eco-friendly waste management, eco-friendly packaging, eco-labelling, packaging take-back, product end-of-life recovery, and communicating the environmentally friendly products to consumers and use of green transportation. It has been established that logistics and transportation operations degrade the natural environment by releasing harmful emissions and effluents into the atmosphere during product distribution (Dekker, Bloemhof and Mallidis 2012; Jumadi and Zailani 2010). Consequently, logistics operations and distribution activities have been identified as a supply chain function suitable for implementing sustainability practices in terms of sustainable product management (Perotti et al. 2011; Miemczyk 2012). As an integral part of the product life cycle management (Hart 1995), Guang Shi et al. (2012) depict green distribution as the second element of the inter-OEPS in their NRBV-GSCM integrative framework. This is not out of place as previous studies have also linked green distribution with efficiency and cost minimization (Markley and Davis, 2007; Jumadi and Zailani, 2010; Langella and Zanoni, 2011).

Specifically, reverse logistics plays a pivotal role in linking GSCM and product stewardship. It featured significantly in Hart's (1995) NRBV discussion on product stewardship and was later emphasized in other studies (Miemczyk 2008; Ashby et al. 2012; Matopoulos, Kovács and Hayes 2014). According to Carter and Elram (1998), firms that build capacity in reverse logistics can enhance their environmental performances through material reuse, recycling, and reduction. Similarly, reverse logistics can contribute to firms' economic performance by reducing costs associated with material scrapping and handling hazardous materials while generating additional revenues from converting wastes to usable products. These are also consistent with the conceptual linkage of product stewardship to competitiveness in NRBV (Hart 1995; Hart and Dowell 2011).

- **Design for environment**

Design for environment (DfE) is emphasized in the original conceptualization of NRBV as a product stewardship strategy (Hart 1995). Also, Markley and Davis (2007) posit that DfE is crucial in linking NRBV and competitive advantage. Furthermore, Guang Shi et al. (2012) depict DfE as an integral part of inter-OEPs, forming NRBV product stewardship capabilities. The above is not surprising as DfE allows firms to modify their product design process to prioritize environmental factors toward realizing organizational benefits (Kurk and Eagan 2008). Consistent with the product stewardship strategy, DfE contemplates a lifecycle approach to prioritizing environmental impact minimization across every stage of the supply chain (Diwekar and Shastri 2011). In essence, DfE enables firms to develop products with minimum impacts from *'cradle to grave'* (Kurk and Eagan 2008). This creates an advantage of cost, operational and technical risk reduction, with improved efficiency, for firms (Diwekar and Shastri 2011). Therefore, firms can enhance their product stewardship capabilities through DfE (Guang Shi et al. 2012).

- **Sustainable supply chain collaboration (SSCC)**

SSCC exists when an organization directly involves *its suppliers and customers in planning jointly for environmental management and solutions* (Vachon and Klassen 2008: 301). According to Hart (1995), organizations develop product stewardship capabilities by cooperating with suppliers and other stakeholders to integrate the '*voice of environment'* into their product lifecycle. Similarly, Guag Shi et al. (2012) canvassed awareness seminars for suppliers in the area of the inter-OEPS to develop product stewardship capabilities. The above views are consistent with a body of literature that suggests that supply chain collaboration is essential for achieving sustainability objectives (Vachon, 2007; Seuring and Müller 2008; Abbasi and Nilsson 2012; Giminez and Tachizawa 2012; Miemczyk et al. 2012; Jensen et al. 2013). In this wise, it is argued that SSCC is a meeting point between GSCM and NRBV product stewardship capabilities (e.g. Vachon and Klassen, 2008; Johnsen et al. 2014; Miemczyk, Johnsen and Macquet 2016).

- **Closed-loop supply chain management (CLSCM)**

CLSCM is linked with NRBV product stewardship capability to incorporate forward and reverse logistics into the CLSCM (Jensen et al. 2013; Garg et al. 2015), which perfectly aligns with the life-cycle and recyclability concept of the product stewardship (Hart, 1995). Govidan et al. (2015: 603) define CLSCM as *'the design, control, and operation of a system to maximize value creation over the entire product life cycle with the dynamic recovery of value from different types and volumes of returns over time'.* Many strategic capabilities such as 'cradle-to-grave' reuse, product acquisition, refurbishment, product recycling and many more are embedded in CLSM (Jensen et al. 2013; Garg et al. 2015). Furthermore, CLSCM enables firms to reincorporate by-products and unsold products back into the supply chain to be re-applied for value-adding outputs (Ashby et al. 2012; Bell et al. 2012; Garg et al. 2015; Govindan et al. 2015). Undoubtedly, the above is in accordance with the NRBV product stewardship strategy. In this wise, Miemczyk et al. (2016) argue that CLSCM is a crucial driver of sustainable stewardship across the supply chain, thereby crediting the link between CLSCM and product stewardship.

2.6.4.3 Clean technology and GSCM practices

As earlier mentioned, clean technology emerged as a sub-category of the sustainable development strategy of NRBV fifteen years after the theory was initially propounded (Hart and Dowell 2011). Although clean technology as conceptualized in NRBV has not received sufficient attention within the GSCM literature, a growing body of literature on environmental technologies within the SCM literature provides insights into the linkage between GSCM and clean technology. The main areas of connection between clean technology and NRBV are depicted in figure 2.6.

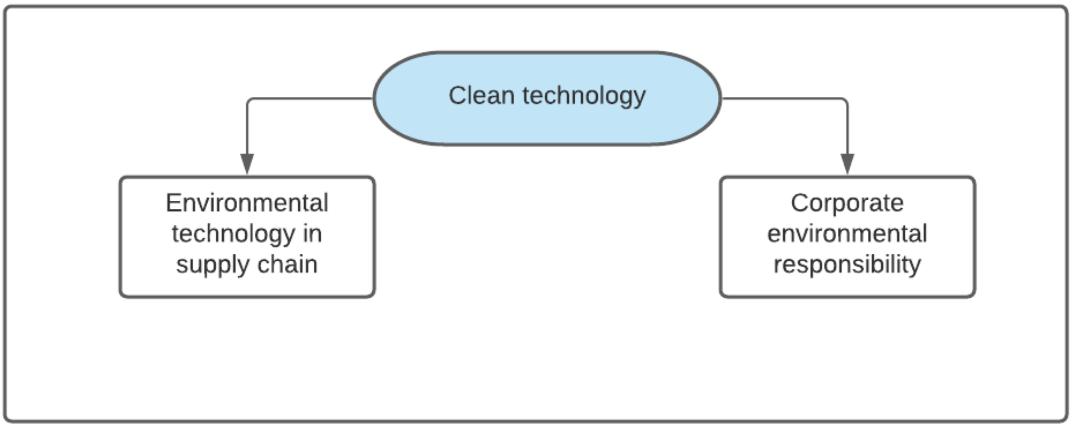

Figure 2.6: A framework of NRBV clean technology and GSCM linkage

- **Environmental technology in supply chain management**

Consistent with the NRBV clean technology strategic capability, the role of technology in protecting the natural environment is emphasized in the GSCM literature (Vachon 2007; Schrettle 2014). Various Problems emanating from ecological degradation will continue to create a market for environmental technologies (Weinberger, Jörissen and Schippl 2012). Consequently, different technology-related issues such as collaborative communication technology (Vachon 2007; Vachon and Klassen 2008), tracking technology (Prajogo and Sohal 2014), and supporting technology for environmental management systems (Hajmohammad et al. 2012) have been discussed in the GSCM literature. Of great relevance in this capacity is a significant focus of GSCM literature on green technologies similar to Hart and Dowell's (2011) clean technology capabilities. Such green technologies are directly linked with the actualization of sustainable operations for the enhancement of firms' competitive advantage (Ageron, Lavastre and Spalanzani 2013; Boons et al. 2013; Jensen, Munksgaard and Arlbjørn 2013; Khanchanapong et al. 2014; Prajogo and Sohal 2013; Szekely and Strebel 2013; Weinberger, Jörissen and Schippl 2012).

In GSCM, environmental technology is focused on technological innovations that simultaneously enhance performance and reduce damages from production (Schrettle et al. 2014). Biotechnology is an example of traditional environmental technology emphasised in NRBV (Hart and Dowell 2011) and

GSCM (Maloni and Brown 2006) as an approach to corporate social responsibility. Biotechnologies enable a firm to convert biological wastes to valuable output (Maloni and Brown), thereby innovatively preventing pollution (Hart 1997) while reducing cost and enhancing performance. According to Wu (2013), clean technology innovation is very dynamic. Nevertheless, Vachon (2007) posits that environmental management technology in production encompasses employees' involvement, green scheduling, and inventory management.

- **Corporate environmental responsibility (CER)**

Before the emergence of clean technology in the NRBV literature, corporate social responsibility (CSR) is linked with the NRBV sustainable development (Mencug and Ozanne 2005; Markley and Davis 2007). Kovács (2008) classified the environmental orientations within CSR as corporate environmental responsibility (CER). The author emphasised the role of stakeholder integration in developing processes and products that address environmental concerns from material sourcing to the global environment. Thus, CER's focus extends beyond internal practices but incorporates a global supply chain. This aligns with the sustainable development capability of NRBV (Hart 1995). Kogg and Mont (2012) noted that CER helps firms articulate a global operations life cycle. Therefore, CER is fostered by the ability of firms to continually generate environmental management innovations that improve the global reputation of organisations (Holtbrügge and Dögl 2012). Thus, considering the alignment of CER with the radical environmental innovation, which is also the core of the NRBV clean technology capability (Hart and Dowell 2011), McDougall, Wagner and MacBryde (2021) conceptualized CER as a point of alignment between NRBV clean technology and CER. They further linked the socially responsible supply chain with the NRBV base of the pyramid. Therefore, the current study also recognizes CER as a point of alignment between GSCM and NRBV clean technology in line with McDougall, Wagner and MacBryde's (2021) framework.

2.6.4.4 The base of the pyramid and GSCM practices

The base of the pyramid has received the least attention both in the NRBV and SSCM (GSCM) literature (McDougall, Wagner and MacBryde 2021). Nevertheless, the extant literature has attempted to identify the alignment between the two concepts. In its simplest form, the base of the pyramid focuses on alleviating social ills and promoting economic development that targets poverty alleviation in emerging markets at the pyramid's economic base (Hart and Christesen 2002; Hart and Dowell 2011). While this seems to be a firm's mere adoption of CSR practices, the letter and spirit of the base of pyramid capabilities appear deeper than CSR as it focuses on adopting a pragmatic approach to alleviate global social ills (Hart and Dowell 2011). Nevertheless, the base of the pyramid may still be interlinked with CSR on the surface. Markley and Davis (2007) made one of the earliest attempts to link NRBV with CSR in SSCM (GSCM). Although their study does not mainly discuss the base of the pyramid, its focus on activating CSR in GSCM within the NRBV to achieve sustainable development perfectly aligns with the base of the pyramid concept. However, the lack of empiricism constitutes a notable limitation of this study. The authors called for an empirical investigation of NRBV using the concepts discussed in the study. Based on the extant literature, figure 2. 7 presents the key areas of alignment between GSCM and NRBV Base of the pyramid.

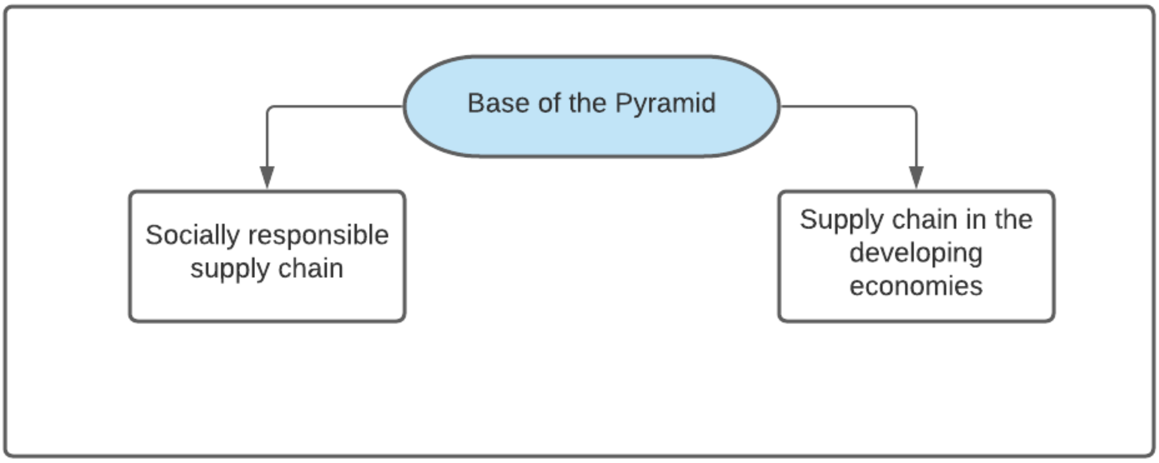

Figure 2.7: A framework of NRBV Base of the Pyramid and GSCM linkage

- **Socially responsible supply chain (SRSC)**

SRSC is a common area of agreement between NRBV and GSCM as both concepts prescribe social responsibility as a competitive strategy (McWilliams and Siegel 2001; Hoejmose et al. 2013). For this purpose, scholars have suggested that NRBV and SRSC are related (e.g. Menguc and Ozanne, 2005; Markley and Davis, 2007). Specifically, Arnold and Valentin (2013) elucidated the alignment between the NRBV base of the pyramid and SRSC. The authors posit that a company's base of the pyramid strategic capabilities are related to the degree to which social responsibility is infused into a supply chain. This is not surprising as the focus of social responsibility includes promoting human rights, poverty alleviation, and labour rights in the emerging economies of the global market (Markley and Davis, 2007; Arnold and Valentin, 2013). This is further reinforced by Kolk et al. (2014), who argue base of the pyramid strategy deemphasizes firms' traditional focus on profitability. This is consistent with the social dimension of CSR, which also deemphasized profitability (Carroll, 1979; Maloni and Brown, 2006).

- **Supply chain in the developing economies**

Hart and Dowell (2011) highlight the responsibility of firms to develop their base of the pyramid capabilities to focus on addressing poverty, human rights, unemployment, and similar vices in the developing economies and across the globe. Undoubtedly, this suggests the need for firms to consider the impact of their supply chain activities in developing economies. This is because transitioning into global markets has implications for supply chains (Klassen and Vereecke, 2012; Zsidisin et al. 2015) in terms of environmental impacts and resource utilization (Matopoulos, Kovács and Hayes, Kovács and Hayes 2014). According to Faisal (2010), the supply chains in developing economies are prone to various complexities, including control reduction, weak collaboration, poor information dissemination, and many more. Consequently, scholars have argued that infusing sustainability into the supply chain in the developing economies constitutes a significant challenge to firms (Faisal, 2010; Silvestre, 2015; Zsidisin et al. 2015), of which firms' resources may not be translatable into foreign markets, leading to loss of competitiveness (Darkow et al. 2015; Silvestre 2015). Nevertheless, Flynn et al. (2015) opine that extending the supply chain to the developing economies presents innovative and appealing opportunities for firms, thereby reinforcing the base of the pyramid capabilities. In this wise, Zsidisin et al. (2015) highlight the need for firms to acquire relevant knowledge in managing supply in developing economies.

2.6.5 Empirical research on NRBV strategic capabilities

To establish the state of empirical research on NRBV strategic capabilities, NRBV was combined with each strategic capability to form sets of keywords applied to search the literature. While this provides an element of structured and systematic literature search, it does not claim a systematic literature review. Indeed, the paucity of empirical research on NRBV capabilities (McDougall, Wagner and MacBryde 2019) makes a rigorous application of systematic literature review unattractive in this process. Nevertheless, the approach adopted created some replicability and transparency in the literature search. The keywords were applied to search five major academic databases: EBSCO, Emerald, Scopus, Science direct, and Google scholar. The main criterion for selection is that a study must empirically investigate at least one element of NRBV capabilities. Due to the multidisciplinary nature of NRBV (Hart and Dowell 2011), articles were not limited to the supply chain domain. Also, since NRBV was propounded in 1995, the literature search was performed on databases between 1995 and 2021, covering a twenty-six-year period. After reading through titles and abstracts, twenty-five articles (Please find the details in appendix A) were considered relevant. By analysing these articles, two objectives were targeted: One, to ascertain the extent of empirical investigation of NRBV capabilities, and; two, to determine the empirical link between the NRBV capabilities and firms' competitive performance.

As shown in figure 2.8, the review of the identified papers in Appendix A indicates that only one research paper (McDougall, Wagner and MacBryde 2019) examined all of the four NRBV capabilities earlier presented. 36% of scholars examined any three of the NRBV capabilities (Hastings, 1999;

Menguc and Ozanne, Fowler and Hope 2007; Chen et al. 2009; Michalisin and Stinchfield 2010; Hollban, Boteanu and Petrescu 2013; Masoumik, Abdul-Rashid and Olugu 2015; Anthony Jnr 2019; Al-Mutairi et al. 2019). Furthermore, 32% investigated any two NRBV capabilities. (Wong et al. 2012; Maas et al. 2014; Bhupendra and Sangle 2015; De Stefano, Montes-Sancho and Busch 2016; Gabriel et al. 2018; Graham 2018; Xie et al. 2020). Finally, 28% of the papers (Sarkis and Cordeiro 2001; Bhupendra and Sangle 2017; Ashby 2018; Dembek York and Singh 2018; Mishra, Chiwenga and Ali 2019; Ashraf et al. 2019; Andersén 2021) focused on only one NRBV capability. One interesting finding from the above is that some of the papers that examined three NRBV capabilities still treated the sustainable development capability as a single construct, rather than unbundling the capability into clean technology and base of the pyramid as suggested by Hart and Dowell (2011).

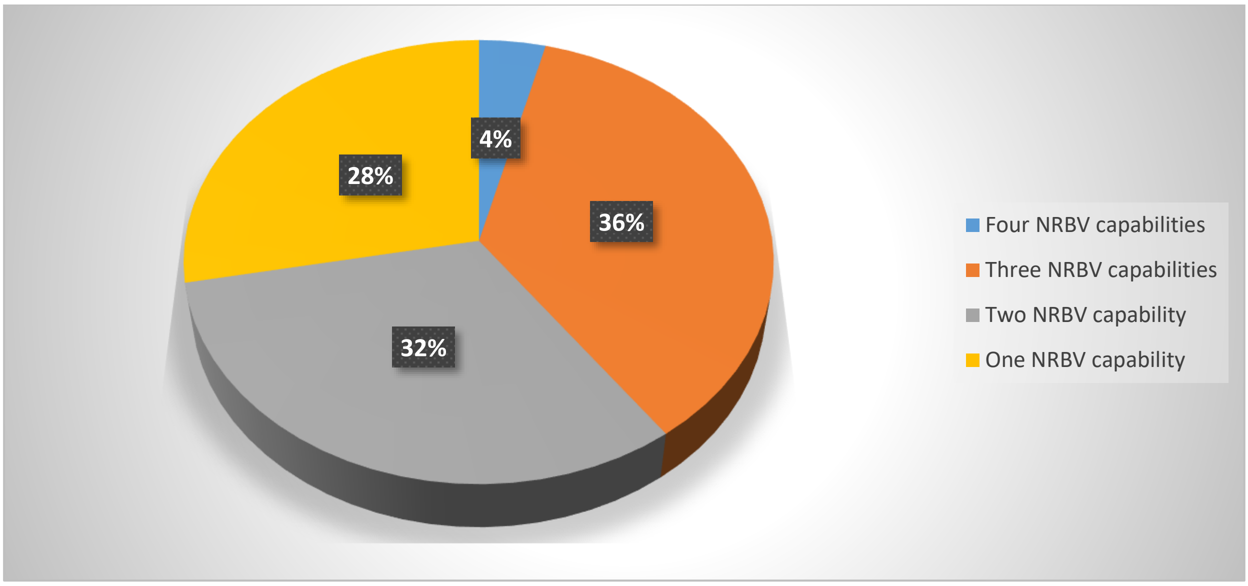

Figure 2.8: Empirical research on NRBV capabilities

Consistent with Hart and Dowell (2011), a further review indicates that pollution prevention has received more research attention than other NRBV capabilities. As shown in figure 2.9, this is followed by product stewardship capabilities. While clean technology capability ranks behind product stewardship, empirical investigation of the base of the pyramid is extremely low as only one study (Dembek, York and Singh 2018) adopted secondary data to develop a business model for addressing poverty at the base pyramid. Indeed, McDougall, Wagner and MacBryde (2019) could not empirically validate the existence of the base of the pyramid capabilities in the UK Agro-food industry.

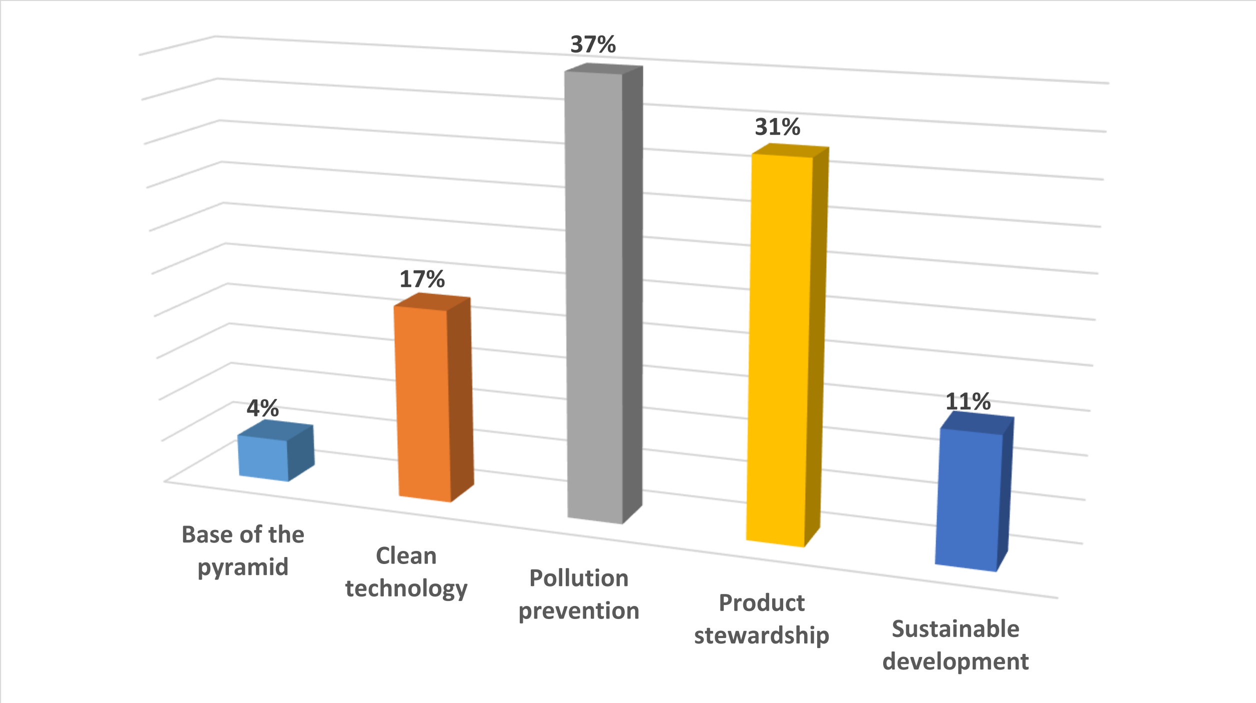

Figure 2.9: Percentage distribution of research focus on NRBV capabilities

The findings that clean technology and the base of the pyramid are the least researched elements of the NRBV capabilities are also consistent with Hart and Dowell (2011), who posit that the sustainable development elements of NRBV have not received any considerable research attention.

Another interesting finding from this analysis is that empirical investigation of the NRBV capabilities started to grow consistently since 2014, as indicated in figure 2.10. This peaked in 2019 when five papers empirically examined NRBV capabilities. The figure has dropped since 2020. The above may be linked with the impact of COVID-19, which has significantly affected the world, including the academic since 2020. Nevertheless, the trend in figure 2.10 suggests the need for further research in this direction.

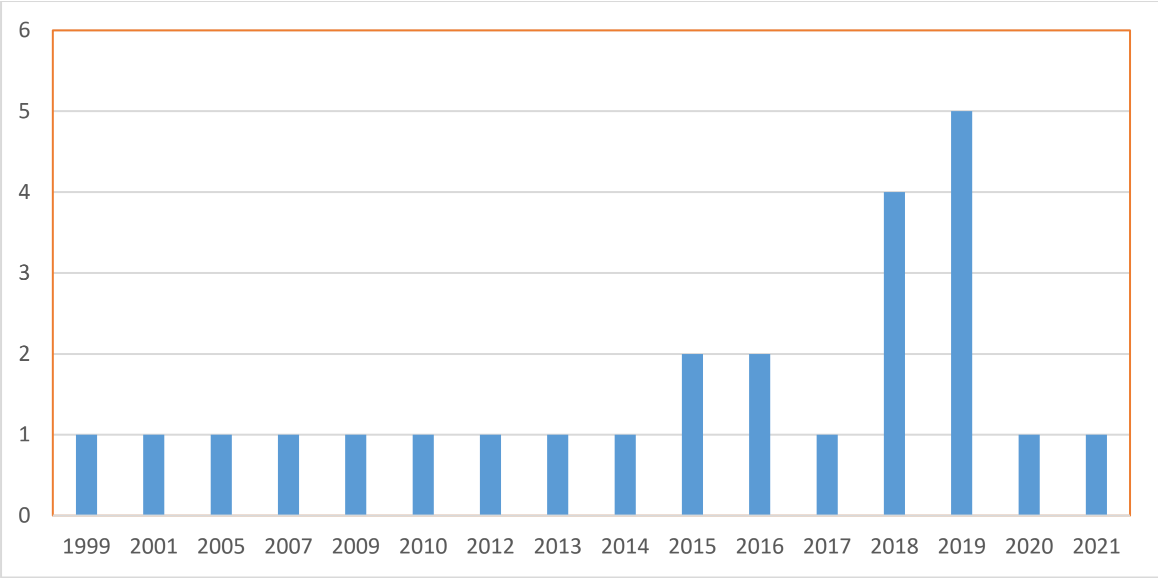

Figure 2.10: Trend analysis of empirical research on NRBV capabilities (1999 and 2021).

A further review of these studies reveals that most of the research focuses on developed economies. Many of these studies focus on the UK (McDougall, Wagner and MacBryde 2019; Ashby 2018; Graham 2018) and the USA (Sarkis and Cordeiro 2001; Gabriel et al. 2016). Available studies in developing economies focus mainly on India, Kuwait, Malaysia, and North Africa (Anthony Jr 2019; Bhupendra and Sangle 2015; Masoumik, Abdul-Rashid and Olugu 2015; Mishra, Chiwenga and Ali 2019). The author is unable to identify any study that focuses on Nigeria. The above becomes one of the gaps that this study attempts to address. Also, most studies to date focus on the manufacturing sector, apparel industry, and agro-food industry (Fowler and Hope 2007; Graham 2018; McDougall, Wagner and MacBryde 2019). Only one study examined NRBV capabilities in the O&G industry (Hastings 1999). Therefore, considering the polluting nature of the O&G industry, it is contended that further research on the impact of NRBV capabilities on the competitiveness of O&G firms is required.

2.6.5.1 NRBV capabilities and competitive advantage

Many studies have attempted to establish the impact of the NRBV strategic capabilities on firms' competitive performance, with the findings showing mixed results. Regarding pollution prevention, Chan (2005) conceptualized the capability as part of environmental strategies to examine the practicability of the NRBV among the Chinese foreign-invested companies. Using structural equation modelling, the author empirically confirmed the applicability of NRBV in China, with environmental strategies (inclusive of pollution prevention) impacting positively on firms' environmental and financial performances. Similarly, Mishra and Yadav (2021) considered pollution prevention capabilities an integral part of proactive environmental strategies (PES) to understand the relationships among environmental capabilities, PES, and competitive advantage in the Indian automobile industry. Using multiple hierarchical regression and bootstrapping of 162 questionnaire responses of firms operating in the Indian automobile sector, the authors found that PES (including pollution prevention) positively influences firms' competitive advantage.

To understand the impact of green information systems on organizational performance, Anthony Jr (2019) developed an NRBV eccentric model that examined the role of IT personnel's belief-action-outcome on the NRBV capabilities of information system (IS). The authors included NRBV pollution prevention, product stewardship, and clean development as catalysts for competitive performance. The results indicate that all the NRBV capabilities (including pollution prevention) positively influence environmental performance. Maas et al. (2014) applied multivariate regression and moderation techniques to analyse 202 questionnaire responses received from German third-party logistics service providers' top management officers on the impact of pollution prevention and product (conceptualized as service) stewardship on differentiation advantage. The results indicate that both pollution prevention and service stewardship enhance differentiation advantage. In the oil and gas industry, Hastings (1999) asserts that O&G firms that acquire new capabilities, including pollution prevention (represented as environmental management), may achieve a sustained competitive advantage in better access to oil fields in sensitive areas.

Notwithstanding the above, other studies have also empirically established that investment in pollution prevention capabilities can have a negative impact on firms' competitive performance. For example, Sarkis and Cordeiro (2001) applied multiple regression techniques to analyse the effect of pollution prevention on the financial performance of 430 firms operating across various industries in the USA. The author found that pollution prevention negatively impacts firms' financial performance. Similarly, Singh, Ma and Yang (2016) applied path-based analysis to a dataset gathered among 120 firms across the globe to examine the impact of environmental expenditures on firms' financial performance. The results indicate that ecological costs of pollution prevention have a negative effect on financial performance.

The empirical findings on the impact of product stewardship on the competitive performance of firms are also similar to the results obtained from the pollution prevention capability. According to Wong (2012), Taiwanese electronic manufacturing firms that dedicate efforts to developing product stewardship capability can improve their financial performance. Their conclusion is based on the analysis of 122 surveys conducted among Taiwanese electronic manufacturing companies. Furthermore, through regression and moderation techniques applied to analyse a dataset from third-party logistics service providers in Germany, Maas et al. (2014) found that product stewardship positively impacts the differentiation advantage of the logistics industry. In the same vein, in his study conducted across Malaysian industries, Anthony Jr (2019) found that all NRBV capabilities, including product stewardship capabilities, positively influence firms' environmental competitiveness.

Similarly, a study conducted by Al-Mutairi et al. (2019) among Kuwait manufacturers, through a combination of analytical hierarchy (HNP) and structural equation modelling (SEM), reveals that product stewardship has a more significant impact on cost and green competitiveness than pollution prevention and clean technology. This is also consistent with Singh, Ma and Yang (2016), who found that environmental expenditure on product stewardship positively impacts economic performance. However, these findings are contrary to Gabriel et al. (2018), who found that adopting a product stewardship strategy by a medical product supplying company in the USA has a more significant negative impact on the environment than the pollution prevention strategy.

Moreover, mixed results on the impact of product stewardship capabilities on firms' competitive performance are also noted in GSCM literature. For example, Diabat, Khodaverdi and Olfat (2013) analysed fifty (50) responses from the automobile industry and found that eco-design, supply chain collaboration, and reverse logistics aspects of product stewardship positively impact economic performance. Their findings are somewhat consistent with Green et al. (2012), who applied a structural equation modelling technique to analyse 159 responses from managers in the USA manufacturing sector. They found that eco-design and customer collaboration aspects of product stewardship are positively associated with firms' economic and environmental performance. Interestingly, the study further revealed that the green purchasing aspect of product stewardship negatively impacts competitive performance. In contrast to the above, the results of the analysis of 109 survey responses collected from purchasing and supply managers in Germany revealed that the supplier collaboration aspect of product stewardship has a negative impact on economic, competitive performance, represented by purchasing performance (Large and Thomsen 2011).

Concerning clean technology capabilities, Holban, Boteanu and Petrescu (2013) analysed quantitative data received from 430 Romanian agricultural companies and found that investment in clean technology generates economic benefits while improving environmental compliance. Thus, clean technology investment enhances economic and environmental competitive performance. Also, Masoumik, Abdul-Rashid and Olugu (2015) applied structural equation modelling to examine the impact of green strategy adoption on the competitiveness of ISO 14001 certified manufacturers in Malaysia. The authors found that clean technology has received the least attention in the industry despite generating competitive benefits. Comparing clean technology with product stewardship innovations in the automobile industry, De Stefano, Montes-Sancho and Busch (2016) found that clean technology innovation has a more significant impact on CO_2 emission (environmental performance) than product stewardship innovation. Similarly, Anthony Jr (2019) found that clean technology (alongside pollution prevention and product stewardship) positively influences environmental performance. As earlier indicated, clean technology has not received sufficient research attention within the NRBV framework, thereby necessitating further research on the impact of clean technology capabilities on competitive advantage.

Finally, empirical study on the base of the pyramid capability is still emerging. The only empirical study identified in this area does not explicitly examine the impact of the capability on competitiveness (Dembek, York and Singh 2018). Instead, it developed a data-based business model for addressing poverty at the base of the pyramid. Similarly, McDougall, Wagner and MacBryde (2019) were unable to empirically validate the existence of the base of the pyramid capability in the UK agro-food industry. The above suggests that further research is required on the NRBV base of the pyramid capabilities.

2.6.6 Summary of conceptual literature review

As hinted in section 2.1, the first part of this chapter is conceptual. Sections 2.2 to 2.6 review the extant literature on sustainability and GSCM about the relevant theories. Having established that GSCM connotes an infusion of the TBL dimension into supply chain functions (Elkington 1998; Seurin and Muller 2008), it was found that there is a dearth of theory application in GSCM research (Touboulic and Walker 2015). Therefore, this becomes an area of interest to the current study, necessitating employing established management theories to examine real-life problems.

Among others, stakeholder theory and NRBV were compatible with this study's overarching aim. The stakeholder theory provides the lens to understand how the requirements and expectations can pressure firms to adopt GSCM practices (Freeman 1999). On the other hand, the NRBV portends that firms can attain sustained competitive advantage by utilising specific strategic resources to develop four strategic capabilities: pollution prevention, product stewardship, clean technology, and the pyramid base (Hart and Dowell 2011). Using the existing frameworks (Guang Shi et al. 2012; McDougall, Wagner and MacBryde 2021; Yunus and Michalisin 2016), conceptual linkages were created between relevant elements of GSCM and the four NRBV strategic capabilities. Thus, the four strategic capabilities provide a theory-based alternative for examining practical GSCM issues.

Combining stakeholder theory with NRBV concerning the overarching aim of this study, it is argued that stakeholder pressures drive firms to acquire the strategic resources and capabilities for GSCM implementation, resulting in a competitive advantage. This theoretical idea is expanded to propose the initial conceptual framework to be assessed in this research. The specific findings relating to the thematic areas are presented in table 2.6.

Table 2.6: Thematic summary of the conceptual literature.

Thematic Areas	Key Findings	Key Authors	Research Implications
Conceptualising GSCM	GSCM integrates environmental focus with the traditional economic orientation of SCM. There is paucity of theory-based research in GSCM literature Few theory-based research adopt five main theories: RBV/NRBV, stakeholders, institutional and transaction cost theories.	Elkington (1998); Zhu and Sarkis (2006); Carter and Easton (2011); Sarkis, Zhu and Lai (2011); Green et al. (202); Touboulic and Walker (2015)	Adoption of the relevant definition of GSCM that aligns with the purpose of this research. Adoption of NRBV and neo-institutional stakeholder theories in this research.
Stakeholders theory	Stakeholders' pressures are drivers of GSCM adoption Stakeholders vary on the degree of pressures exerted on companies Stakeholder theory is interlinked with institutional theory	Freeman (1984); Ansoff (2007); Darnall, Henriques and Sardosky (2010); Geng and Dai (2018); Sarkis, Gonzalez-Torre and Adenso-Diaz (2010): Wang, Li and Qi (2020)	Benchmarking stakeholders' pressures as the antecedent of GSCM in the research model. Investigating the most cogent stakeholder pressures driving GSCM in the O&G industry.
NRBV	NRBV integrate four strategic environmental capabilities (pollution prevention, product stewardship, clean technology and base of the pyramid) with the RBV logic. There is a theoretical link between NRBV strategic capabilities and GSCM, but it lacks empirical validation. Strategic resources are required to develop the NRBV strategic capabilities which may result in a sustained competitive advantage Competitiveness may be considered from various perspectives.	Hart (1995); Hart and Dowell (2011); Porter (1985); Rao and Holt (2005); Zhu, Sarkis and Geng (2005); Guang Shi et al. (2012); McDougall, Wagner and MacBryde (2021); Yunus and Michalisin (2016)	Conceptualising the NRBV strategic capabilities as the proxy of GSCM in the research model. Investigation of the empirical link between GSCM and NRBV in the O&G industry. Exploration of the key specific strategic resources that drive GSCM in the O&G industry. Consideration of competitiveness from the economic and environmental dimensions
Empirical study on strategic environmental capabilities	Research on NRBV strategic capabilities is fragmented. Few research integrates all the NRBV strategic capabilities Clean technology and Base of the pyramid capabilities have not received research attention. Findings on the impact of the NRBV strategic capabilities on competitiveness are conflicting and inconclusive	Hastings (1999); Menguc and Ozanne, Fowler and Hope (2007); Chen et al. (2009); Michalisin and Stinchfield (2010); Hollban, Boteanu and Petrescu (2013); Masoumik, Abdul-Rashid and Olugu (2015); Anthony Jnr (2019); Al-Mutairi et al. (2019) McDougall, Wagner and MacBryde (2019);	Developing integrative framework that considers all empirically validated NRBV strategic capabilities. Examination of the impact of all validated NRBV strategic capabilities on the competitiveness of the O&G industry.

Having presented the conceptual and the theoretical review in the previous sections. The second part of this chapter focuses on the O&G industry to contextualise this research within the Nigerian O&G industry. Thus, the state of research on sustainability and GSCM in the O&G industry is reviewed to identify the existing gaps in the literature.

2.7 Oil and Gas Supply Chain

The supply chain of the O&G industry is an integral part of the global supply chain (Urciuoli et al. 2014; Yusuf et al. 2014). It is uniquely based on highly engineering-intensive activities carried out in extremely environmentally sensitive areas (Ahmad et al. 2017a). It involves developing and transporting highly inflammable and toxic products across countries through various modes, such as barges, ships, rails, pipelines and trucks (Wan Ahmad, de Brito and Tavasszy 2016). Consequently, the O&G supply chain is inbuilt with extreme complexities and dynamism with far-reaching implications on the environment, health, and safety (Saad and Udin 2012). From the extant literature, scholars appear to differ in depicting a typical O&G supply chain. Whereas some studies adumbrate the O&G supply chain as a two-sector construct, made-up of the upstream and downstream sectors (Ahmad et al. 2016b), others categorize it into a three-sector structure, consisting of the upstream, midstream, and downstream sectors (Modarress, Ansari and Thies 2016) as depicted in figure 2:11.

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Figure 2.11: A model of three sectors O&G supply chain *(Source: Kilponen 2010).*

Notably, the industry's supply chain categorization difference is arguably more nomenclatural than conceptual. For this purpose, it is pertinent to note that the midstream sector is usually considered an integral part of the downstream sector in a typical two-sector O&G supply chain. However, following the view of Zhao and Chen (2014) that a clear description of an O&G supply chain is necessary for the effective implementation of any supply chain concept (strategies), the various segments of the supply chain are briefly discussed below.

2.7.1 The upstream sector

The upstream sector operations cover the exploration and production of crude O&G from offshore and onshore reserves (Ahmad et al. 2016). It is a sector that focuses on various geological, geophysical, and seismic activities to find deposits, test-drilling, and appraisal for commercial viability (Kilponen 2010; Modarress, Ansari and Thies 2016). In many nations, the upstream sector is usually dominated by large multi-national companies that operate through shared asset ownership (Green and Keogh 2000). Since exploration and production activities are kick-started in the upstream sector, the functionality of its activities serves as a determinant of the operations in the remaining sectors of the industry (Briggs, Tolliver and Szmerekovsky 2012). The SCM requires that suppliers' and contractors' activities be managed as fabrications by the supply chain contractors are usually the first phase that precedes actual production and exploration (Weijermars 2010). The above is the bedrock of a technical and complex supply chain that demands considerable operational caution as unsustainable practices in the sector have become a primary source of concern to stakeholders. Accordingly, most of the accidents with devastating effects on the environment occur in this segment of the industry (Ekiugbo and Papanagnou 2017).

2.7.1.1 Sustainability issues in the upstream sector

Due to the nature of its activities, the upstream sector is particularly prone to oil spillage, gas flaring, fire, deep water, and onshore exploration perils, resulting in substantial clean-up costs and many more. The impacts of these accidents are always very devastating (Gosden 2013). Apart from the above, the aquatic habitat is also contaminated with oil discharged through the washing of oil storage tanks and ballast water from oil-carrying vessels (Jernelöv 2010). The proportion of this type of discharge is arguably higher than accidental discharge into the marine environment in the 1970s (Jernelöv 2010). Parish et al. (2013) highlight many environmental problems associated with oil exploration and production. They include contamination of soil properties, water pollution with toxic and radioactive substances, biodiversity destruction, damaging mangrove and marine habitat, destruction of the animal food chain, Greenhouse gas emission, conflagration-inflicting spills, and agony of resettling affected communities.

Apart from the above, many social issues are also linked with the upstream sector of the O&G industry. Scholars have argued that many oil-producing nations are affected by corruption, poverty, unemployment, community-oil companies' conflicts, community displacement, destruction of cultural heritage, and many more (Anyanwu 2009; Anyanwu and Erhijakpor 2014; Brollo 2010; Ross 1999).

Furthermore, issues of the high cost of living, high crime rate, prostitution, and drug use are also known to be prevalent in oil-producing regions of the world (Karl 2007; O'Rourke and Connolly 2003; Omodanisi, Eludoyin and Salami 2014). In addition, upstream activities tend to trigger serious health issues in the host community due to exposure to toxic and radioactive materials during oil production (O'Rouke and Connolly 2003). For example, acute skin diseases, including asthma and acne, have been linked with the activities in the upstream sector (O'Rouke and Connolly 2003). A study conducted on the environmental and health impacts of petroleum projects in Chad further revealed that malaria and sexually transmitted diseases, mainly HIV grew rapidly among truck drivers who conveyed pipelines across the project location (Jobin 2003).

Given the above hazards and many others, too numerous to mention, the upstream sector has been consistently criticized for unsustainable practices (Yusuf et al. 2014). Consequently, many firms in this sector are making concerted efforts to be portrayed as sustainability-driven organizations by publishing sustainability reports that articulate their sustainability performances across the TBL (Ahmed et al. 2016). Nevertheless, a review of some selected global oil and gas firms (Chevron, BP, ExxonMobil, Shell, Total, CNPC, Saudi Aramco, Valero, Petrobras and ConocoPhillips) indicates sustainability reporting and performances are generally weak (Shneider et al. 2011). Hence, there is a need for further inquiry into adopting sustainability practices in this sector.

2.7.2 The midstream sector

The midstream sector comprises facilities and processes that connect the upstream and the downstream sectors (Kilponen 2010). It includes pipeline networks that move crude oil and natural gas from exploration points (passing through land and ocean) to refineries, distribution terminals, crude tankers, logistics and maritime transportation, and port operations (Modarress, Ansari and Thies 2016). In a typical two-sector O&G supply chain, the midstream sector is usually integrated into the upstream sector. Thus, the midstream activities focus on logistics management, including transportation and storage of crude oil, without any production or refining activities. While this sector also constitutes serious sustainability threats to society and the environment, the current research considers the midstream sector an integral part of the downstream sector, in line with previous studies (Yusuf et al. 2014; Ahmad et al. 2016). Therefore, the current study adopts the two-sector approach (upstream and midstream) to examine the O&G supply chain. This research treats the midstream sector as an integral part of the downstream sector.

2.7.3 The downstream sector

The downstream sector operations cover the distribution and transportation of petroleum products to the service stations and retail outlets (Pan, Liu and Li 2017). In addition, it covers refinery activities and marketing of refined products like gasoline, jet fuel, heating gas, and other products to the final consumers (Modarress, Ansari and Thies 2016). The peculiar nature of this sector is that it is the only segment of the O&G industry that directly links with the consuming public (Hamedi et al. 2009). To this end, various facilities such as petrochemical, power plants, gas distribution companies, petrol stations and individual consumers are involved in the sector (Jenkins and Wright 1998). The above process triggers the logistics activities that interlink the distribution of the derivatives to the appropriate customers through marketing activities (Jenkings and Wright 1998).

Undoubtedly, dedicated efforts are required to manage and coordinate complex relationships within and across the various segments of the supply chain. Therefore, multiple strategies have been contemplated within the extant literature. For example, Urciucoli et al. (2014) portend that an infusion of disruption strategies within the supply chain can serve as resilience against the risks of terrorism and piracy within the UK O&G industry. From the financial point of view, (Jacoby 2012) argues that two strategies of rationalization and synchronization are critical to cost management within the O&G supply chain. Modarress, Ansari and Thies (2016) prescribe outsourcing as an effective cost management strategy within the Persian Gulf O&G supply chains. However, the authors caution that outsourcing could generate distracting resistance within the supply chain. Therefore, to achieve efficiency in cost management within the O&G supply chain, Joshi et al. (2017) suggest that organizations should increase supply chain visibility, improve compliance, and enhance supplier collaboration. Notwithstanding the above, other studies have indicated that the downstream sector is highly prone to sustainability threats (Saad and Udin 2012). The following subsection discusses the common sustainability issues in the downstream sector of the O&G industry.

2.7.3.1 Sustainability issues in the downstream sector

The downstream activities commence from the refinery up to the disbursement of O&G products to the final consumers. The nature of crude oil and its derivatives, which are processed at the refinery using various technology, constitutes hazards to the environment (Ambitunni, Amezaga and Emeseh 2014). According to Thomson (2013), every refinery has at least a 10% chance of sustaining a significant accident. Similarly, the transportation of crude oil from upstream to the refinery and of the refined outputs from the refinery to depots through to the final consumers also negatively impact the economic, environmental, and social sustainability of firms and the society (Anifowose 2008; Jernelöv 2010; Omodanisi, Eludoyin and Salami 2014; Oviasuyi and Uwadiae 2010).

As earlier highlighted, oil spillage is a common environmental problem in the upstream sector. However, it is pertinent to note that oil spillages also occur in the downstream sector, with a relatively lower degree. Such spills could emanate through pipelines, refinery activities, ships, waste tank discharges, and low-quality products (O'Rourke and Connolly 2003). Unfortunately, spillages from downstream activities are largely unpublicized despite having significant negative impacts on sustainability (O'Rouke and Connolly 2003). For example, the spillages from pipelines into waters cause severe destruction in the aquatic habitats (O'Rourke and Connolly 2003). Regardless, solution-based attention appears to be channelled into spillages in the upstream sector. According to Jernelov (2010), while technological improvement and stringent regulations have recently reduced large-scale spillages in the O&G industry, there appears to be an increase in spills from pipelines and leakages. This may be attributable to several factors such as increasing the longer distance covered by the modern-day pipelines, weak pipelines, and dilapidated infrastructures with poor maintenance (Arnold 2006; Nwilo and Badejo 2006; Restrepo, Simonoff and Zimmerman 2009). In addition, vandalization of oil infrastructures by disgruntled stakeholders, as a way of expressing hostility and grievances for 'unfair' treatment against oil firms and the government (as typical in the Niger-Delta area of Nigeria), is also a major cause of oil spillages from pipelines (Anifowose 2008; Jernelöv 2010; Omodanisi, Eludoyin and Salami 2014; Oviasuyi and Uwadiae 2010).

The downstream sector is also a significant environmental polluter through GHG emissions into the air during refinery and logistics activities. The above is more pronounced in developing nations, where weak regulations have resulted in inadequate monitoring of the sector (Ambitunni, Amezaga and Emeseh 2014). For example, the explosion that rocked the Venezuelan state-owned refinery, resulting in the loss of lives and estimated damages of over $1.7 billion, was reported to have been caused by archaic and poorly maintained infrastructures (Lopez 2012). Other reported downstream incidences such as the 2006 Buncefield, 2011 Pembroke plant, and 2013 Detroit refinery explosion are arguably avoidable if proper safety precautions and proactive sustainability strategies were deployed. Therefore, there is a need to conduct further empirical investigations into the adoption of green practices in this sector.

2.7.4 GSCM in the O&G industry

Over the years, activities and events in the oil and gas industry have caused devastating effects with far-reaching negative implications on the environment and its inhabitants (Ahmed, de Brito and Tavasszy, 2016). For example, the Piper Alpha oil rig explosion of 1988 resulted in the death of 167 workers, loss of oil production, and a massive sum of insurance payout (Pate-Cornell 1993; Vinnem 2007). Similarly, in 1989, the Exxon Valdez accident on the Alaskan coast spilled 37,000 tons of crude oil, leading to the death of more than 250,000 birds and other marine animals (Carson et al. 2003). The total cost of this accident is estimated at $7BN. This figure includes fines, claims, and penalties (Zion and Aven 2010) attributable to the accidents. In 2010, the British Petroleum (BP) Gulf of Mexico oil disaster resulted in the death of eleven (11) persons, with a humongous initial cost estimated at $40BN (Wearden 2010). Out of this, the outright cleaning cost estimates were $8BN (Bergin 2010). Looking at the above occurrences and other environmentally impactful activities in the industry has consistently questioned the environmental sustainability practices in the industry (Silvestre, Gimenes and Neto, 2017).

Although stakeholders in the industry adopt measures to forestall such incidences within the industry, these measures appear to be more reactive than proactive. For example, Gutpa et al. (2005) observe that new and stricter regulations are quickly implemented to forestall a reoccurrence of such an event after major accidents occur in the industry. Similarly, more sophisticated risk measures and additional protective barriers are adopted as response strategies to significant accidents in the industry (Decola 2009; Mendes et al. 2014). To this end, the industry has been a focus of scrutiny by stakeholders (including media and activist groups regarding its health, safety and environmental standards (Ghettas 2015; Lewis and Henkels 2014; McCarthy, Silvestre and Kietzmann 2013).

As earlier highlighted, sustainability issues permeate the entire supply chain of the oil and gas industry, thereby underscoring the importance of GSCM practices in the oil and gas industry (Ahmad, de Brito and Tavasszy, 2016). However, Mohammed (2008) observes that supply chain activities in the oil and gas industry were initially considered a ’soft issue’ by practitioners because of the technical nature of the industry until they realized that more than 80% of their expenses are ‘burnt’ on supply chain-related activities. Also, in the academic, sustainability issues in the oil and gas industry have received less attention despite their importance to humanity and their risk to the environment (Ahmad et al., 2017). For instance, while the concept of sustainability has become a point of attraction to researchers since the publication of the Brundtland report in 1987 (Carter and Rogers, 2008; Rajeev, 2017), the first research focusing on sustainability in the oil and gas supply chain was conducted in 2007. Indeed, in a recent literature review on GSCM, Ansari and Kant (2017) found that only three out of the eighty-six studies published between 2002 and 2016 specifically focused on the O&G industry, compared with eighteen articles on the manufacturing industry.

Table 2.6 presents the thematic analysis of the existing literature on green practices in the O&G industry since 2007 (when the first article was published). The table indicates that the literature to date covers a few thematic areas. These are sustainability drivers and enablers (Yusuf et al., 2012; Modaress, Ansari and Thies, 2016; Ahmed et al.; 2016; Ahmed et al., 2017; Raut, Narkhede and Ghadas, 2017), sustainability strategies (Lhakal, Khan and Islam, 2007; Lhakal, Khan and Islam, 2009; Uricoli et al., 2014; Modinasab et al., 2017; Silvestre et al., 2017) and sustainability communication in the oil and gas industry (Ahmad et al., 2016

Table 2.7: Current sustainability research in the O&G industry.

Source	Central idea	Methodology	Context	Focus	Theme
Kumar and Barua (2022)	Identification of green practices and the barriers to implementation in the O&G industry	Mixed method	Developing economy (India)	Upstream	O&G GSCM strategy
Abdussalam, Fello and Chaabane (2021)	Minimization of associated costs of crude, refinery and petrochemical while complying with regulations.	Mathematical modelling	Developing economy (Libya)	Both	O&G GSCM strategy
Abdussalam et al. (2021)	A systematic review of the green petroleum supply chain	Systematic literature review	Unspecified	Unspecified	Gap identification
Tanimu, Yusuf and Geyi (2021)	Examining the relationships among management quality, SSCM and business performance.	Quantitative (Multiple regression)	Unspecified	Unspecified	Performance measurement
Narimissa et al. (2020)	Conceptualization of the drivers and barriers of GSCM in the O&G industry	Conceptual	Developing economy (Iran)	Unspecified	Drivers of sustainability
Vivas et al. (2020)	Developing analytical and mathematical modelling for evaluating O&G GSCM	Mathematical and analytical modelling	Developing economy (Brazil)	Upstream	O&G GSCM strategy
Rentizelas et al. (2020)	Institutional drivers of social sustainability in the O&G industry	Mixed-method	Developing country (Oman)	Upstream	Drivers of sustainability
Florecsu et al. (2019)	Impact of SSCM strategies on SCM functions	Quantitative (Regression)	Romania and Moldova	Unspecified	Performance measurement
Gardas, Raut and Narkhede (2019)	Determinants of SSCM and influence on business performance	Quantitative (ISM and SEM)	Developing economy (India)	Upstream	Performance measurement
Omar, Ali and Jaharadak (2019)	Examining the relationship between GSCM, sustainability and environmental uncertainty	Quantitative (PLS-SEM)	Developing economy (Oman)	Upstream	Performance measurement
Kurian, Unnikrishnan and Sawant (2018)	GSCM practices and the driving forces	Quantitative	Developing economy (India)	Upstream	Drivers of GSCM
Ahmad et al. (2017)	External factors of O&G GSCM	Best-worst method (Quantitative)	Developed vs developing economies	Upstream	Drivers of GSCM
Ahmad et al. (2017)	A contextual framework for O&G GSCM	Qualitative exploratory study	Unspecified	Upstream	Drivers of GSCM
Ekiugbo and Papanagnou (2017)	Sustainable procurement for sustainable development in the O&G industry	Quantitative Exploratory factor analysis	Developing economy (Nigeria)	Upstream	O&G GSCM strategy
Mordinasab et al. (2017)	Comparison of private-public pricing in O&G GSCM and effects of competition and cooperation	Quantitative Nash and Stackelberg equilibrium	Developing economy (Iran)	Both	O&G GSCM strategy
Raut, Narkhede and Gardas (2017)	Critical success factors of GSCM	Quantitative (interpretive structural modelling)	Developing economy (India)	Upstream	Drivers of GSCM
Ahmad et al. (2016)	Study of internal factors that enhance O&G GSCM	Quantitative linear regression	Unspecified	Upstream	Drivers of GSCM
Ahmad et al.(2016)	Sustainability reporting in the O&G industry	Qualitative content analysis	Unspecified	Upstream	Sustainability communication/Reporting
Modarress, Ansari and Thies (2016)	Drivers of O&G supply chain outsourcing in the Persian Gulf	Exploratory mixed method	Developing nations (Iran, Iraq, Kuwait, UAE)	Both	Drivers of GSCM

Uriciuoli et al. (2014)	Using O&G supply chain as a strategy against supply chain disruption	Quantitative multiple regression	Developed nations (Europe)	Downstream	O&G GSCM strategy
Yusuf et al. (2014)	Impact of SC agility on the sustainability of the UK O&G SC	Quantitative (one-way ANOVA)	Developed nation (UK)	Upstream	Driver of GSCM
Thurner and Proskuryakova (2014)	Rising importance of environmental management in the Russian oil and gas industry	Qualitative content analysis	Developing country (Russia)	Upstream	Drivers of GSCM
Ngoasong (2014)	Strategic response to local content by the IOCs	Qualitative (narrative analysis)	Developing nations (Angola, Nigeria, Brazil, Venezuela, Kazakhstan, Indonesia and Yemen)	Upstream	Strategy
Matos and Silvestre (2013)	Stakeholders' relationship management	Qualitative	Developing nation (Brazil)	unspecified	Strategy
Yusuf et al. (2013b)	Adoption and performance impacts of O&G GSCM	Quantitative regression analysis	Developed nation (UK)	Upstream	Performance measurement
Asaolu et al. (2012)	Sustainability reporting in the O&G Industry	Qualitative content analysis	Developing nation (Nigeria)	Upstream	Sustainability communication/reporting
Deng and Liu (2011)	Proposed framework for greening the supply chain of the O&G industry	Qualitative	China (developing nation)	Both	O&G GSCM strategy
Dong and Burritt (2010)	Quality of environmental and social disclosure in the report of O&G firms	Qualitative content analysis	Developed nation (Australia)	Unspecified	Sustainability communication/reporting
Lakhal, Khan and Islam (2009)	Framework for decommissioning process of the offshore platform of offshore platforms	Qualitative method	Developed nation (Canada)	Upstream	Strategy
Matos and Hall (2007)	Challenges and complexities of infusing sustainability in GSCM, comparing Agricultural biotechnology with O&G	Qualitative grounded theory	Multi-contextual	Downstream	Drivers of GSCM
Midttun et al. (2007)	Integration of CSR as part of GSCM practices in the O&G industry	Qualitative	Developed country (UK)	Upstream	Strategy
Lakhal, H'Mida and Islam (2007)	Green supply chain framework for assessing oil refinery operations in terms of waste and emission management	Qualitative Case study analysis	Developed nations (Canada)	Upstream	Drivers of GSCM

In the area of drivers and motivators of GSCM, Yusuf et al. (2014) investigated the impacts of supply chain agility on the sustainability of the oil and gas firms in the UK and found that supply chain agility can drive sustainability in the industry. From another perspective, Modarress, Ansari and Thies (2016) studied the effects of outsourcing on the sustainability of the Persian Gulf petroleum supply chain and found that even though outsourcing could drive sustainability through cost minimization, it can also lead to a distraction within the supply chain. Ahmad, de Brito and Tavasszy (2016) studied the internal drivers of oil and gas GSCM in an organizational context and found that management preparedness drives oil and gas GSCM more than general commitment.

Using the PESTEL framework to analyze the opinions of O&G practitioners from developing countries and academic experts from America, Ahmad et al. (2017) found a consensus among the participants that economic and political stability are the most important external forces that drive environmental sustainability in the oil and gas industry. However, their findings further indicate that the academic experts regarded the regulatory factor as the second least important external factor of sustainability, while the oil and gas practitioners ranked the same as the third least factor. In contrast, Thurner and Proskuryakova (2014) found that government regulation is not a primary extern driver of sustainability in the supply chain of the Russian oil and gas industry. This finding is corroborated by Rentizelas et al. (2020), who found that government regulations are insufficient to drive sustainability adoption among the firms operating in the Oman O&G industry. Nevertheless, Raut, Narkhede and Gardas (2017) found that global climatic pressure and ecological scarcity of resources are the most influential criterion for adopting green practices in the Indian O&G supply chain. Based on the foregoing, it could be deduced that scholars do not only differ on the most critical driver of sustainability in the industry; their findings also vary across nations. This suggests the need for a further research investigation.

Research on sustainability strategies in the O&G supply chain appears to be quite evolving because of the different perspectives adopted by authors. For example, Lakhal, Khan and Islam (2009) proposed a framework for decommissioning offshore platforms in Canada to green the refinery sector. This framework, which is an extension of their early work (see Lakhal, H'Mida and Islam 2007), is designed to assist operators in improving the sustainability of their operations. Also, Uricioli et al. (2014) argue that building disruption strategies like portfolio diversification, flexible contracts, transport capacity, and safety stocks into the O&G supply chain to ensure resilience against external threats is an effective GSCM strategy for O&G firms. Moradinasab et al. (2018) combined price mechanism with pollution management to develop a sustainable petroleum supply chain management (SPSCM) model for the Iranian oil and gas industry. Comparing the government oil and gas supply chain with the private sector's chain, the authors found that the model increased the government profit while the private sector's profit decreased. Also, Silvestre, Gimenes and Neto (2017) studied the extent of organizations' compliance with the standard process safety management system within the Brazilian oil and gas industry and found a lack of uniformity and inefficient enforcement mechanism for sustainability practices within the industry.

In recent times, sustainability reporting and communication in the O& G industry have attracted scholars' interest. Ahmad, de Brito, and Tavasszy (2016) observe an increase in companies that publish sustainability reports in the oil and gas industry. Despite this, the accuracy of these reports remains a point of criticism in the literature. For example, Dong and Burritt (2010) studied the quantity and quality of sustainability reporting of Canada's oil and gas firms, focusing on social and environmental issues. They found that companies tend to under-report sustainability issues in contravention of the industry's benchmarks. Similarly, Asaolu et al. (2012) found that the Nigerian oil and gas industry firms present arbitrary sustainability reports, different from the global best practices. Recently, Ahmad, de Brito, and Tavasszy (2016) studied the extent of sustainability reporting in the global oil and gas industry and found that reports published by firms are prone to remarkable inconsistency. Given that sustainability reporting is an effective tool of stakeholder engagement and a strategic response to pressure (Tate, Ellram and Kirchoff 2010), the noted inadequate disclosures in sustainability reports of O&G firms could seriously undermine the credibility and usefulness of the reports (Dong and Burritt 2010).

Furthermore, available literature indicates that most studies on oil and gas GSCM are mono-sectoral. Hence, studies that cover the entire supply chain are very scant. As shown in Table 2.6, the upstream sector of the supply chain remains the most researched area of the supply chain. The above could be justified because the upstream sector is arguably more destructive to the host communities, thereby recording the highest number of incidents in the industry (Musa et al. 2013). Nevertheless, the need to conduct more holistic studies covering the entire supply chain cannot be overemphasized. This is because other studies have also indicated that sustainability can differ across various supply chain echelons (Meckenstock, Barbosa-Póvoa and Carvalho 2015).

Finally, the extant literature reveals a paucity of empirical knowledge on the impact of GSCM on the competitive performance of the firms in the O&G industry. In this regard, Yusuf et al. (2013) conducted an empirical analysis of the impact of sustainability practices on the performance outcome of the firms operating in the UK oil and gas supply chain. Empirical results indicate that sustainability practices are positively related to the operational and business performance of the firms in the UK oil and gas industry. Although this study is a good attempt at addressing an existing gap, the study is limited in scope by some factors. First, the study focuses more on the industry's upstream sector, thereby lacking a holistic view of the entire O&G supply chain. Second, since the research data were generated from the UK O&G industry (a developed nation), with stringent environmental regulations (Holt 2009); the findings of the study may not be readily applicable in a developing nation’s O&G industry with generally weak laws and lower stakeholders’ pressures (Silvestre, 2015). Nevertheless, this study is essential to the current research as the overall aim is to determine the impact of sustainability practices on the competitive performance of the firms in the O&G industry.

Considering the findings from the review of the current literature on sustainability in the O&G industry, there is a need to further research on the impact of sustainability practices on the competitiveness of the firms operating in the supply chain of a developing country’s O&G industry. Such research would create the possibility to compare the previous findings in a developed economy such as the UK (Yusuf et al. 2013) with the results generated from a developing nation. This can assist global O&G firms in developing and channelling strategies based on the peculiarity of their environment. Furthermore, many studies on GSCM in the O&G industry are atheoretical. To the best of the researcher’s knowledge, research that relates the NRBV strategic capabilities to GSCM in the industry is non-existent. Following the call for theory-based research in GSCM (Carter and Easton 2011; Sarkis, Zhu and Lai 2011), the need to test a model that specifies hypothetical linkages between NRBV and GSCM, with the impact on competitiveness, in the context of the O&G industry, is a crucial area of interest in this research.

2.7.5 The Nigerian O&G Supply Chain: A sustainability perspective

Over the years, the Nigerian oil and gas industry has attracted substantial global attention bothering various negative sustainability issues, especially in the Niger-Delta area (Elenwo and Akankali 2014). The prevailing sustainability issues in the industry are gas flaring (Dung, Bombom and Agusomu 2008), oil spills (Ordinioha and Brisibe 2013), and pipeline ‘interdiction’ (Anifowose 2008). All of the above has led to many socio-economic problems in Nigeria. Some of these problems include host communities-oil companies tension (Schneider et al. 2013) and extreme environmental pollution (Duffield 2010), among others, in the Niger-Delta.

Ajugwo (2013) observes that about 17.2 billion M3 of gas is flared in the oil-producing Niger-Delta area yearly in gas flaring. Based on a record derived from satellite data between 1994 and 2008, Elvidge et al. (2009) observe that Nigeria and Russia have the highest gas flaring level, responsible for over 40% of the world’s gas flaring volume. Available record from the Central Bank of Nigeria (CBN) indicates that the rate of gas flaring in Nigeria between 1970 and 1979 stood at 97%. The gas flaring rate slightly reduced to 95% between 1990 and 1999. Although there was a significant reduction in the gas flaring rate to 51% between 2000 and 2004 (when the report was prepared), it was recorded that about 76% of the total gas produced in Nigeria between 1970 and 2004 was flared (Cbn 2004). To this end, Emoyan (2008) argues that Nigeria is the number one 'flarer' of natural gas on the planet.

While the above constitutes economic wastage to the nation, its implications on the socio-economic wellbeing of the residents of the Niger-Delta area are better imagined than experienced. According to Kadafa (2012), about 45.8 billion kilowatts of heat is discharged into the atmosphere from 1.8 billion cubic feet of gas in the Niger-Delta daily, leading to extremely high temperature that renders most places uninhabitable. Onyekuru (2011) observes that the peasant rural traders and farmers in the Niger-Delta area usually dry their farm produces, such as fish and cassava, for sales at the gas flaring sites, unaware of the contaminated, toxic, and poisonous effects of the gas flare. These products are eventually sold and consumed by buyers across the region and the nation (Agbonifo 2016). According to Diugwu et al. (2013), the heat and toxins from these activities are dangerous to the vegetation and humankind, leading to severe health consequences like miscarriages, asthma, blood disorders, and skin diseases.

Furthermore, the effects of consistent oil spills on the Niger-delta environment, the livelihood of the residents, and the attending social unrest are well documented in the literature. According to Ordinioha and Brisibe (2013), an average of 240 000 barrels of crude oil are spilt in the Niger-delta annually. The cumulative volume of oil spilt in the area for the past fifty years is estimated at 9-13 million barrels, equivalent to fifty Exxon Valdez spills (Kadafa 2012). While these oil spillages abate, they continue to have devastating effects on the environment. For example, about 836 acres of mangrove forest within six miles of the Funiwa oil well located in the Niger-Delta, was utterly destroyed by a blow-out of about 421,000 barrels of oil into the ocean in January 1980 (Gabriel 2004; Tolulope 2004; Ukoli 2005). Other spillages like the Oshika village spills in 1982 and the Ogbada-Brass pipeline oil spillage in 1992 resulted in widespread contamination of freshwater swamp forest, mangrove swamp, and high mortality of crabs, fish, and shrimps (Kadafa 2012b).

Given the level of environmental degradation of the Niger-Delta area through oil spills over the years, Duffield (2010) describes Nigeria as the '*World oil pollution headquarters.* A study by Ordinioha and Brisibe (2013) on the health implications of oil spills on the social wellbeing of the Niger-Delta residents found that oil spills lead to severe contamination of the surface air, groundwater, and ambient air, among others. The effects of the above include a 60% reduction in household food security, a 24% increase in the prevalent childhood malnutrition, and an increased risk of cancer and infertility through the hemotoxic and hepatotoxic nature of the spills.

From an economic point of view, Kadafa (2012a) argues that years of continuous oil spillage in the Niger Delta have made it almost impossible for residents to embark on their traditional commercial activities like farming and fishing. The author observes that this has resulted in high unemployment and poverty rates. The resultant effects are seen in the prevalent civil unrest (in terms of a constant clash between the citizens and the oil companies), oil theft, pipeline vandalism, kidnap of oil company workers, and other social vices (Ikelegbe 2001). For example, due to Shell Petroleum Development Company (SPDC) operational activities, resulting in environmental and water pollution of rivers within Ogoni land in the 1990s, a severe tension that attracted global attention was generated among Ogoniland citizens (Schneider et al. 2013).

According to (Kadafa 2012b), issues of this nature are traceable to unsustainable oil exploration and production in the Nigerian O&G industry.

Whereas all the aforementioned are recorded in the upstream sector of the Nigerian O&G industry, sustainability issues in the downstream sector have also been documented (Dare et al., 2009; Fadeyibia et al., 2011; Anifowose et al., 2012). The above ranges from uncontrolled GHG emission from the distribution and retail channel, high rate of tanker accidents leading to high rate of death, conflagration from gas stations cited very close to residential areas, and many more. Interestingly, despite various multi-dimensional sustainability issues that permeate the Nigeria O&G industry, research about the sustainability initiatives adopted across the supply chain in the industry is scant. Nevertheless, the responses to the sustainability challenges in the Nigerian O&G industry seem to be majorly regulatory. Various legislations have been enacted in the industry to hold operators accountable for unsustainable practices. These include the Harmful Waste Act (2004), Environmental Impact Assessment Act (1992), and National Environmental Standards Regulations Enforcement Agency Act (2007) (Ambituuni, Amezaga and Emeseh 2014). Specifically, the Department of Petroleum Resources (DPR) oversees the industry's compliance with sustainability standards (DPR 2016). However, the weak enforcement framework constitutes a barrier to sustainability issues in the industry. For example, Emeseh (2006) observes that despite the provisions of the Environmental Assessment (EIA) Act (1992), mandating IEA documentation as a prerequisite for any O&G projects in Nigeria, a large project such as Bonny liquefied natural gas was carried out without any EIA certification in place and without any consequence. This finding aligns with Silvestre, Gimenes and Neto (2017), who posit that weak legislation and enforcement are GSCM implementation inhibitors in developing countries. Considering the position of Dyllick and Hockerts (2002) that responsible organizations seek to integrate environmental practices into organizational framework beyond legal requirement, this study holds that there is a need to examine how the stakeholder pressures influence the adoption of GSCM practices in the Nigerian O&G industry and how these practices impact firms' competitiveness.

2.7.6 Summary of contextual literature review

The foregoing discussion has attempted to contextualise the focus of this research in the O&G industry. From the literature review in the second part of this chapter, the summary of the findings and the relevance to this research is presented in table 2.8.

Table 2.8: Thematic summary of the contextual review

Thematic Areas	Key Findings	Key Authors	Research Implications
O&G industry SC	The Industry's SC may be classified into three: upstream, midstream and downstream. Midstream and downstream can be merged to depict a two-sector SC. All sectors of the O&G SC poise environmental sustainability challenges to the society. The O&G SC has certain peculiarities owing to its location and technical nature.	Urciuoli et al. (2014); Modarress, Ansari and Thies (2016); Kilponen (2010); Briggs, Tolliver and Szmerekovsky (2012); Gosden (2013); Jernelöv (2010); Parish et al. (2013); Pan, Liu and Li (2017); Ambitunni, Amezaga and Emeseh (2014)	Conceptualisation of the O&G SC as a two-sector industry in this research Identification of the specific sustainability issues across the SC
GSCM in O&G industry	GSCM literature has channelled less attention to the O&G industry. Existing literature focus on few thematic areas: GSCM drivers, sustainability strategies and sustainability communication. The findings on the key stakeholder drivers of GSCM in the O&G industry is inconclusive. The role of strategic capabilities and resources in GSCM adoption in the industry is yet to be examined. The impact of GSCM implementation on the competitiveness of the O&G firms is unclear.	Yusuf et al., (2012); Modaress, Ansari and Thies, (2016); Ahmed et al.; (2016); Ahmed et al., (2017); Raut, Narkhede and Ghadas, (2017); Lhakal, Khan and Islam, (2007); Lhakal, Khan and Islam, (2009); Uricoli et al., (2014); Modinasab et al., (2017); Silvestre et al., (2017); Ahmad et al., (2016)	Identification of research gaps Examination of key stakeholder antecedents of GSCM in the industry. Development of an integrative framework examining the role of stakeholder antecedent and strategic resources in developing strategic environmental capabilities/GSCM and the impact on the competitiveness of the O&G industry.

Based on the conceptual and contextual review findings as summarized in tables 2.6 and 2.8, the research gaps identified in this chapter are presented in the next section.

2.8 Overview of identified research gap

As indicated in section 2.4, there is a dearth of theory-based research in GSCM literature. This study identified stakeholder theory and NRBV as the most compatible theoretical lenses related to its objectives. Although NRBV is one of the most commonly adopted theoretical lenses in GSCM research (Touboulic and Walker 2015), only a few studies have attempted to establish a direct linkage between GSCM and NRBV (Guang Shi et al. 2012; McDougall, Wagner and MacBryde 2021; Yunus and Michalisin 2016). Research in this direction significantly lacks empirical verification. Addressing this gap would contribute to theory-based research in GSCM as requested by scholars (Carter and Easton 2011; Sarkis, Zhu and Lai 2011). It would also deepen the applicability of NRBV as a practice-oriented concept against its current perception as a mere conceptual theory (McDougall, Wagner and MacBryde 2019). It would therefore create an alternative route for examining GSCM.

Furthermore, the role of strategic resources in enhancing competitiveness within the NRBV framework is well defined (Hart 1995; Hart and Dowell 2011). However, the critics of NRBV have hinged its lack of applicability on the non-practicability of the rarity of NRBV strategic resources (Lockett et al. 2009). Also, the extant literature suggests that the bundle of resources that drive competitiveness could vary across firms and industries (Barney 1991; Grant 1991; Hart 1995). Therefore, exploring the strategic resources required by the firms in the Nigerian O&G industry to enhance their competitiveness capabilities can assist the industry's policymakers and strategic managers to effectively prioritise investment allocation into the relevant strategic resources that could improve their competitiveness.

Another issue is that findings on the critical drivers of GSCM adoption in the O&G industry are mixed (Thurner and Proskuryakova 2014; Ahmed et al. 2017). Similarly, scholars differ on the impacts of stakeholder pressures on firms' adoption of sustainability practices (Zhu 2013; Esfahbodi et al. 2017). The literature suggests that country impact factor and industry peculiarity can influence the type of stakeholder pressure that drive GSCM implementation. Since there is no current research on the role of stakeholder requirements in GSCM adoption by the firms in the Nigerian O&G industry, the need to address this gap cannot be overemphasized.

Moreover, there is a paucity of knowledge on the impact of GSCM practices on the competitive performance of O&G firms. Yusuf et al. (2013) is the only study that has examined the impacts of GSCM practices on the performance of O&G firms in the context of the UK O&G industry. Interestingly, this study is not theory-based. In this vein, NRBV provides a veritable theoretical lens for examining the impacts of proactive environmental strategies, such as GSCM, on the competitive performance of firms using a relevant research framework. Currently, the existing frameworks linking GSCM and NRBV to firms' competitive performance lack significant empirical evidence (Guang Shi et al. 2012; McDougall, Wagner and MacBryde 2021; Yunus and Michalisin 2016). Therefore, developing and empirically assessing an integrative model of the role of the stakeholder antecedent of GSCM through NRBV strategic capabilities on firms' competitiveness would address the inadequacy of the NRBV literature in this area (McDougall, Wagner and MacBryde 2021). It could also enable supply chain managers to justify their firms' investment in green practices, given the expected positive competitive benefits derivable from GSCM implementation. Considering the polluting nature of the O&G industry and a dearth of GSCM research in the industry, a research opportunity for the development and assessment of an integrative model of stakeholder drivers, NRBV strategic resources and capabilities (GSCM) and competitive advantage is provided in this research.

Within the NRBV framework, elements of sustainable development (clean technology and the base of the pyramid) have received the least research attention. Similarly, the social aspect of TBL has been under-researched. The above constitutes another research gap that is worthy of exploration. Researching this area would result in a holistic examination of NRBV and TBL, thereby making an original contribution to the NRBV and sustainability literature.

Based on the foregoing, the existing gaps identified in the extant literature, with the relevance and possible contributions, are presented in table 2.7.

Table 2.9: Existing research gaps identified in the literature

	Research gaps identified	Study area	Relevance to the research objectives	Possible significance	Data availability	Novelty/ originality of outcome
1	What relationships exist between GSCM practices and NRBV capabilities in the Nigerian O&G industry	GSCM-NRBV compatibility in the O&G industry	This would provide empirical verification of NRBV capabilities in the O&G industry, thereby deepening theory-based research in GSCM.	The applicability of NRBV in GSCM to date has remained conceptual. Previous studies that have developed linkages between the two concepts have not empirically verified these linkages in practice. Addressing this gap would significantly contribute to NRBV literature in terms of applicability.	Since there is a paucity of research in this area, qualitative data can be obtained from the relevant managers across the supply chain of the Nigerian O&G industry.	The outcome of this research can result in original output as scholars have called for empirical examination of NRBV capabilities, of which current attempts are conceptual.
2	Identification of the specific strategic resources that drive the development of GSCM-NRBV strategic environmental capabilities in the Nigerian O&G industry.	Strategic resources and NRBV capabilities	Considering that all resources available to firms cannot enhance firms' competitiveness, exploring the specific resources that the Nigerian O&G firms require to develop the needed capabilities for competitiveness would assist the managers and policymakers in the Nigerian O&G industry to prioritise their investments towards those resources that can enhance their competitiveness.	The issue of strategic resources is very critical in the NRBV framework. Previous studies have utilised various strategic resources within the NRBV framework. No research has identified the specific strategic resources that firms in the Nigerian O&G industry need. Research in this area can generate a new dimension of resource allocation in the O&G industry.	Primary data to be qualitatively analysed can be gathered from the relevant managers across the supply chain of the Nigerian O&G industry.	An exploration of this gap would make an original contribution to the NRBV literature by exploring evidence-based resources in the context of the O&G supply chain.

3	Identifying stakeholder drivers of GSCM practices in the Nigeria O&G industry	Stakeholder theory and GSCM	The literature on GSCM in the O&G industry indicates that country-impact factors can determine the primary drivers of GSCM adoption in the industry. The factors that drive the implementation of GSCM practices in the Nigerian O&G industry are yet to be explored. Doing this would assist policymakers in fostering policy toward such critical factors to enhance the sustainability of the O&G industry.	Research in this area will significantly contribute to stakeholder theory and its applicability in an O&G SC of a developing company.		Addressing this gap will contribute to the ongoing debate on stakeholder pressures in GSCM implementation in the O&G industry.
4	Development, refinement and assessment of an integrative framework of stakeholder driver-strategic resources-GSCM implementation - Competitiveness for the O&G industry's supply chain.	Stakeholder theory, NRBV and TBL	A refined integrative model to assess the role of stakeholder pressures in the acquisition of strategic resources and capabilities and the impact on the competitiveness of the O&G industry is necessary to justify the firm's investment in sustainability practices. The competitive outcome of such investment can encourage managers in the O&G industry to dedicate more significant efforts to sustainability practices.	Although previous studies have attempted to develop a conceptual framework using NRBV and GSCM, these frameworks failed to incorporate all the NRBV strategic capabilities and majorly lack empirical assessment.	A large scale survey can be carried out across the supply chain of the Nigerian O&G industry to collect primary data from the relevant managers in the industry.	This gap is worth exploring in detail as it would help determine if investment in sustainability practices is a worthwhile venture in the O&G industry. It would also help determine the role of stakeholder pressures as the driver of GSCM.

2.9 Chapter conclusion

The extant literature around the major concepts of this study has been reviewed in this chapter. The chapter started with general issues in sustainability and GSCM. Specific theories relevant to this study's objectives were identified. A critical approach was taken to highlight the literature around the research area, focusing on the stakeholder drivers of GSCM implementation, NRBV focused strategic resources and capabilities, and competitive advantage. Also, sustainability issues in the Nigerian O&G industry were discussed, and a thematic approach was adopted to review the literature on GSCM in the O&G industry. Based on the foregoing, the critical gaps to be addressed by this study were established within the extant literature. Overall, this research found that many of the concepts presented in this chapter have not been validated in the O&G industry. Thus, the specific constructs in the context of the O&G industry concerning the aim of this research are not available. Nevertheless, the theoretical review in this chapter reveals constructs that can be linked to the objectives of this study. Therefore, the next chapter proposes a *generic* conceptual framework that fosters the attainment of the aim of this research. The proposed initial conceptual framework is further refined with exploratory study in the subsequent chapters.

Chapter 3: Initial conceptual framework

3.1 Introduction

The literature review in chapter two highlights two significant issues concerning the objectives of this study. First, the stakeholder theory and NRBV are found to be compatible with the aim of this study. Also, the chapter highlighted some research issues requiring further empirical investigation in the Nigerian O&G industry. Specifically, the literature review reveals that the empirical linkage between NRBV strategic capabilities (pollution prevention, product stewardship, clean technology and base of the pyramid) and GSCM practices in the Nigerian O&G industry has not been explored. Also, empirical research on the influence of stakeholders' pressures and strategic resources on a firm's deployment of strategic capabilities to implement GSCM practices and the impacts of these capabilities on the competitiveness of the O&G industry is lacking in the extant literature.

Given the above, the current chapter proposes the initial conceptual framework to address these research gaps. For this purpose, this chapter explores the logic embedded in the NRBV and stakeholder theory to identify the appropriate constructs for attaining this research's objectives. The structure of this chapter is presented in figure 3.1.

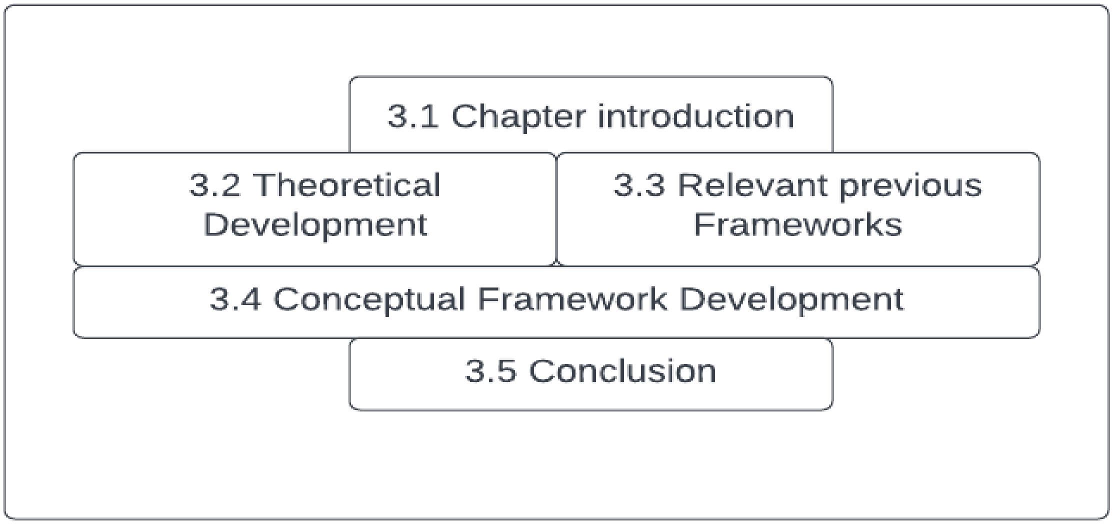

Figure 3.1: The structure of chapter 3

3.2 Theoretical Development

According to Carter and Rogers (2008), the importance of developing a conceptual framework in research transcends beyond a mere offering of a conceptual tool but incorporates the presentation of normative values underpinned by sound theories. Consequently, the framework proposed in this research is based on a logical interlinkage of two interrelated theories (NRBV and stakeholder theory) in the oil and gas supply chain. As highlighted in section 2.4, several theories have been applied in GSCM research (Touboulic and Walker 2015). The primary criterion considered in theory application is the objective that a research *intends* to achieve. For example, studies that focus on understanding the drivers of GSCM tend to adopt institutional theory and stakeholder theory (Dubey, Gunasekaran and Ali 2015; Glover et al. 2014; Maloni and Brown 2006). Similarly, studies that examine resource management in a supply chain tend to adopt the resource-dependent and relational view theories. This study aims to investigate how strategic capabilities for GSCM practices impact the competitiveness of the firms operating in the supply chain of the Nigerian O&G industry. It also objectifies to identify the role of stakeholders' pressures and strategic resources as the antecedents of the strategic capabilities for GSCM, leading to competitive advantage in the O&G SC.

As indicated in section 2.4, the NRBV and stakeholder theory are considered the most compatible theories with the objectives of this study. The proponent of NRBV argues that acquiring specific strategic resources can help firms develop strategic environmental capabilities to enhance competitive advantage (Hart 1995). Hence, this theory is relevant for understanding the impact of strategic resources and capabilities for GSCM on competitive advantage. On the other hand, the stakeholder theory states that the expectations, requirements and pressures emanating from various stakeholders can influence firms' business and strategic choices (Freeman 1984). Therefore, this theory is relevant for understanding the role of stakeholders' pressures on a firm's acquisition of strategic resources and the development of strategic capabilities for GSCM practices. Several studies have adopted the NRBV to develop conceptual frameworks to investigate various research phenomena. For example, Guang Shi et al. (2012) combine the NRBV with institutional theory to develop a conceptual framework of GSCM. Also, Escobar and Vredenburg (2011) integrated institutional theory with RBV (the root of NRBV) to investigate the attainment of sustainable development by multinational oil companies (MOCs). Thus, the previous adoption of the theoretical lens in GSCM and O&G studies also justifies the adoption in the current research.

NRBV is rooted in the principle of RBV theory that postulates that beyond the internal capabilities of firms, strategic capabilities related to environmental issues are likely to become the sources of sustained competitive advantage for firms. In line with RBV (Barney 1991), NRBV argues that for firms to acquire strategic environmental capabilities, they must possess specific resources that are valuable, reliable, inimitable, and non-substitutable (Barney 1991). In the words of Hart (1995), such resources must be tacit, socially complex, and causally ambiguous. The above suggests that such resources are likely to be embedded among many collaborators. Furthermore, Hart (1995) proposed three strategic environmental capabilities for firms to achieve sustained competitive advantage. These are pollution prevention, product stewardship, and sustainable development capabilities (Buysse and Verbeke 2003; Fowler and Hope 2007; Hart 1995; Hart and Ahuja 1996). Hart and Dowell (2011) unbundled the sustainable development elements into clean technology and the base of the pyramid as extensively discussed in section 2.6.1.3.

According to Touboulic and Walker (2015), RBV/NRBV is one of the most popular theories adopted in GSCM research. The theory is extended into the supply chain domain to facilitate the incorporation of 'green' and sustainable concepts and philosophy. In the context of the O&G industry, Hastings (1999) adopted the theoretical lens of NRBV to conduct a case study of three oil companies in Latin America and highlighted environmental management, social responsibility, and sustainable development as the required capabilities for competitiveness in the O&G industry. Also, Michalisin and Stinchfield (2010) argued that proactive O&G firms should build the capacity to develop energy substitutes, adopt renewable energy, and engage stakeholders to combat climate change issues in the O&G industry. Based on the foregoing, this study argues that NRBV effectively aligns with GSCM practices in the O&G. Similarly, since the stakeholder theory has been effectively applied in GSCM (Sarkis, Gonzalez-Torre and Adenso-Diaz 2010a). It can also be integrated with NRBV to investigate research phenomena contemplated in this study. The development of the study's conceptual framework commenced with a review of relevant frameworks in the literature. After this, the conceptual framework of this study is proposed.

3.3 Relevant frameworks in the literature

Several studies have proposed and tested various GSCM frameworks to examine how firms can effectively address environmental sustainability issues in the supply chain (Al-Odeh and Smallwood 2012; Seuring and Muller 2008). Following the debates on the relationship between firms' adoption of green practices and competitive advantage, many frameworks have adopted a quantitative approach to evaluate the impact of GSCM practices on firms' performance in line with the focus of this study (Green et al. 2012). However, considering the theoretical focus of the current study, a deliberate attempt has been made to focus on frameworks that include NRBV, stakeholder theory or institutional theory in their conceptualisation in the context of GSCM. Whereas NRBV is a popular theory in GSCM literature, an empirical investigation of the strategic capabilities in the GSCM literature is scant. Nevertheless, three conceptual frameworks presented in table 3.1 are considered closely related to the focus of this study.

Table 3.1. Relevant previous research frameworks

Authors	**Title of the framework**	**Year**
Shi et al.	Natural resource-based GSCM model	2012

Yunus and Michalisin	Model of GSCM and sustained competitive advantage	2016
Mishra and Yadav	Model of environmental capabilities and competitive advantage	2021

Shi et al.'s (2012) Natural resource-based GSCM model is one the earliest attempts to develop an integrative model that annexes the specific GSCM practices with the NRBV strategic capabilities and the impact on firms' performance. As indicated in figure 3.2 the authors hinged on the logic of NRBV to hypothesise that firms' strategic environmental capabilities can improve organizational performance.

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Figure 3.2: Natural Resource-Based GSCM model
(Source: Shi et al. 2012).

Specifically, the model compressed the NRBV strategic environmental capabilities into intra-organisational environmental practices (Intra-OEPs). Inta-OEPs comprise the NRBV pollution prevention strategies. The authors link these with internal green supply chain practices such as recovery and reuse, waste reduction, recycling, safe disposal, and other environmental strategies. Accordingly, these capabilities are driven by causally ambiguous resources within the organization (McDougall et al. 2021). In contrast, the Inter-OEPs are conceptualised as causally ambiguous strategies that thrive on supply chain collaboration, and they are linked with the NRBV strategic capabilities of product stewardship. This is made up of various GSCM practices such as green purchasing, design for the environment (DfE), and green distribution Convingcinly, Shi et al (2012) conceptualised institutional drivers as the antecedents of the NRBV linked GSCM practices of Intra-OEPs and Inter-OEPs. Thus, the authors argue that institutional factors can motivate organisations to develop the relevant capabilities to implement green practices. In effect, the model proposed institutional theory as the antecedent of NRBV in the context of GSCM, in line with the focus of the current study. Furthermore, the model hypothesised the outcome of the interaction of institutional drivers with the NRBV-linked green practices as operational, environmental and financial performance.

Although Shi et al.'s (2012) Natural resource-based GSCM model offers valuable propositions on the linkage between NRBV and GSCM and the impact on firms' competitive performance, the model is deficient in many ways. First, despite conceptualising institutional drivers as the antecedent of NRBV/GSCM practices, the role of strategic resources as emphasised in the original proposition of NRBV (Hart 1995) is conspicuously missing in the model. Second, the natural resource-based GSCM model failed to consider all strategic capabilities in the NRBV proposition. Only pollution prevention and product stewardship are considered in the mode that excludes clean technology and the pyramid base (Hart and Dowell 2011). Finally, this model has remained conceptual as there is no evidence of empirical validation of the model in the extant literature.

Yunus and Michalisin (2016) proposed a theoretical model of GSCM and sustained competitive advantage to establish a linkage between GSCM and NRBV strategic environmental capabilities. The authors classified GSCM into the upstream, internal and external supply chain. The specific practices within the GSCM classification are linked with the NRBV strategic capabilities of pollution prevention, product stewardship, and sustainable development, as shown in figure 3.3.

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Figure 3.3: Model of GSCM and sustained competitive advantage
(Source: Yunus and Michalasin 2016).

Following the logic in NRBV, this model proposed a positive impact of the strategic environmental capabilities of pollution prevention, product stewardship, and sustainable development on sustained competitive advantage. Furthermore, the model offered valuable, tacit, rare, and socially complex resources as the antecedents of the NRBV strategic capabilities (Hart and Dowell 2011). Unlike Shi et al.'s. (2012) Natural resource-based GSCM model, Yunus and Michalisin (2016) considered the role of resources in conceptualising their model in line with NRBV. Furthermore, the model integrates explicitly NRBV strategic environmental capabilities. However, the model is limited by its failure to consider the antecedents of the NRBV strategies in the first instance. Furthermore, despite considering the three original NRBV strategic capabilities, the model does not unbundle sustainable development strategy into clean technology and base of the pyramid in line with Hart and Dowell (2011). Also, the conceptualisation of resources and sustained competitive advantage is generic as the model does not clearly define the specific resources and elements of competitive advantage resulting from the implementation of GSCM practices. Finally, this model lacks empirical verification, thus, failing to address the theory-practice gap.

A model of environmental capabilities and competitive advantage (Mishra and Yadav 2021) is considered as another related framework in this study. As indicated in figure 3.4, this model is based on the principle of the NRBV that states that firms' strategic resources can help develop strategic capabilities and proactive environmental strategies (PES) which may result in competitive advantage (Hart 1995; Hart and Dowell 2011). In this regard, Mishra and Yadav (2021) conceptualised the original NRBV strategic resources of strategic proactivity, shared vision and continuous innovation as the drivers of PES. The above is hypothesised to result in competitive advantage.

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Figure 3.4: Model of environmental capabilities and competitive advantage
(Source: Mishra and Yadav 2021)

Although an empirical validation of the model using quantitative data collected from managers in Indian manufacturing and service industries confirmed the stated hypotheses, this model is limited by several factors regarding the focus of the current study. First, Mishra and Yadav's (2021) compression of the four NRBV strategic environmental capabilities into a single construct limits the possibility of understanding the impact of each PES on the competitiveness of the participating firm. Secondly, the model fails to recognise that competitive advantage can be considered from multi-dimensional perspectives (Porter 1985; Hossain, Kannan and Raman 2021). Other studies have confirmed that environmental capabilities may not necessarily enhance competitiveness in all dimensions (Esfahbodi et al. 2017). Thus, conceptualising competitiveness as a single construct in this model limits the ability of the framework to derive how environmental capabilities affect different aspects of competitiveness. Also, the environmental capabilities and competitive advantage model does not include external factors that influence a firm's decisions to acquire the strategic resources to build their environmental capabilities for competitive advantage. This is one of the perceived shortcomings of the NRBV logic that requires research attention (Shi et al. 2012).

Having reviewed the relevant previous models concerning the focus of this study, the next section develops the initial conceptual framework of this research. The initial conceptual framework is compared with the models discussed in this section upon development.

3.4 Conceptual framework development

Ravitch and Riggan (2017: 5) define conceptual framework as *"an argument about why the topic one wishes to study matters and why the means to study it are appropriate and rigorous".* Also, (Huberman and Miles 2014) describe conceptual framework as the graphical representation of the various relationships within the research concepts. Accordingly, a conceptual framework specifies research variables concerning its design. Moreover, it reinforces the research objectives and how the research questions can be answered. Following the above, the conceptual framework developed in this section identifies the relevant variables from the extant literature that could lead to attaining the research objectives.

Considering that the core objective of this study is to investigate the role of stakeholder pressures and strategic resources on the environmental capabilities associated with GSCM implementations and how these capabilities might enhance firms' competitiveness, the relevant literature was synthesised into core conceptual clusters depicted in figure 3.2.

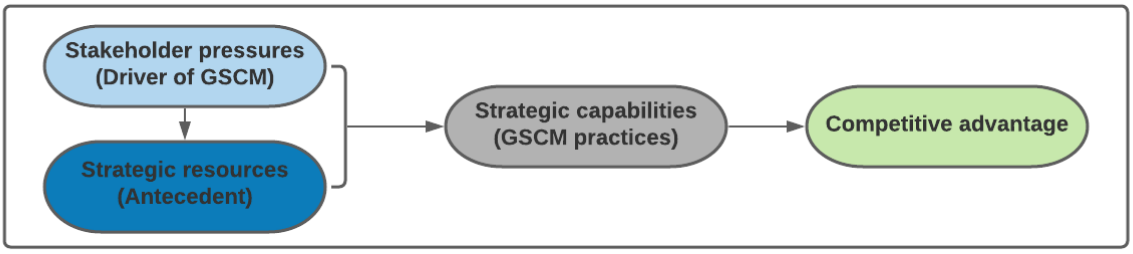

Figure 3.5: The conceptual research cluster

This study proposes stakeholder pressures as the driver of strategic resources and the NRBV strategic capabilities for GSCM implementation. The cluster further depicts strategic capabilities as the antecedents of firms' competitive advantage. The conceptual cluster stipulates that the relevant elements of the stakeholder theory (stakeholder pressures) are the drivers of the NRBV logic of strategic resources-environmental capabilities-competitiveness relationships. The clusters above are discussed in relation to the conceptual framework

3.4.1 Conceptualising stakeholders pressures as the antecedent of GSCM

Section 2.6 reveals that the stakeholders' expectations and requirements could result in pressures that drive firms to adopt sustainability practices. The stakeholder theory stresses that both the internal and external stakeholders can influence the decision of firms to adopt sustainability practices in their SCM (Buysse and Verbeke 2003; Eesley and Lenox 2006). Taking a neo-institutional perspective, Wang, Li and Qi (2020) assert that the pressures emanating from the stakeholders can be classified as internal pressures, market pressures, coercive pressures, and social pressures (normative pressures), as indicated in figure 3.3.

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Figure 3.6: A framework of stakeholder pressures.
(Source: Wang, Li and Qi 2020)

Internal pressures emanating from the internal governance of firms consist of the requirements of the shareholders and the top management (Wang, Li and Qi 2020). There is a consensus among scholars that firms cannot effectively implement GSCM practices without the support of a firm internal governance structure, particularly the top management (Ageron, Gunasekaran and Spalanzani 2012; Reuter et al. 2010; Walker and Jones 2012). The current study lays less emphasis on internal pressures in its conceptualisation since previous studies have validated the positive impact of internal pressures on firms' adoption of sustainability practices.

Market pressures are related to the pressures exerted on the focal companies by the supply chain partners (suppliers and customers) and competition (industry standards and competitors). Generally, suppliers with a green orientation can help focal firms reduce operational pollution by demanding improved environmental strategies through their assessment of the reputation and the ecological network mechanism of the focal firms (Chen et al. 2018; Chkanikova and Mont 2015; Gimenez and Sierra 2013). However, the extent to which green suppliers influence the adoption of GSCM practices of the firms in the O&G industry remains unknown. Apart from suppliers, customers' sustainability orientation can also drive firms to adopt green practices in their supply chain, as highlighted in section 2.5.1. Arguably, consumers have a more significant influence on firms' adoption of GSCM practices than the suppliers, as they have the power to collectively boycott the products of environmentally polluting organisations or institute legal actions against companies (Horbach, Rammer and Rennings 2012; Jiang and Bansal 2003).

The other aspect of market pressures is the competitive environment, represented by competitors and industry associations. Competitors' implementation of successful strategies, such as environmental technology, can drive the focal firm to reconfigure its ecological strategy to compete in the market effectively (Bansal and Roth 2000; Dowell and Muthulingam 2017; Wang, Li and Qi 2020). DiMaggio and Powell (1983) describe market pressures emanating from the competition as a form of mimetic pressure that drives firms to replicate the actions and strategies of successful competitors to achieve legitimacy, especially during periods of uncertainty. Evidence from the global petroleum industry indicates that such mimetic pressure from the competition can drive O&G firms to adopt green practices (Escobar and Vredenburg 2011). However, there is no evidence of the above in the Nigerian O&G industry. Also, industry associations can set standards and norms that regulate the activities of corporate members to enhance environmental sustainability (Delmas and Montes-Sancho 2010). For example, the international petroleum industry environmental conservation association (IPIECA) published a code of conduct that fosters its members' adoption of sustainability practices (IPIECA 2015, 2017). Industry associations' requirements and benchmarks can exert market pressures on focal firms to implement green practices in their supply chain (Wang, Li and Qi 2020).

Another source of stakeholder pressure emanates from government institutions in the form of coercive pressure. As highlighted in section 2.5.1, the responsibility for environmental protection confers the obligation to enact sustainability laws and regulations on government (Jaffe and Palmer 1997; Zhu, Sarkis and Lai 2013). Remarkably, the O&G industry is subject to stringent regulations because of its severe environmental impacts (Ahmad et al. 2017). Nevertheless, empirical study on the influence of government regulations as a coercive pressure in the O&G industry has yielded mixed results. For example, Ahmad et al. (2016) found that government regulation is a critical driver of sustainability practices in the Russian O&G industry, while Escobar and Vredenburg (2011) asserted that government regulation does not influence the adoption of sustainability practices among IOCs. These findings suggest the need for a further investigation into the impact of coercive pressure (government regulation) on the adoption of GSCM practices in the O&G industry.

Finally, normative pressures from NGOs, media, public and host communities can drive organisations to implement GSCM practices. Wang, Li and Qi (2020) describe normative pressure as social pressure based on social norms and practices. The increasing level of environmental consciousness among the general public (including the host community) significantly influences corporate environmental responsibility (Marquis, Glynn and Davis 2007). Also, environmental consciousness can influence people's perception of environmental problems associated with organisations' operations (Sexton and Sexton 2014). Thus, an environmentally conscious society (public) will pressure the focal firm to integrate environmental practices into its operations. For instance, Sine and Lee (2009) assert that a high level of environmental awareness in a society can drive local enterprises to adopt clean energy. Nevertheless, Dowell and Muthulingam (2017) argue that the influence of the public on corporate environmental practices is insignificant because firms only implement sustainability practices that align with their economic interests.

Furthermore, NGOs and media also influence corporate environmental behaviour. Particularly, NGOs explore the indirect mechanism of public campaigns, protests and litigations to influence the sustainability decisions of corporations (Eesley and Lenox 2006; Sharma and Henriques 2005). Past events in the O&G industry confirm that NGOs, in collaboration with the media, can influence firms the green practices of firms in the industry. For example, the Greenpeace activists successfully pressured Shell to reverse its decision to decommission the Brent Spent Spar into the North Sea, through consistent protests and media collaboration, despite the British government's support for Shell's decision in 1995 (Entine 2002). Also, various studies have examined how various NGOs have pressurised firms operating in the Nigerian O&G industry to adopt environmentally responsible practices (Ekhator 2014; Ikelegbe 2001; Kadafa 2012a; Oshionebo 2007).

Based on the above, the current study acknowledges that all types of stakeholder pressures earlier discussed can influence firms to adopt GSCM practices. However, the degree of the influence of each type of pressure on firms' implementation of green practices may vary across industries, firms and regions, depending on the saliency and the power of the respective stakeholders (Mitchell, Agle and Wood 1997). It is important to note that this research does not intend to examine the impact of all the types of stakeholder pressures on the adoption of green practices by firms operating across the supply chain of the Nigerian O&G industry as such an attempt would unnecessarily widen the scope of this study. Rather, the current research focuses on identifying the most critical stakeholder pressure that influences the adoption of GSCM practices by the firms operating in the supply chain of the Nigerian O&G industry. To the best of the researcher's knowledge, the literature focusing on sustainability adoption in the supply chain of the Nigerian O&G industry has not examined this area of study. Thus, empirical evidence of the most critical shareholder driver of GSCM in the Nigerian O&G industry is inexistent.

The initial conceptualisation of stakeholder pressures for the adoption of green practices by the firms operating in the supply chain of the Nigerian O&G firms is, at this stage, based on the notion that all types of stakeholder pressures (internal, market, coercive and normative) drive the implementation of GSCM practices in the industry. Therefore, following Guang Shi et al. (2012), this study argues that stakeholders' pressures can influence firms to acquire strategic resources and necessary capabilities to implement GSCM practices.

3.4.2 Conceptualising strategic resources for GSCM

The core thesis of NRBV (based on the tenets of RBV) is that organisations can only attain sustained competitive advantage when they utilise their strategic resources to develop specific strategic capabilities (Barney 1991; Hart 1995; Hart and Dowell 2011). Thus, strategic resources are required by firms to attain sustained competitive advantage. Subsection 2.6.2 indicates that the characteristics of strategic resources include value, rarity, inimitability and non-substitutability. When these capabilities are effectively deployed, organisations that foster future competitive advantage can develop proactive environmental capabilities in terms of pollution prevention, product stewardship, clean technology and the base of the pyramid (Hart and Dowell 2011; McDougall, Wagner and MacBryde 2021).

Firms' resources are classed as tangible or intangible. Resources are tangible when associated with physical features (Garcia-Parra et al. 2009). By nature, tangible resources can be easily identified and measured. Tangible resources are physical and include various physical assets at a company's disposal. Because of the ease of identification and measurability, tangible resources have attracted little or no controversy among scholars (Andersen and Kheam 1998). On the other hand, the International Accounting Standard (IAS) 38 defines intangible resources as *"non-monetary assets without physical substance held for use in production or supply of goods and services, for rental to others, or for* *administrative purposes that are identifiable, that an enterprise controls as a result of past events, and from which future economic benefits are expected to flow to the enterprise"* (Wittsiepe 2008:5). Many scholars have raised concerns about the measurability of intangible resources (McDougall, Wagner and MacBryde 2019). Interestingly, the RBV (NRBV) conceptualises intangibles as strategic resources that generate competitive advantage. According to Barney (1991), firms operating in dynamic business environments can attain a competitive edge when applying their heterogeneous intangible resources instead of tangible resources because tangible resources are hardly rare, inimitable, and non-substitutable. In the NRBV literature, Hart and Dowell (2011) conceptualised the intangible resources of continuous innovation, stakeholder engagement, disruptive change, and embedded innovations as the drivers of the NRBV strategic capabilities of pollution prevention, product stewardship, clean technology, and base of the pyramid.

The advocates of intangible resources argue that intangibles' peculiar duplicity difficulty attributes provide advantages over tangible resources (Amit and Schoemaker 1993; Barney 1991; Michalisin, Smith and Kline 1997). Empirical studies on the role of strategic resources in competitive advantage, from the RBV perspective, have equally focused more on intangible resources (Ambrosini, Bowman and Collier 2009; Carmeli 2001; Cousins et al. 2019; Hall 1992, 1993; Hitt et al. 2001; Wang, He and Mahoney 2009; Wiklund and Shepherd 2003). Most of these studies validated the positive impact of intangible strategic resources on firms' capabilities and competitiveness. For example, Carmeli (2001) analysed the views of ten CEOs of selected public firms in Israel. The author found that organisational strategy is the most crucial strategic resource that enhances the competitiveness of high-performing firms, while marketing and selling are the most critical strategic resources for low performing firms. Their findings suggest that firms' strategic resources can also differ across industries. Cousins et al. (2019) analysed 248 survey data gathered from the UK manufacturing sector using moderated hierarchical regression. The authors found that high levels of eccentricity and supply chain traceability are critical strategic resources for improved cost performance through GSCM practices. Also, Kwak, Seo and Mason (2018) applied the SEM technique to analyse survey data from the South Korean logistics sector. They found that supply chain innovation is a strategic resource that enhances risk management capabilities for competitive advantage in the global supply chain.

Following the empirically verified positive impact of intangible resources on firms' capabilities and competitiveness, the literature suggests that firms increasingly commit investment to intangible resources such as research and development, software, education and training, marketing while dedicating less attention to physical assets (Cheng et al. 2009; Tanriverdi and Lee 2008). The commonly cited intangible resources in RBV/NRBV literature are provided in table 3.1.

Table 3.2: Intangible resources in previous research.

Intangible resources	Sample references
Employee know-how	Hall (1992); Hall (1993); Coff (1999)
Firm-specific tacit-knowledge	Wiklund and Shepperd (2003); Wang et al. (2009)
Human capital	Hitt et al. (2001); Russo and Harrison (2005); Ambrosini et al. (2007)
Innovation/continuous innovation	Hart (1995) Hart and Dowell (2011) Palacios, Gil and Garrigos (2009)
Customer relationships	Aaker (1989); Ambrosini et al., (2007)
Firm reputation and organisational culture	Hall (1992); Roberts and Dowling (2002); Rindova, Williamson and Petkova (2010).
Social capital	Chisholm and Nielsen (2009).
Entrepreneurial skills	Hoskisson et al. (2000)
Information technology	Powell and Dent-Micallef (1997); Ray, Xue and Barney (2013)
Supply chain innovation	Kwak, Seo and Mason (2018); Sabahi and Parast (2020)
Stakeholder engagement	Hart (1995); Hart and Dowell (2011)
Disruptive change	Hart and Dowell (2011)
Strategic supply chain collaboration	Soosay, Hyland and Ferrer (2008)
Supply chain traceability	Cousins et al (2019)
Eccentricity	Cousins et al (2019)

The constituents of strategic resources in the O&G industry have not received research attention. Generally, the availability of crude deposits is regarded as a strategic resource in the industry. At the project level, Al-Hanshi et al. (2020) suggest that human resources issues, including talented project managers and employee development programmes, are the most significant strategic resources in the O&G project management. Since there is no research focusing on strategic resources in the Nigerian O&G industry, the current study conceptualises all strategic resources as the antecedents of strategic capabilities for GSCM implementation in the O&G industry. However, exploratory research would later be conducted in this study to identify the specific resources that drive the strategic capabilities for GSCM adoption in the Nigerian O&G industry.

3.4.3 Conceptualising strategic capabilities for GSCM

The current study adopts the NRBV framework to conceptualise the strategic capabilities that summarise the GSCM implementation in the Nigerian O&G industry. Many studies have indicated that GSCM practices and environmental capabilities can enhance firms' competitiveness (Esfahbodi et al. 2017; Granek and Hassanali 2006; Green Jr et al. 2012; Zhu, Sarkis and Lai 2012). The four strategic capabilities within the NRBV framework (pollution prevention, product stewardship, clean technology, and the base of the pyramid) were identified and discussed in Section 2.6. Also, the specific points of alignment between GSCM and each of these capabilities were identified in section 2.6.4.

From a theoretical perspective, some studies have asserted that the NRBV strategic capabilities discussed in section 2.6 could be adopted as a proxy for GSCM practices. For example, Yunus and Michalisin (2016) developed a framework of competitive advantage based on the inclusion of GSCM practices within the NRBV strategic capabilities of pollution prevention, product stewardship and sustainable development. Also, Guang Shi et al. (2012) developed a structural model of NRBV-GSCM that infused GSCM practices (summarised as intra-organisational environmental practices and inter-organisational environmental practices) within the NRBV strategic capabilities of pollution prevention and product stewardship. McDougall, Wagner and MacBryde (2021) proposed a framework of dynamic capabilities and NRBV linking SSCM practices with the four NRBV strategic capabilities of pollution prevention, product stewardship, clean technology and base of the pyramid. Although the empirical validation of these theoretical propositions is scant, McDougall, Wagner and MacBryde (2019) found that sustainability practices in the supply chain of the UK food processing industry are interlinked with the NRBV strategic capabilities of pollution prevention, product stewardship and clean technology. The authors could not verify the existence of sustainability practices linked with the base of the pyramid capabilities.

Following the above, this research argues that the four strategic environmental capabilities (pollution prevention, product stewardship, clean technology and base of the pyramid) can be effectively adopted as the proxy for GSCM practices in the Nigerian O&G industry. Whereas few studies have examined some of these capabilities in the context of the O&G industry (Escobar and Vredenburg 2011), indicating the applicability of the NRBV in the O&G industry, further research is necessary in this regard, especially in the context of a developing nation O&G industry. In line with the logic of the NRBV, this study argues further that the four strategic capabilities within the NRBV framework mediate the relationship between strategic resources and competitiveness (Hart and Dowell 2011). However, since the specific linkages between GSCM practices and the NRBV strategic capabilities have not been previously validated in the Nigerian O&G industry, this study adopts an exploratory approach to first identify the specific area of alignment between the NRBV strategic capabilities (McDougall, Wagner and MacBryde 2019) before determining the impact of these capabilities on firms' competitiveness.

3.4.4 Conceptualising the competitiveness outcome of GSCM practices

Generally, firms target competitiveness by developing new technologies, markets, and products (McGrath, MacMillan and Venkataraman 1995). For this purpose, companies effectively deploy their strategic resources to develop specific strategic capabilities that position them above the competition (Barney 1991; Grant 1991; Hart 1995). Hart (1995) portends that future competitive advantage is dependent on firms' environmental strategy. Thus, environmental management practices such as GSCM can generate stakeholder value and enhance competitiveness (Thummalapalli 2019). Following the theoretical linkage between GSCM and NRBV strategic capabilities (Guang Shi et al. 2012; McDougall, Wagner and MacBryde 2021; Yunus and Michalisin 2016), it is reiterated that the strategic capabilities for GSCM presented in section 3.3.3 are sources of competitive advantage to organisations in line with the postulations of NRBV (Hart 1995; Hart and Dowell 2011). According to Esty and Winston (2009), environmental practices do not only minimise costs and operational risks; they also improve revenue and enhance firms' intangibles such as brand reputation and trust. Despite the above, scholars lack consensus on the impact of environmental practices on firms' competitiveness.

Porters (1985) argues that competitive advantage can be linked to cost and differentiation. Section 2.6.3 asserts that competitive advantage can manifest in different forms such as quality, time, customisation and many others. Previous studies have also adopted different constructs to measure the competitive outcome of environmental practices. For example, Rao and Holt (2005) assessed competitiveness through improved efficiency, quality, productivity and cost reduction, while Testa and Iraldo (2010) measured competitiveness with profitability. Other studies in GSCM and NRBV have conceptualised competitiveness from environmental and economic outcomes (Eltayeb et al. 2011; Esfahbodi et al. 2017; Fankhauser et al. 2013; Salem et al. 2016). The results of the impacts of environmental sustainability practices on the competitive outcome are generally inconsistent.

In this research, firms' competitiveness is conceptualised as economic and environmental competitiveness. In line with previous studies (Esfahbodi et al. 2017; Li et al. 2006; Rao and Holt 2005), economic competitiveness is defined as the cost savings attributable to the implementation of GSCM practices and a firm's ability to meet customer's demand ahead of the competition. Environmental competitiveness is construed as the competitive advantage attributable to a firm corporate environmental reputation derived from the implementation of GSCM practices (Testa and Iraldo 2010; Vachon and Klassen Robert 2006). Due to its polluting nature, the O&G industry has attracted global attention and criticism through various campaigns and stringent regulations (Ahmad et al. 2017). This research argues that environmental reputation is a source of competitiveness for firms in the supply chain of the Nigerian O&G industry. Thus O&G firms do not only need to enhance their economic competitiveness; they also need to improve their environmental competitiveness. Indeed, it is argued that an enhanced environmental reputation can boost the economic competitiveness of O&G firms.

Summarizing the conceptualisation of the constructs of this research as previously discussed, the initial conceptual model of this research is based on the following propositions:

- Stakeholder pressures can drive O&G firms to acquire strategic resources and develop environmental capabilities for GSCM practices.

- Effective deployment of strategic resources could help O&G firms develop the four NRBV strategic capabilities of pollution prevention, product stewardship, clean technology, and the base of the pyramid.
- The NRBV strategic capabilities can be used as the proxy of GSCM practices as both concepts are effectively linked.
- NRBV strategic capabilities (GSCM practices) can enhance environmental and economic competitiveness.
- Environmental competitiveness can improve economic competitiveness.

The initial conceptual framework proposed in this study argues that stakeholder pressures are effective drivers of firms' decisions to acquire strategic resources and capabilities for GSCM adoption. Further, the deployment of strategic resources can help firms develop the NRBV strategic capabilities for GSCM, resulting in enhanced economic and environmental competitiveness. Thus, stakeholder theory is conceptualised as the antecedent of NRBV. The proposed initial conceptual framework is presented in figure 3.4.

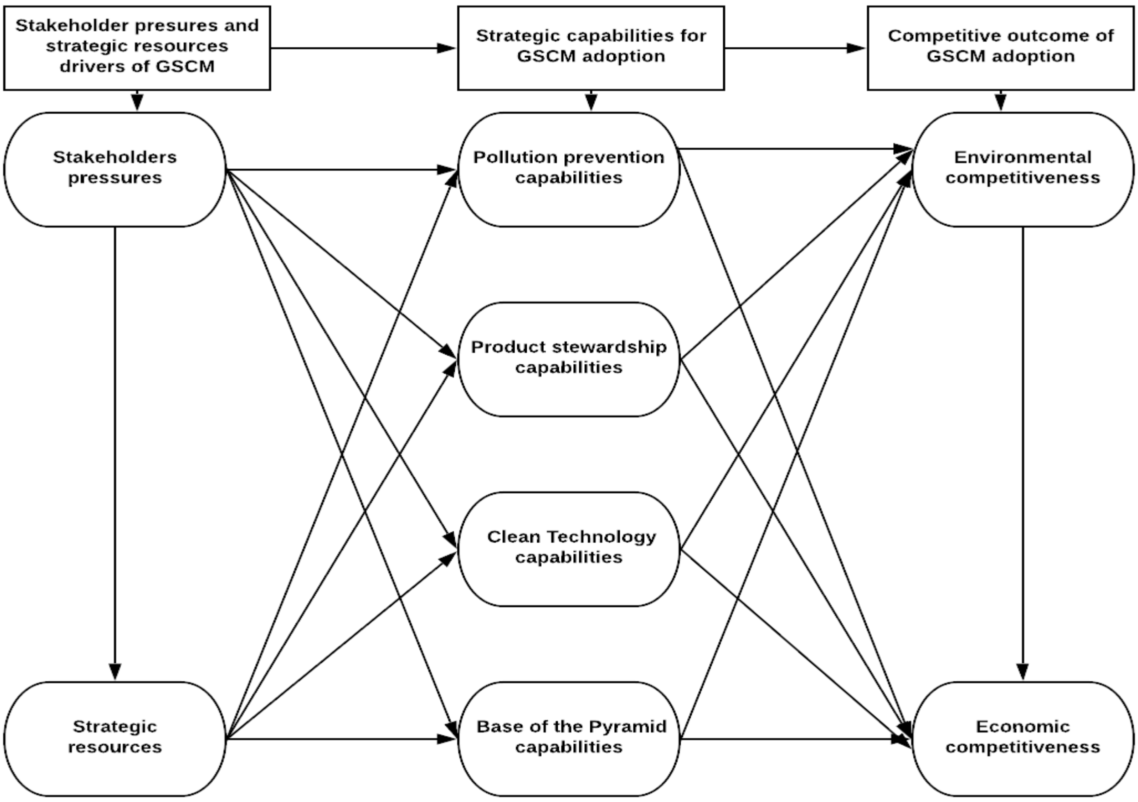

Figure 3.7: Proposed conceptual framework.

This framework presumes all stakeholder pressures presented in section 3.3.1 as the antecedents of strategic resources and strategic capabilities for GSCM adoption. Also, the framework conceptualises all strategic resources as the drivers of the strategic capabilities for GSCM adoption. According to Zhu et al. (2013), the pressures emanating from stakeholders have varying influences on firms' strategic decisions. For example, Esfahbodi et al. (2017) identified coercive pressure (government regulations) as the primary driver of sustainability adoption by UK manufacturing firms. In contrast, Escobar and Vredenburg (2011) found that coercive pressures have no significant impact on sustainability adoption among O&G firms. The authors identified mimetic pressures emanating from competitors as the most critical driver of environmental practices in the O&G industry. The above validates that stakeholder pressures may differ across countries and industries. Hence, since this study focuses on the Nigerian O&G industry, it argued that all institutional pressures presented in section 3.3.1 might not drive the acquisition of strategic resources and capabilities for GSCM implementation in the industry. The paucity of literature on GSCM in the Nigerian O&G industry has made it impossible to identify the critical stakeholder pressures that drive sustainability practices. Therefore, this research argued that there is a need to explore the specific stakeholder pressures that influence the adoption of GSCM practices in the Nigerian O&G industry and conceptualise the same as the fundamental driver of strategic resources and capabilities for GSCM in the Nigerian O&G industry. Thus, the generic conceptualisation of strategic resources in the framework above requires a refinement with an empirically validated construct specific to the Nigerian O&G industry.

Furthermore, the generic conceptualisation of strategic resources in the framework might not reflect the reality in the Nigerian O&G industry, as there is no empirical evidence that validates the specific strategic resources that drive GSCM adoption in the Nigerian O&G industry. The critics of RBV/NRBV have hinged their argument on the latent nature of the strategic resources based on value, rarity, inimitability and non-substitutability (Lockett, Thompson and Morgenstern 2009; Powell 1992). Nevertheless, Hart and Dowell (2011) emphasise the need for researchers to identify the specific strategic resources that enhance the strategic environmental capabilities within the NRBV framework. Consequently, this research explores the specific strategic resources that drive the strategic environmental capabilities in the Nigerian O&G industry in chapter 5. The exploratory study results refine the strategic resources construct in figure 3.3 with the specific variables identified in the industry.

Also, the conceptual framework presented in this chapter has conceptualised the NRBV strategic capabilities of pollution prevention, product stewardship, clean technology and the base of the pyramid as the proxy for GSCM practices (Guang Shi et al. 2012; McDougall, Wagner and MacBryde 2021; Yunus and Michalisin 2016). Whereas this position is theoretically established, there is a lack of empiricism, especially in the O&G industry. In the UK food processing industry, McDougall, Wagner and MacBryde (2019) found that sustainability practices are interlinked with all the NRBV strategic capabilities except for the base of the pyramid capability. This research further explores the specific

GSCM practices linked with each of the NRBV strategic capabilities (pollution prevention, product stewardship, clean technology and base of the pyramid). Through this process, the strategic capabilities are validated and effectively adopted as the proxy for GSCM practices in the Nigerian O&G industry.

3.4.5 Comparison with the previous models

The proposed conceptual framework of this research is different from previous research models in many aspects. First, this framework adopts a holistic approach that integrates all strategic environmental capabilities in the NRBV. Previous frameworks that integrate NRBV with GSCM are somewhat limited in this capacity. For instance, Shi et al's. (2012) Natural resource-based GSCM model excluded the NRBV clean technology and base of the pyramid capabilities. Also, Yunus and Michalisin's (2016) model of GSCM and sustained competitive advantage bundled failed to unbundle the sustainable development into clean technology and base of the pyramid capabilities as proposed in the current NRBV literature (Hart and Dowelll 2011; McDougall et al. 2021). The current model is arguably one of the few frameworks that holistically integrate all elements of the NRBV in the context of GSCM as previous frameworks, considering NRBV in this perspective is generally on strategic management issues rather than GSCM (Anthony Jnr 2019).

Second, previous GSCM models in NRBV have significantly neglected the place of strategic resources in building organisations' strategic environmental capabilities as contemplated in the NRBV literature. Few models that attempted to integrate strategic resources have presented an ambiguous approach to recognising strategic resources. For instance, Yunus and Michalisin (2016) presented the nature of strategic resources in their model of GSCM and sustained competitive advantage instead of conceptualising the specific resources that drive the GSCM-linked NRBV capabilities. The current framework addresses this shortcoming by conceptualising strategic resources as the key driver of the NRBV strategic environmental capabilities. This study further examines the proposed conceptual framework with the specific strategic resources empirically verified in the Nigerian O&G industry. This helps to address the problem of ambiguity in recognising the resource-driver of strategic environmental capabilities, which has been identified as a challenge in operationalising the NRBV concept.

Furthermore, studies that investigate the specific neo-institutional stakeholders influencing firms' resources and capabilities for the adoption of GSCM practices, as proposed in this study, are rare. Shi et al. (2012) attempted to address the above issue by hypothesising institutional factors as the driver of NRBV-GSCM practices. However, since the study is entirely conceptual, the specific institutional drivers of NRBV-GSCM practices are not empirically validated in their model. The model proposed in the current study addresses this lacuna by identifying the specific neo-institutional stakeholder factors that drive the implementation of GSCM practices in the Nigerian O&G industry.

Finally, the proposed framework in this study is unique because of its adaptability to the current issues in the O&G industry. The petroleum industry is arguably one of the most exposed to environmental sustainability pressures from external stakeholders. All regulations that limit carbonisation are indirectly targeted at the O&G industry as a major root cause of GHG emissions (Ahmed et al. 2017). In effect, the current legislation, policies and activities of social and institutional actors demand the O&G industry to supply products with minimal impacts on the environment and society to the global market. While it could be argued that the O&G industry may be unable to achieve sustainability due to its carbon-intensive nature, (Ahmed et al. 2017) asserted that an acceptable level of environmental sustainability can be attained if O&G operations are on a smaller scale, complemented with energy transition. Other studies have argued that the O&G industry is critical to energy transition (Shojaeddini et al. 2019; Morgunova and Shaton 2022). The proposed research framework in this study helps to understand how the O&G industry responds to external sustainability pressures by applying its strategic resources and capabilities. Remarkably, the inclusion of the clean technology construct in this framework enables this research to examine the diversification strategies of the O&G industry in the face of the energy transition.

3.5 Chapter conclusion

This chapter presents the initial conceptual framework of this research to address the research gap identified in the previous chapter. The proposed framework is based on stakeholder theory and NRBV. Specifically, stakeholder pressures are depicted as the antecedent of strategic resources and strategic capabilities for GSCM practices. Also, strategic resources are conceptualised as the driver of the strategic capabilities for GSCM implementation leading to improved economic and environmental competitiveness. However, this chapter's conceptualisation of stakeholder pressures and strategic resources is considered generic. This is because there is no previous empirical validation of the specific stakeholder pressures and strategic resources that enhance the strategic capabilities for GSCM practices in the Nigerian O&G industry. Similarly, the NRBV strategic capabilities conceptualised as the proxy of GSCM practices lack empirical validation in the Nigerian O&G industry. Thus, despite the initial conceptual framework's ability to address this study's research questions, some of the constructs require refinement for applicability in the Nigerian O&G industry. Therefore, this research will refine the conceptual framework in this chapter with an exploratory study to identify the specific stakeholder pressures and strategic resources that drive the strategic capabilities for GSCM practices in the Nigerian O&G industry. The exploratory research will further identify the point of linkages between GSCM practices and the NRBV strategic capabilities, thereby validating the adoption of NRBV strategic capabilities as the proxy for GSCM practices in this research. Consequently, the next chapter presents the methodology adopted in this study to refine the proposed conceptual framework and empirically assess the refined version of the framework in line with the aim of this study.

Chapter 4: Research methodology

4.1 Chapter Introduction

Upon developing the foundational basis of this research in the preceding chapters, it is necessary to present the methodology applicable to this study. Specifically, this chapter focuses on transitioning from a mere theoretical study to an actionable, practical research process tailored to answer this study's research questions. The chapter essentially discusses the philosophical and methodological choices adopted in carrying out this research and the justifications for those choices. Structurally, the chapter is divided into various sections, as indicated in figure 4.1.

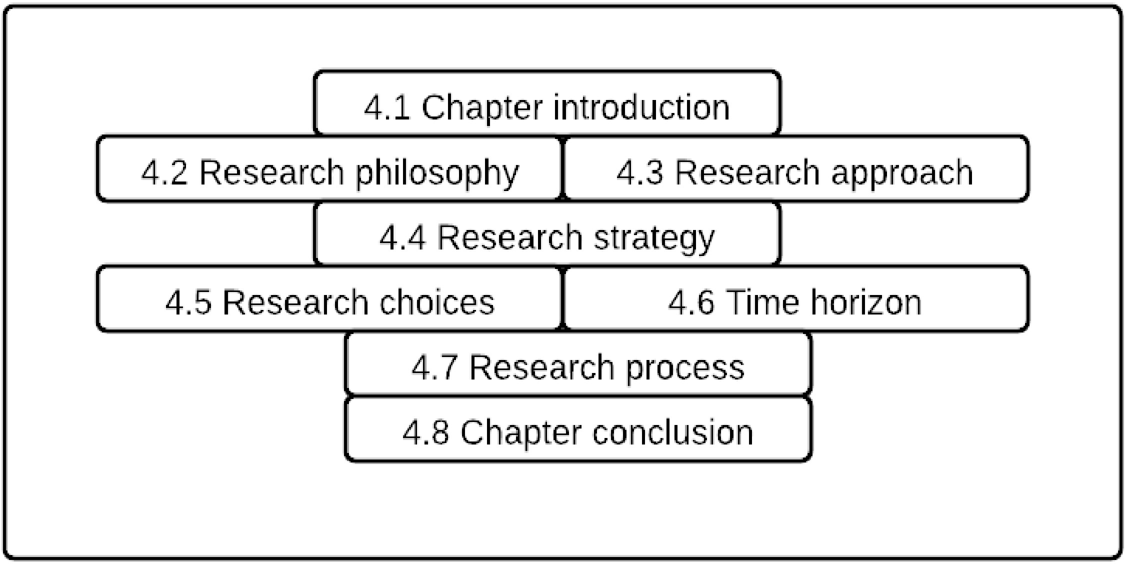

Figure 4.1: The structure of chapter four

These sections address two significant methodological issues. The first aspect presents the underlining philosophical assumptions, such as the research philosophy and research approach. The second aspect of the chapter focuses on practical considerations about the methodological design, covering critical areas such as research strategy, research design, research method, data collection method, and analysis techniques (for the qualitative and quantitative study). Other practical issues discussed in this chapter include questionnaire design, ethical consideration, pilot study, sampling technique, and details of data gathering procedures. The overall methodological design of this study is presented in figure 4.2.

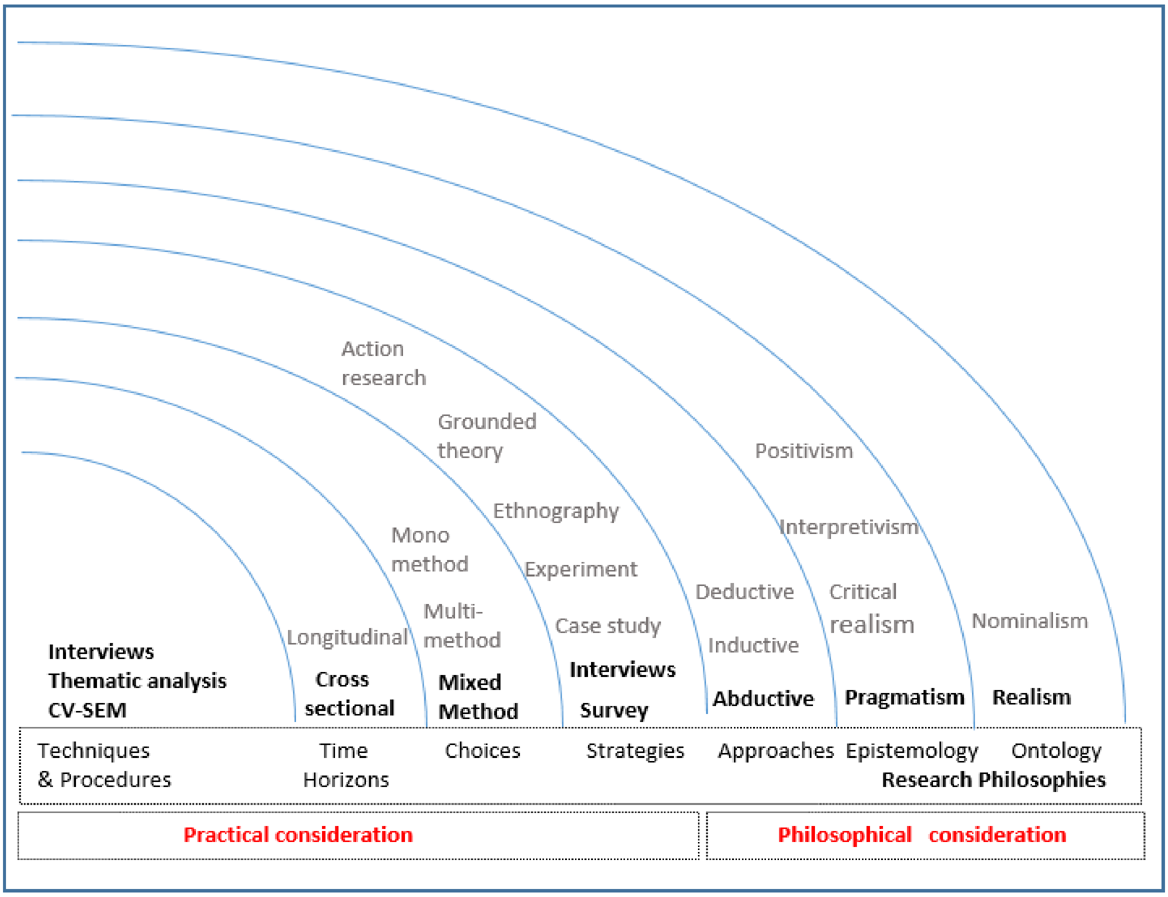

Figure 4.2: The methodological overview of this study

The figure above shows the methodological options available to social researchers, with the choices adopted in this research indicated in bold text. The basis of the selection of these choices and their justification are discussed in the subsequent sections.

4.2 Research philosophy

Investigating a research phenomenon in social science is usually underscored by the philosophical paradigm adopted by the researcher (Bryman and Bell 2011; Saunders, Lewis and Thornhill 2009). A researcher's philosophical assumptions fundamentally influence how a research question is addressed. Consequently, it is essential to review the available philosophical paradigm choices available to researchers while justifying the underpinning research philosophy of the current study. In social research, philosophical paradigms are often viewed from the ontological and epistemological perspectives (Saunders, Thornhill and Lewis 2009; Bryman and Bell 2011). Therefore, the ontological and epistemological stances concerning the current study are discussed below.

4.2.1 Ontology

Ontology is the theory of 'being' and how we derive knowledge of the nature of reality (Delanty and Strydom 2003). It is an aspect of philosophy that focuses on the existence of the world and its components (Crotty 1998). In social research, ontological philosophy raises the question of whether social entities objectively exist independent of the social actors. As indicated in figure 4.2, ontology is classified into realism and nominalism (Burrell and Morgan 2006).

Realism is based on the notion that social entities exist independent of social actors (Bryman and Bell 2011). Hence, realists assume that the actions and interactions of social actors are external to the social entity under research examination (Burrell and Morgan 2006). In contrast, nominalism ontology stipulates that the meaning and reality of social phenomena do not have an independent existence but are construed based on the interaction of social actors with the social phenomena (Bryman and Bell 2011). Therefore, the nominalist assumes that outputs derived from a research investigation can only be meaningfully interpreted based on cultural norms and individuals' social interactions (Robson and McCartan 2011; Schwandt, Lincoln and Guba 2007).

This research adopts the ontological stance of realism to address the research questions. This is because the overall aim of this research is to empirically ascertain the impact of the NRBV related GSCM practices on the competitiveness of the Nigerian O&G industry. Looking at the aim of this study, it could be deduced that this research intends to measure the impact of certain independent variables on independent variables in the context of GSCM and NRBV. This indicates that an ontological position that promotes the free interaction of variables without the interference of social actors would be appropriate in this situation. Therefore, in line with Brunel and Morgan (2006), the realist's ontology perfectly aligns with this objective. The above justifies its adoption as the ontological stance of this study.

4.2.2 Epistemology

Epistemology is the second aspect of research philosophy. Epistemology underscores the theory of knowledge and how we come about them (Gray 2014). Since knowledge is diverse and dynamic, epistemology questions the idea of what is regarded as true or false knowledge regarding a research phenomenon. Creswell (2009) noted that epistemology creates a ground for distinguishing between knowledge and opinion and belief or falsehood. In doing this, epistemology specifies how the researcher relates to reality (Maynard 1994) by defining whether or not a social scientist can adopt a natural scientist's approach of experimentation and observation to study a social phenomenon. Epistemology is mainly classified into the objective stance of positivism and the subjective perspective of Interpretivism.

Positivism is the objective stance of epistemological philosophy (Burrell and Morgan 2000), where the researcher addresses the research problems as an external actor who is distinct from the subject of the research. This approach is characterised by using a natural scientist's strategy to quantitatively assess developed hypotheses in theory (Bryman and Bell 2011). In social research, the positivist attempts to decipher scientific cause and effect rules that regulate the interactions among identified variables in a social phenomenon (Comte 1975). The researcher effectively acts as an observer of social reality without influencing the research process and results (Wisker 2007).

In contrast, Interpretivism, which is the subjective stance of epistemology, holds that building accurate knowledge of the social world is *relativistic* and can only be depicted from the perspectives of the social actors (Burrell and Morgan 2006). Thus, an interpretivist portends that a natural scientist's approach, based on experimentation and observation, is insufficient to fully understand social reality (Saunders, Lewis and Thornhill, 2009). An interpretivist focuses more on understanding human behaviour and its influence on the research subject (Bryman and Bell 2011).

Both positivism and Interpretivism have attracted some level of criticism among scholars. For instance, Gill and Johnson (2002) portend that the positivist's natural scientist's approach lacks the logic to understand the influence of subjective human nature in social science. Also, Briggs and Coleman (2007) argue that the interpretivist's emphasis on the subjective human nature results in multi-perspective meanings that may not reveal the due nature of social realities.

In addition to the above, research may share the characteristics of both positivism and Interpretivism. In this study, the NRBV and stakeholder theory were combined to suggest various constructs' relationships. This approach is in alignment with the positivist paradigm. Also, the dearth of research on the linkage between NRBV and GCSM requires interrogating social actors in the Nigerian O&G industry to establish the NRBV strategies linked with GSCM. This approach aligns with the interpretivism philosophy. Thus, the current study has the elements of both positivism and Interpretivism. To reconcile the *paradigm war* that cocooned researchers into the two extremes of epistemological stances of positivism and objectivism (Kuhn 1970), hybrid paradigms that combines the features of both positivism and Interpretivism have been proposed by scholars. These are critical realism and pragmatism, as discussed below.

Critical realism stems from the ontological position that the empirical observation of a research phenomenon is manifested in its natural and actual nature (Archer et al. 2013). Therefore, the real nature of social entities is defined by the communication among humanity through interpretation, experiences and practices (Smith 2005). Critical realism holds that while facts can be construed from observable phenomena, meanings of sensations created by social entities are subject to contextual interpretation.

On the other hand, pragmatism is a philosophical approach to solving practical problems in the real world (Yvonne Feilzer 2010). It is based on the notion that knowledge can be developed from observable phenomena and subjective meanings, depending on the nature of the research question. Hence, different perspectives can practically be integrated. Thus, its adoption affords a researcher the flexibility of adapting the prevailing circumstances of the phenomenon to the research work (Bryman and Bell 2011).

It is pertinent to note that both critical realism and pragmatism apply in mixed-method research. Looking at the nature of the current research, any of these epistemological stances can be used. The next section discusses the epistemological position of this study.

4.2.3 The epistemological stance of the current research

As indicated in figure 4.2, the epistemological basis of the current study is pragmatism. According to Saunders, Lewis and Thornhill (2009), the nature of a study's research questions and objectives is a critical determinant of research philosophy. As earlier highlighted, positivism and Interpretivism are relevant to various aspects of this research. These philosophical bases align with its overall aim of determining the impacts of proactive environmental practices (GSCM) on the competitiveness of the Nigerian O&G industry. Based on the above, a hybrid epistemological stance that combines the advantage of both positivism and Interpretivism is the most appropriate paradigm for this study.

Therefore, critical realism or pragmatism can be appropriately applied in this study. However, a cursory look at the nature of the research questions would reveal that there may be a need to combine multiple research methods in gathering and analysing the relevant data for this study. Considering that pragmatism is widely acknowledged as a compatible paradigm for mixed-method research (Venkatesh, Brown and Bala 2013; Yvonne Feilzer 2010)**,** pragmatism is regarded as the most appropriate paradigm for this research. The use of pragmatism in this research enables the researcher to adopt an interpretivist's stance to empirically explore the existence of specific GSCM practices that are linked with the four NRBV environmental strategies of pollution prevention, product stewardship, clean technology and base of the pyramid before eventually transitioning to the adoption of the positivist's approach for determining the impacts of GSCM practices on the competitiveness of the firms in the industry (Venkatesh, Brown and Bala 2013).

4.3 Research approach

The research approach is concerned with the application of theory in research work (Saunders, Lewis and Thornhill 2009). The three research approaches in social research are deductive, inductive, and abductive (Saunders, Lewis and Thornhill 2009; Bryman and Bell 2011). The nature and the objectives of these approaches are presented in table 4.1.

Table 4.1: Overview of research approach

Research approach	**Beginning point**	**Objective**
Deductive	It starts with a theory that will be tested with data.	To test a theory, thereby accepting/rejecting hypotheses.
Inductive	It starts from empirical observations	To develop a theory based on findings from the data.
Abductive	**It may start either from a real-life/empirical observation or from a theoretical viewpoint.**	**To develop a theory and confirming the same as a way of deepening the understanding of a new phenomenon.**

The deductive approach starts by developing a theory to be tested with data, leading to the rejection or acceptance of hypotheses based on statistical analysis (Bryman and Bell 2011). Therefore, the deductive approach is usually based on the ontological philosophy of realism and epistemological philosophy of positivism (Creswell 2012; Gray 2014). In contrast, the inductive approach works in the reverse direction to the deductive approach by analysing data to develop a theory without statistical techniques for confirming hypotheses (Bryman and Bell 2011). Generally, the inductive approach is based on interpretivism and nominalism philosophy (Saunders, Thornhill and Lewis 2011).

This study is based on the abductive approach, which is the third category of research approach in social research. The Abductive research approach is an iterative theory matching process that enables a researcher to progressively alternate between theory and empirical study (Dubois and Gadde 2002). Thus, the abductive approach combines the features of both inductive and deductive approaches in a single study.

The focus of this research justifies the adoption of abduction in this research. In the first instance, the research develops a theoretical framework to be empirically tested to confirm a theory. This process is consistent with a deductive approach. Also, the study explores the specific sustainability drivers, strategic resources and GSCM practices with their links to NRBV strategic capabilities in the context of the O&G supply chain. This qualitative study is necessary to deepen the understanding of the relevant variables that are appropriate to achieve the objectives of this research. This approach is inductive. Accordingly, combining these approaches to enable the researcher to move back and forth between the deductive and inductive approaches and vice versa (Venkatesh, Brown and Bala 2013) is the most appropriate approach to this study. This Abductive approach provides this possibility as it enables the research to benefit from the advantages of both approaches. Therefore, considering the objective of this study, the abductive is selected as the most appropriate research approach. The argument further justifies that the abductive approach is compatible with the pragmatism paradigm (Venkatesh Brown and Bala 2013) selected for this study.

4.4 Research strategy

Research strategies are the specific techniques employed by a researcher to attain the research objectives and answer the research questions. Authors have adopted different approaches to classify research strategies. For example, Robson (2002) recognised three research strategies: experiment, survey, and case study. Saunders, Lewis and Thornhill (2009) added action research, grounded theory, ethnography, and archival research to the three strategies above. From another perspective, Bryman and Bell (2011) depict research strategies consisting of only qualitative and quantitative strategies, emphasising their peculiar data collection methods.

Irrespective of the classification, this research adopts a multi-strategy approach that combines qualitative interviews with a quantitative survey to achieve its objectives. Following its philosophical basis of pragmatism and deductive approach, a mixture of qualitative and quantitative strategies is appropriate for this study. As indicated in figure 4.3, these strategies are interlinked with the research questions to provide the relevant answers from this research investigation effectively.

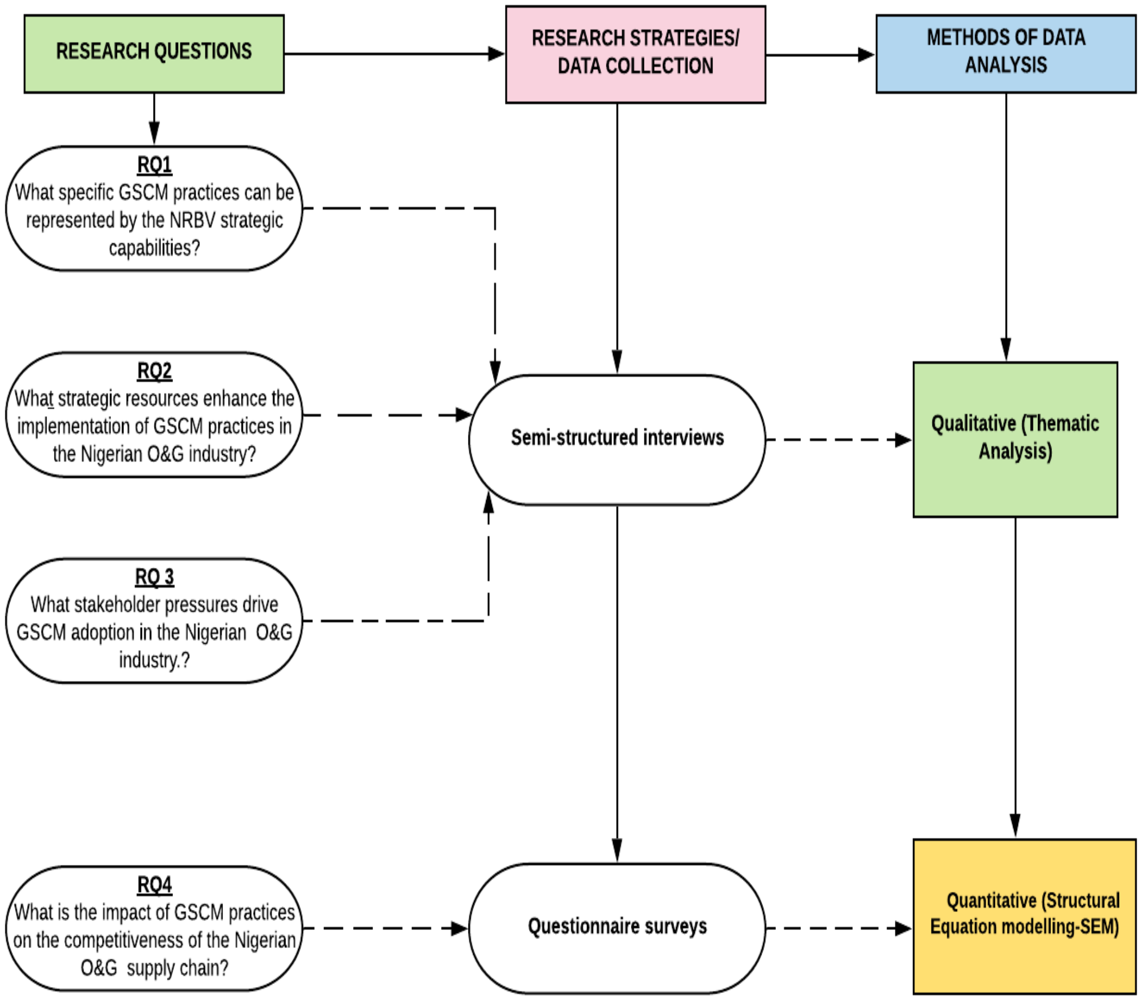

Figure 4.3: Research strategy linkage with research questions

The exploratory nature of the RQ 1, RQ2 and RQ 3 of this research requires a strategy to develop a deep understanding of the research focus from the participants' perspectives. The most appropriate technique for this objective is the interview strategy, as it enables researchers to gain deep insights into a research phenomenon (Robson 2002; Saunders *et al.* 2012). Interview is categorised into structured, semi-structured, and unstructured interviews (Bryman and Bell 2011). This study adopts a semi-structured interview because it enables the researcher to elicit information from the participants in a focused manner while creating the flexibility to ask follow-up questions to produce richer data (Bryman and Bell 2011). Therefore, the role of the interview strategy in the current research is to explore the specific variables for refining the proposed conceptual framework before its assessment.

In contrast, the survey strategy is adopted to address the RQ4 of this study. This research strategy is beneficial for collecting large scale quantitative data to be deductively analysed using the relevant statistical techniques. Survey strategy is the most popular technique in SCM (Giunipero et al. 2008; Mentzer and Kahn 1995; Sachan and Datta 2005). This is because the strategy is considered economical and creates an opportunity to measure latent constructs as common in operations management research (Mentzer and Kahn 1995). A researcher can effectively assess research models and evaluate theories with empirical data using a survey strategy (Forza 2002). Thus, the findings of the exploratory study can be modelled into a theory that can be assessed using a survey strategy. Therefore, considering that the RQ4 of this study is focused on evaluating a research model refined with the findings of the exploratory research, the use of a survey strategy to address this question is justified.

4.5 Research choices-Mixed method research

Research choices are concerned with practical consideration regarding the methods applied in data collection and analysis in research work (Saunders, Lewis and Thornhill 2009). The selection of an appropriate method enables the researcher to address cogent issues such as sample selection, research instruments and data collection required to answer the research questions effectively. A researcher may use a mono-method (involving only one method of data collection and analysis), multi-methods (using two or more methods of the same techniques) or mixed methods (combining two different methods – qualitative and quantitative in a single study). The current study is mixed-method research (MMR) that combines qualitative and quantitative methods to collect and analyse the relevant data to address the research questions. Combining both qualitative and quantitative methods in this study is inevitable because the research objectives of this study can be best attained using different data collection and analysis methods. In this study, MMR provides the strength to overcome the attributable weaknesses of qualitative and quantitative methods while benefiting the strengths of both methods (Creswell and Clark 2011).

In addition to the above, the MMR choice confers other advantages to this study. One of these is triangulation. As noted by Fidel (2008), triangulation is one of the primary reasons for the adoption of MMR. According to Johnson et al. (2007), the adoption of multiple research methods is a source of methodological triangulation. Through such triangulation, a researcher can enhance the validity and generalisability of research findings by combining various methods (Kaplan and Duchon 1988). Furthermore, MMR is very useful in developing constructs and relevant hypotheses in a field with a dearth of previous studies by taking an exploratory qualitative approach towards deepening knowledge in such an area, later completed by quantitative analysis (Fidel 2008). This situation applies to the current study, where the relationship between GSCM and NRBV strategies lacks empirical verification in the extant literature.

To successfully carry out MMR research, a researcher is required to determine the sequence of interaction between qualitative and quantitative methods in the study (Rocco et al. 2003; Fidel 2008). According to Creswell and Clarke (2007), MMR can combine qualitative and quantitative research in three ways. These are sequential exploratory design (where the quantitative analysis precedes the qualitative), sequential exploratory design (where the qualitative comes before the quantitative) and concurrent triangulation design (where both the qualitative and quantitative are carried out simultaneously).

Creswell and Clarke (2007) advise that critical factors such as the research problem, purpose, and questions must be considered when selecting the appropriate research design for MMR. In this research, the main reason behind the adoption of the MMR is to first explore the links between GSCM practices and NRBV strategies with their stakeholders and resource antecedents before assessing the impacts of GCSM practices on competitiveness of the Nigerian O&G firms. The above process indicates that qualitative research precedes the quantitative study in this thesis. Indeed, the results of the qualitative research refine the conceptual framework that is eventually evaluated with the statistical technique of CV-SEM, as indicated in figure 4.3. This process is typical of a sequential exploratory MMR. Therefore, this study is an *'exploratory sequential MMR'* design where the qualitative phase of the study is carried out before the qualitative stage.

4.5.1 Justification for Mixed method research

Triangulation is one of the principal justifications for the adoption of MMR in research (Fidel 2008). Johnson et al. (2007) identified four types of triangulation: data, investigator, theoretical, and methodological triangulation. In data triangulation, data are gathered from multiple sources to consider issues from various perspectives. In contrast, investigator triangulation involves several researchers in research work. Theoretical triangulation is attained by combining many theories in a study, while methodological triangulation is achieved by adopting multiple methods to investigate a phenomenon. The current research benefits chiefly from data triangulation as data are generated from various managers across the supply chain of the Nigerian O&G industry. Also, the study attained theoretical triangulation by combining multiple theories such as the NRBV and neo-institutional stakeholders theory (Hart 1995; Freeman 1984) to investigate the research phenomenon. Finally, this research achieved methodological triangulation by combining different data collection methods and that analysis (i.e. qualitative and quantitative) to provide answers to research questions. The combined effects of these forms of triangulation enabled the researcher to integrate various perspectives into this study from the theoretical, epistemological and methodological standpoints. This helps to improve the validity and generalisability of the research findings.

In addition to the above, other practical and specific factors serve as the rationale for adopting MMR in this study. First, the nature of the research questions, as indicated in figure 4.3, suggests that multiple approaches are needed to provide the required answers effectively. For example, the RQ1 'what specific GSCM practices can be represented by the NRBV strategic capabilities?" requires diverse views of respondents, which can be richly elucidated through qualitative interviews. In contrast, the RQ 4 'What is the impact of GSCM practices on the competitiveness of the Nigerian O&G firms?" indicates that a relationship should be established between an independent variable (GSCM practices) and a dependent variable (competitiveness). This requires a quantitative analysis using statistical techniques. Thus, this research can only effectively answer the research questions by combining qualitative and quantitative methods.

Secondly, the literature review in chapter 2 reveals a paucity of knowledge in this research area. Whereas several studies have examined the relationship between GSCM practices and competitiveness, only a few authors have investigated how GSCM practices are interlinked with the NRBV strategic capabilities of pollution prevention, product stewardship and clean technology. Hence the research first carried out an exploratory investigation to validate the existence of the NRBV strategic capabilities and the areas of linkages within the Nigerian O&G industry before testing the hypotheses on the impact of GSCM practices in the Nigerian O&G industry.

Finally, this research achieved epistemological and methodological compatibility through the adoption of MMR. The study's ontological and epistemological stances of realism and pragmatism are aligned with MMR (Creswell and Clark 2011). Similarly, the abductive research approach of this study is also compatible with MMR. Accordingly, MMR is considered appropriate for attaining coherence and consistency in this research.

4.6 Time horizon

The time horizon of this research is the cross-sectional design. A study is based on a cross-sectional design when data are collected from different individuals at a single point in time (Bryman and Bell 2011). The popular methods for data collection in cross-sectional research include questionnaire surveys and interviews, among others. In this research, both questionnaire surveys and interviews are used to gather data from several managers in the Nigerian O&G industry at a single point in time. An alternative to this design is the longitudinal design, which would enable data to be collected over a long time, thereby enhancing the research's external validity. The adoption of GSCM practices and their impacts on competitiveness may be better observed over a long period in a longitudinal study. However, given practical limitations such as limited time for a PhD study, this study utilised data collected at a single point in time to answer the research questions.

4.7 Research process

A two-phase approach is usually applied to adopt a sequential exploratory MMR as selected for this study. Therefore, this research is carried out in two different but interconnected phases, as shown in figure 4.4.

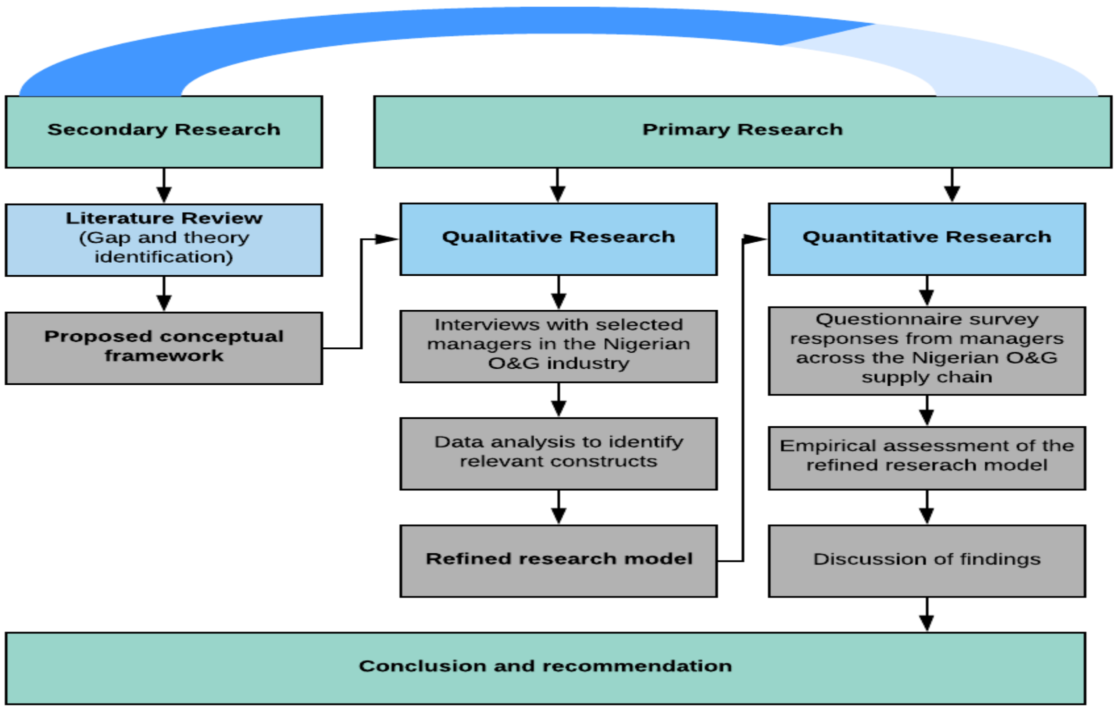

Figure 4.4: The research process of this study.

As shown above, the qualitative and the quantitative phases build upon the literature review and the proposed conceptual framework in chapter 2 and chapter 3, respectively.

4.7.1 Phase 1: Qualitative/Exploratory study

The exploratory phase of this research aims to explore and identify the specific areas of linkages between GSCM practices and NRBV strategic capabilities of pollution prevention, product stewardship, clean technology and the base of the pyramid in the Nigeria O&G industry. Furthermore, this qualitative phase explores the strategic resources and the stakeholder pressures that influence GSCM and the NRBV strategic capabilities in the industry. As highlighted in the research gap of the literature review, researchers have dedicated inadequate attention to GSCM and its link with NRBV strategic capabilities, thereby necessitating proper empirical exploration.

The fundamental and core idea of NRBV is that specific strategic resources can enhance four strategic capabilities (pollution prevention, product stewardship, clean technology, and base of the pyramid) to achieve enhanced competitiveness (Hart 1995; Hart and Dowell 2011). Previous frameworks have suggested a theoretical link between GSCM and NRBV, but they lack empirical validation (Guang Shi et al. 2012; McDougall, Wagner and MacBryde 2021; Yunus and Michalisin 2016). In the same vein, there is no empirical research on the strategic resources antecedent of NRBV strategic capabilities or GSCM in the O&G industry. Furthermore, the proposed conceptual framework in chapter three depicts stakeholder pressure forces as the antecedent of linkage GSCM practices and NRBV strategic capabilities. However, the extant literature suggests that critical stakeholder pressures that influence green practices adoption may vary across industries.

Summing up the above, the starting point for attaining the study's overarching aim of determining the impact of GSCM and NRBV strategies on the competitiveness of the Nigerian O&G firms is first to examine whether NRBV strategic capabilities are present and interlinked with GSCM practices in the industry. After this, there is a need to recognize the specific strategic resources and the driving forces that influence NRBV strategic capabilities and GSCM practices of the firms operating in the industries.

Qualitative inquiry is arguably the most appropriate method to address the research gaps above. In line with De Vaus (2002), the study can elicit rich textual data required for understanding the link between GSCM and NRBV and the relevant antecedents in the Nigerian O&G industry. More specifically, this exploratory research provides answers to the RQ1, RQ2, and RQ3 of this research, as indicated in figure 4.3. It is important to note that the exploratory phase of the study neither tests any hypothesis nor performs any statistical test. Its objective is to refine the proposed conceptual framework before proceeding to a full assessment of the research model. Some of the research findings of this phase of the research were presented as a conference paper at the Logistics Research Conference (LRN), an international conference in Logistics and SCM, in 2017 (Olajide, Kwak and He 2017).

4.7.1.1 Data collection for the exploratory study

Data of the exploratory study, focusing on addressing the three research questions earlier stated, were collected using a semi-structured interview method. This method allowed the participants to express in-depth views and meanings of the concepts during the discussions (Ritchie et al. 2013). In line with Brinkmann and Kvale (2018), a predetermined interview protocol is best suited for qualitative research exploring the links between GSCM and NRBV and the relevant stakeholder drivers in the Nigerian O&G industry. The details of the procedures for gathering the data required are provided below.

- **The Interview protocol**

The literature review in chapter two provided information for developing an interview protocol, focusing on the research objectives. The protocol (in appendix D) was divided into five parts. **Part A** attempts to collect demographic information about the company's background, the participants' job functions, and years of experience. As a first step towards approaching the research questions, **Part B** elicits information about the degree of awareness of GSCM in the participants' organizations by asking questions on sustainability issues in the participants' companies. The remaining sections of the interview protocol focus on the initial conceptual framework in chapter 3. Specifically, **Part C** attempts to collect information about the four NRBV strategic capabilities of pollution prevention, product stewardship, clean technology, the base of the pyramid, and their links with GSCM practices. The above is to address the **RQ1** of this thesis. Furthermore, Part **D** collects data to answer the **RQ2** by eliciting information about strategic resources from the participants. Finally, the questions in **Part E** focus on collecting data about stakeholders' influence on GSCM adoption. This data is gathered to answer **RQ3.**

Given that a semi-structured interview provides an opportunity to interact with the relevant parties informally, a deliberate attempt was made to avoid direct questioning to ensure that expression, meanings, and interpretations maximize the participant's perspectives (Strivastava and Thompson 2009). In line with McDougall, Wagner and MacBryde (2019), NRBV and GSCM terminologies were avoided in designing the interview questions to prevent leading. Avoiding such terminologies is necessary to prevent researcher bias, a prevalent issue in qualitative research (Saunders, Lewis and Thornhill 2009). Instead of these terminologies, common concepts in the industry, as validated through a review of industry documents, experts' opinions and the literature, were applied in designing questions. Table 4.2 presents how the questions were coined to avoid bias.

Table 4.2: Coinage of the interview questions

Objective	Literature Summary	Focused Question
Encourage discussion of pollution prevention capabilities and GSCM practices	Preventing the initial occurrence of waste and emissions throughout operations through SCM (Aragón-Correa and Sharma 2003; Hart 1995; Russo and Fouts 1997).	Can you tell me how your company collaborates with partners to address waste management and emissions?
Encourage discussion of product stewardship and SSCM practices	Stakeholder engagement for the prioritisation of the natural environment throughout each stage of the life-cycle (Hart, 1995; Hart and Dowell 2011; IPIECA (2015).	How do you involve stakeholders in managing product health, safety and environmental risks in the distribution chain?
Encourage discussion of clean technologies and GSCM practices	Collaborating with stakeholders to seek investment in the technologies of the future in pursuit of environmentally sustainable operations (Hart, 1997; Pernick and Wilder, 2007)	How does technology play a role in sustainability across your company's value chain?
Encourage discussion of the base of the pyramid and GSCM practices	The alleviation of social ills via simulation of development at the base of the economic pyramid (Hart and Christensen 2002).	Can you tell me about the company's approach to addressing global social sustainability?
Encourage discussion of strategic resources required for sustainability implementation	Valuable, rare, inimitable, and non-substitutable tangible and intangible inputs that are available to a firm from both internal and external sources (Barney 1991; Grant 1991; Hart 1995; Hart and Dowell 2011).	What are physical and non-physical assets that are indispensable for your firm's sustainability practices?
Encourage discussion of stakeholder pressures drivers of sustainability	Stakeholder factors that drive firms' adoption of sustainability practices beyond economic benefits (DiMaggio and Powell 1983; Meyer and Rowan 1997; Berrone et al. 2010)	Can you tell me about the external and internal factors that influence your company's sustainability decisions?

Before its final adoption, the interview protocol was pilot-tested with two managers in the Nigerian O&G industry (each from the downstream and upstream sector) through a phone interview in June 2018. The feedback from the pilot test was incorporated to produce the final version of the interview protocol.

- **Gaining access**

According to Saunders, Lewis and Thornhill (2019), gaining access to the potential respondents in research is a critical undertaking with far-reaching ethical implications. Because of the sensitive nature of the Nigerian O&G industry, negotiating access to the respondents is usually a daunting challenge. Also, coupled with the fact that this research focuses on the senior managers with busy schedules, gaining access becomes a more difficult task. To overcome this challenge, the researcher commenced his task by developing a structured strategy for gaining access to the respondents. In the first instance, the details of the firms in the Nigerian O&G industry were obtained from the Department of Petroleum Resources (DPR), the official regulatory body of the Nigerian O&G industry. After that, a non-probability purposeful sampling method was adopted to select seven firms covering all industry sectors. The selected firms were contacted, and four of them agreed to participate in this research. Since sustainability is a strategic issue, the targeted respondents were the senior management staff of the selected firms. This process was facilitated through a letter introducing the researcher and his research to the DPR and the companies by the sponsor of this research, the Petroleum Technology Development Fund (PTDF), a key stakeholder in the Nigerian O&G industry and a parastatal of the Federal Republic of Nigeria (FGN). (Please find the letter of introduction in appendix C). In line with Coventry University's ethical standards, the participants were made to append their signatures on the '*informed consent form'* after perusing the *participants' information sheet.'* Through this, the participants were assured of the confidentiality of their information and their anonymity. Also, their right to withdraw their consent until data disposal was guaranteed. In July 2018, telephone interviews were conducted with the four respondents. The findings from the above were presented at a conference in September 2018 earlier referenced.

To increase the sample size and enhance the validity of the findings, another round of interviews was carried out between May and July 2019. The approach for gaining access to the respondents is as previously described. However, the DPR, at this stage, issued an additional letter of introduction about this research to the operating firms across the supply chain of the Nigerian O&G industry. Besides, the researcher had to travel to Nigeria to conduct a face-to-face interview with the respondents as many respondents were not comfortable with a telephone interview. This process also allowed trust-building between the researcher and respondents. It is important to note that interviews were sometimes rescheduled at the instance of some participants after initial approval. On a few occasions, interviews were postponed for two weeks after the first appointment. Also, some companies who had initially indicated their interest in participating in the interviews eventually declined (while some explained that the respondent would no longer be available, some stopped responding to follow-up e-mails and calls). After the process, twenty-five interviews were conducted during this period. This brings the total number of interviews conducted in this research to twenty-nine, when added to the four interviews conducted in May 2018.

- **The Interview respondents**

As highlighted in chapter 2, the supply chain of the O&G industry is classified into two interconnected sectors-the upstream (appraisal, exploration, fabrication, installation, drilling, and logistics) and the downstream sectors (refining, storage, procurement, logistics, sales, and marketing). Across these sectors, various companies with different backgrounds and sizes are involved in multiple activities in the entire supply chain. Therefore, the industry classification can be based on multiple factors. For example, companies can be categorized into operators (oil companies), contractors/subcontractors, and suppliers. Also, organizations can be classified into small, medium, and large-scale companies in terms of size. The above classifications are crucial to this research to minimize external validity problems in data analysis.

For this purpose, the targeted respondents for the interviews were drawn from the senior management staff across the industry's supply chain, including different players (operators, contractors, and suppliers. In all, twenty-nine interviews were collected for the exploratory research phase of this study. The profile of the participants is presented in section 5. 2 (table 5.1) alongside the findings of the qualitative analysis.

- **The interview session**

As earlier highlighted, consent was first sought from the interviewees, and organisational approvals were secured before the interviews. The first round of interviews was conducted on the phone with four O&G top management staff in Nigeria in July 2018. This is because the researcher was in the UK while the participants were based in Nigeria. The second round was later conducted between May and July 2019. Unlike the previous one, the second round was held face-to-face. Each participant had enough time to respond to questions, and notes were taken during the interview. Interestingly, the participants were excited to share their views with the researcher despite their busy schedules. The interview notes were shared with the interviewee to confirm that they reflected their opinions on the questions. Additional questions were asked to probe further into the issues under discussion and understand salient points. In addition, the interviewees had the opportunity to reflect on their general views on the subject matter. On average, each interview took about forty-five (45) minutes. The summary of the discussions was later sent through e-mails to the respondents to confirm that they reflected their opinions. They were requested to confirm their agreement to the summary within two weeks, after which it would be deemed approved if responses were not received after the time specified.

4.7.1.2 Data analysis of the exploratory study

Using the guidelines introduced by Boyatzis (1998), a thematic analysis technique was applied to derive meanings from the data collected. According to Miles and Huberman (2014), thematic analysis is one of the most popular methods in qualitative data analysis. It is a method that focuses on identifying and describing emerging themes and patterns within the dataset. This method was adopted to reduce the volume of the data to a manageable quantity for drawing inferences and conclusions from the themes and patterns that emerged from the data analysis process. Qualitative data analysis can be carried out either manually or with assisted Qualitative Data Analysis Software (CAQDA) such as NVivo, depending on the volume of the data collected. In the current study, interview data were transcribed and uploaded on the NVivo version12 for analysis.

The process of data analysis of the interview commences with the data collection. During the data collection process, further views of the respondents were sought on grey areas to seek clarifications and understand the true meaning of the views passed across by the respondents. Also, notes were taken alongside the audio recordings of the interviews. The interview notes were later shared with the respondents to validate their expressed views. Subsequently, the transcripts of the interviews were produced for further analysis. Codes were developed based on the patterns and themes that emerged in the transcripts. The process of analysis using NVivo software in the current research is described in section 5.3.

Generally, qualitative data analysis is prone to difficulty in drawing reasonable inferences from a large volume of data (Patton 2002). An effective way of handling this challenge is to apply a systematic data reduction technique that averts the loss of essential facts leading to accurate analytical inferences (Creswell 1998, Miles and Huberman 1994 and Patton 2002). Data reduction can be achieved by codifying emerging themes and patterns in the dataset. The process involves developing codes, analytical memos, and contextual narrative analysis (Kaplan and Maxwell 2005). In this study, codes were developed in line with the research questions and the findings from the literature. The details of the coding system leading to the emergence of themes are also provided in section 5.3 (table 5.2).

Having achieved a reliable coding system for this study, a complete thematic analysis of the data using the codebook generated was carried out on NVivo. Quotes from interviews were used to present the findings in chapter 5. Following the above process, several themes and sub-themes emerged. An example of theme classification is provided in table 4.3.

Table 4.3: Coding patterns of the exploratory data.

Extracts from transcripts	Line-by-line theme	Parent Theme
IN2 "We are at the forefront of the Liquefied Gas production (LPG), which is cleaner energy. However, in our operations, what we do is comply with the law on emission reduction	Clean energy (LPG), GHG emission reduction, compliance with the law.	Compliance with regulations on emission reduction.
IN8 "I feel that our companies can improve our sustainability strategies if we can work with our supply chain members to generate new innovations."	Innovation from the supply chain can enhance sustainability strategies	Supply chain innovation and improved sustainability strategies
IN15 "At the distribution level, I feel that the logistics management has helped O&G firms to reduce the risk of product to the environment".	Logistics contributes to the reduction of O&G products' hazards	Product stewardship can be enhanced with supply chain (logistics) partners.
IN5 "The truth is that the future belongs to clean energy. I think O&G firms should increase investment in technology that drives clean energy."	Investment in clean energy is necessary to be relevant in the future	The O&G firms need clean technology.

Therefore, the exploratory results of this study are the synthesis of the emerging themes as linked with the specified codes. These findings are presented and discussed in chapter 5 of this thesis, and they were applied to refine the proposed conceptual framework in chapter 6.

4.7.2 Phase 2: Quantitative/confirmatory study

The initial conceptual framework of this research was proposed in chapter 3. Following the methodology presented in the previous section, the exploratory study results in chapter 5 were applied to refine the proposed conceptual framework in chapter 6. This is to adapt the conceptual framework to the context of the O&G industry due to the paucity of knowledge in this area. Therefore, the quantitative research aims to confirm the hypothesized relationships among the constructs of the refined model. More specifically, the quantitative study seeks to answer the RQ 4 of this study, as indicated in figure 4.3. Therefore, this section discusses the process of carrying out the confirmatory aspect of this study in terms of data collection and analysis, participants' selection, sampling, and validity and reliability issues.

4.7.2.1 Data collection for the quantitative/confirmatory study-Questionnaire survey.

Deciding on the appropriate data collection method in research is influenced by several factors such as research question(s), research objective(s), consistency with research philosophy knowledge boundary, and available resources (e.g., time and money) (Saunders, Lewis and Thornhill 2009). As earlier mentioned, the overall aim of this study is to confirm a theory that has been developed based on the research questions. Also, the pragmatism philosophy of the study can be thought to be consistent with many data collection methods. Furthermore, through personal development and other similar activities, the researcher has acquired relevant skills in various data collection techniques pertinent to the current study. Finally, this study is confronted with both time and financial resources. Specifically, being a PhD study with a three-year life cycle conducted by a full-time student, the research is subject to time and financial limitations. Therefore, the questionnaire survey method is considered the most appropriate data collection method for this study.

Firstly, a questionnaire survey, generally used in deductive research to empirically examine a theoretical framework, is also compatible with the abductive nature of this research (Bryman and Bell 2011). Also, the confirmatory objective of this phase of the research aligns perfectly with the questionnaire survey data collection method. Furthermore, questionnaire surveys have many advantages, which include ease of administration, low cost, and the ability to generate large-scale data. The above is essential to this research, highlighting its appropriateness, attractiveness, and adoption in this study. This is without prejudice to the known limitations of a questionnaire survey, such as low response rate, non-response bias, and possible misinterpretation due to lack of knowledge by the respondents (Saunders, Lewis and Thornhill 2009). However, since the above can be mitigated with appropriate statistical techniques (Hair et al. 2010), this method is still considered very suitable for this study. As earlier noted, survey strategy has been acknowledged as a popular approach to data collection in business and management research (Chicksand et al. 2012; Saunders, Lewis and Thornhill 2009), especially in operations management research (Forza 2002; Soni and Kodali 2012). Indeed, Soni and Kodali (2012) found that up to 50% of SCM research is based on survey strategy. The above further justifies the adoption of a questionnaire survey in this research.

4.7.2.3.1 Questionnaire choice

Upon selecting a questionnaire survey as the appropriate data collection approach for this study, the next point of decision is adopting the proper questionnaire choice for the study. Saunders, Lewis and Thornhill (2009) identify two main types of questionnaires as presented in figure 4.5 (Please note that the selected choices for this research are highlighted in blue and printed in bold).

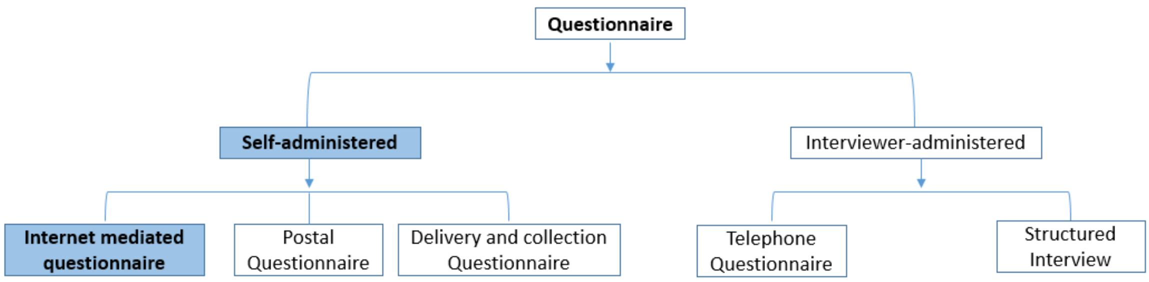

Figure 4.5: Types of questionnaires.
(Adapted from Saunders Lewis and Thornhill 2009).

In a self-administered questionnaire, the interviewer's presence is not required as various platforms are utilized to administer the questionnaires. This is categorized as internet-mediated questionnaires, postal questionnaires, and delivery and collection questionnaires. On the other, the interviewer-administered questionnaire requires the interviewer's presence for administration. Its categories include telephone questionnaires and structured interviews. Several factors suggested by Saunders, Lewis and Thornhill (2009) were considered in selecting the appropriate questionnaire choice for this research. These factors are:

(a) The sample size required for data analysis
(b) The types and numbers of questions for data collection

(c) The nature and characteristics of the responding group
(d) The time frame for data collection
(e) Possibility of automation in data collection
(f) Cost implications of fieldwork and data collection.

Based on these factors, the internet-mediated, self-administered questionnaire is adopted in this research phase. Although the interviewer-administered questionnaire is very helpful in gaining in-depth knowledge about a phenomenon (Saunders, Lewis and Thornhill, 2009), it is generally deficient in targeting a large sample size (Robson 2002). Besides, while the exploratory part of this study has helped gain a deep insight into the relevant constructs of this research, the purpose of this phase of the study is rather confirmatory. Hence the self-administered questionnaire is considered the most appropriate choice. In addition, other advantages of the self-administered questionnaire include convenience, short completion time, low cost of administration, appeal to broader sample size, ease of administration, and many others (Klassen and Jacobs 2001; Robson 2002), which make it relevant to this research.

As shown in figure 4.5, the self-administered questionnaire is classified into three categories: the internet-mediated, postal, and collection and delivery questionnaires. This research adopts the internet-mediated questionnaire because of its many attributes and benefits, making it appropriate for this study. First, the internet-mediated questionnaire can only be adopted when both the researcher and the participants have access to the internet. For the purpose of this research, internet facilities and resources are available to the researcher to deploy this technique. Also, the targeted respondents, being the top management staff in the Nigerian O&G industry, are not only computer-literate; they also have access to internet resources with functional e-mails and social media accounts.

Also, the short completion time of the internet-mediated technique fits perfectly into the data collection plans of this research. Furthermore, the researcher and the respondents are in different geographical locations, hence, administering other forms of questionnaire would not only have been ineffective, but it would have also been expensive. Therefore, the internet-mediated questionnaire provides a good solution in this regard. In addition, the technique makes it possible to reach out to a large qualified sample of managers in the relevant portfolios in the Nigerian O&G industry. Finally, the automated nature of the internet-mediated questionnaire makes it easy to seamlessly proceed from the data collection stage to the analysis stage. These justify the appropriateness of this technique in this research.

4.7.2.3.2 Questionnaire design and structure

In designing and structuring a questionnaire, Churchill and Iacobucci (2006) suggest nine steps to enhance the quality of a questionnaire in terms of content and structure. Accordingly, this process presented in figure 4.6 is adopted in this study to develop the questionnaire.

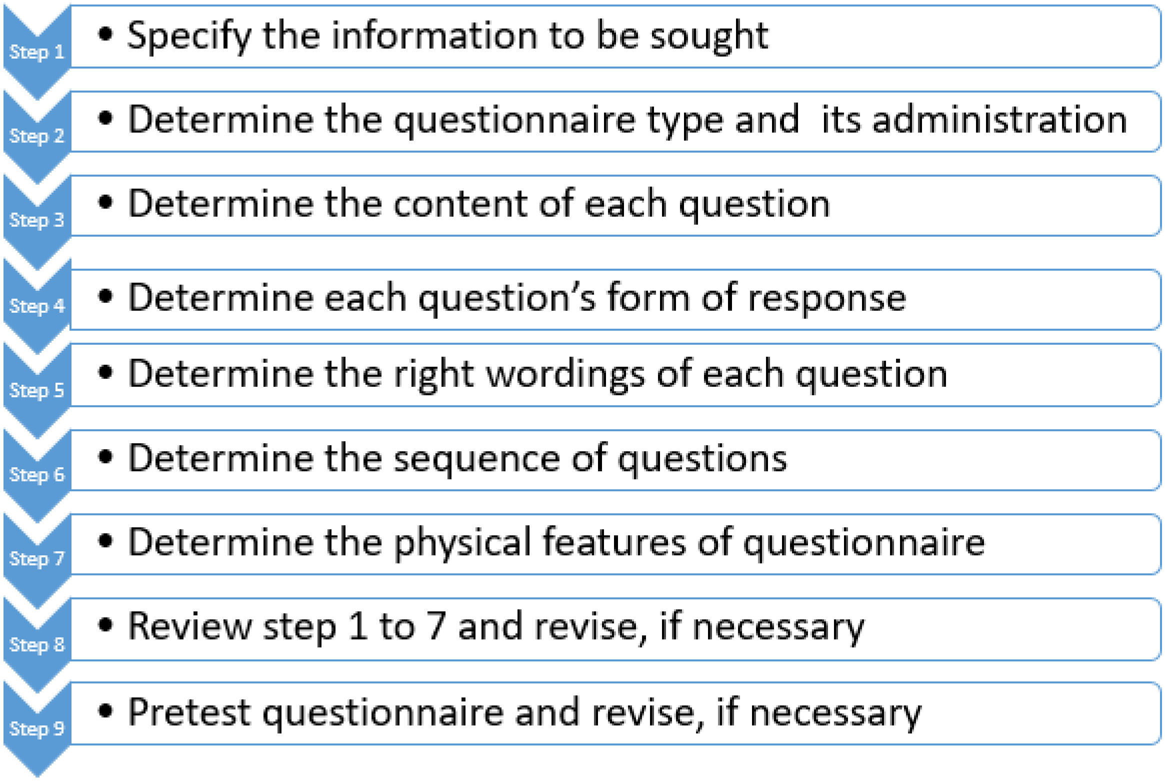

Figure 4.6: The process of questionnaire quality enhancement.
(Source: Adapted from Churchill and Iacobucci 2006).

The first step in figure 4.6 above has been addressed by specifying the research questions of this study. Also, the previous section selected and justified the use of a self-administered, internet-mediated questionnaire choice, thereby addressing the second step. Thus, the first and second steps in this process have been carried out. The remaining steps are briefly discussed below:

Step 3: The questionnaire content

The central theme in developing the questions to be included in this research is the issue of content validity. Following the suggestion of Bryman and Bell (2011) that a rigorous literature review can help researchers identify the questions that are relevant to their studies, the content of the questionnaire in this study was adapted from existing literature. The details are provided in appendix E. It should be noted that where a researcher cannot find relevant questions within the literature, such a researcher can develop new questions or modify the existing ones (Hair et al. 2014). There was no need to develop new questions in this research since relevant and appropriate questions were found in the literature.

Step 4: Form of response to questions.

A five-point Likert scale was used in the questionnaire to gather the relevant data from the respondents. Through this method, the respondents were asked to answer the questions by selecting one answer out of five choices. For most constructs, the options ranged from '*strongly agree'* to ***'****strongly disagree.'* This form of response enables the researcher to collect interval or ratio-based data for analysis. Indeed, the five-point Likert's choice scale is regarded as one of the best ways to gather rich data for statistical analysis (Field 2009; Hair et al. 2010).

Step 5: The right wordings of the questions.

Since ambiguity will lead to distorted responses in a questionnaire (Churchill and Iacobucci 2006), considerable efforts were channelled into ensuring that questions were worded in simple and straightforward language to prevent ambiguity. Indeed, upon the pilot testing of the questionnaire, some questions were reviewed for simplicity and clarity.

Step 6: The sequence of questions.

Fostering a logical flow of the questionnaire's content is a good way of preventing ambiguity in a questionnaire (Hair et al. 2014). Therefore, in designing the questionnaire, questions were emphasised to ensure logical flow. For this purpose, questions were logically arranged concerning the individual construct. Also, the position of the constructs within the framework was considered in arranging questions. For instance, questions on stakeholder drivers were presented before strategic resources in line with the conceptual framework. As depicted in the conceptual framework, questions on environmental capabilities and competitiveness followed this.

Step 7: Physical features of the questionnaire.

The questionnaire in this research was distributed online. Hence no physical copy was distributed to the respondents. Notwithstanding, a hard copy of the questionnaire was printed for record purposes and as a backup. In addition to ensuring that the online version is compatible with both mobile and desktop devices, the hardcopy was on four A4 size pages with a cover sheet and introductory page explaining the purpose of the research (see appendix E). Also, a clear font size, 12 points Time New Roman in a well-organised format, made the questionnaire easy and readable for the respondents.

Step 8: Review and revision of questionnaire.

To eliminate errors in the questionnaire designing process, there is a need to re-examine the questionnaire and revise it where necessary (Churchill and Iacobucci 2006). This procedure was carried out upon developing the content of the original questionnaire. The initial questionnaire discovered several semantic errors and typos through this procedure. Also, the sequence of some questions was considered inappropriate and therefore revised. This ensured that the questionnaire could collect the necessary data to test the research theory of establishing the causal relationships between strategic environmental capabilities (GSCM) and competitiveness of the Nigeria O&G supply chain.

Step 9: Pre-testing questionnaire.

Pre-testing the questionnaire is the final step in the questionnaire development stage (Churchill and Iacobucci 2006). This is also known as pilot testing. With this process, a researcher can administer the research instrument on a small sample that shares similar characteristics with the targeted audience. The feedback from this process is finally used to refine the questionnaire for the main survey. The details of this process concerning the current research are presented in the relevant section.

4.7.3 Pilot test

Regarding the current study, the first level of the data analysis was conducted through a pilot study (after the questionnaire development stage) to determine whether the potential participants fully understood the questionnaire items. According to Hair et al. (2014), pre-testing model scales are necessary even when measured items are derived from previous research (as adopted in this research). To accomplish this, the pre-testing procedure followed the suggestion of Forza (2002) that an effective pre-test survey in operations management should be checked by academics, industry experts and potential informants or respondents.

To this end, these groups of people were involved in the pilot survey. Three academics in the field of SCM and O&G management at Coventry University and the University of the West of Scotland (UWS) were contacted for the pilot study. After initial contacts were made, a copy of the conceptual model, the research hypothesis, and the questionnaires were sent to these experts. The purpose of this is to enable them to understand the research objectives of the current study. After that, a thirty minutes interview was severally conducted with the academic experts. The measurement scales were reviewed to ensure that they measure the constructs as evidence of the face validity of the research. Upon this process, necessary modifications were effected in the measurement scales to reflect the inputs from the academic experts.

To determine the appropriateness of the questionnaire for the O&G industry, another thirty minutes of interviews were conducted with top management staff of four O&G firms across the supply chain of the Nigerian O&G industry. Since these professionals are also the potential respondents in the final survey, their contributions at this stage were also deemed sufficient for the third group of people (potential respondents) suggested by Forza (2002). Upon this stage, irrelevant jargon and overlapping concepts were deleted to ensure that the constructs and measurement scales are related to the O&G industry. Based on the above, the adjusted measurement scales were produced.

4.7.4 Data type-Primary data

The data type required in this research should be sufficient to validate the proposed hypotheses concerning the impacts of stakeholder drivers and strategic resources on GSCM (environmental capabilities) and the competitiveness of firms in the Nigerian O&G industry. Generally, data applied in empirical studies can be collated from the secondary or the primary source. While secondary data are collected by some other persons for a different purpose but adapted by a researcher for his research, primary data are directly gathered by a researcher specifically for the study (Saunders, Lewis and Thornhill 1989; Bryman and Bell 2011). Therefore, secondary data are only used where the researcher can access a repository of relevant data to the study's objective. Generally, sustainability in supply chain management is still an emerging research area that some previous studies consider evolving from its embryonic stage (Seuring and Muller 2008; Green et al. 2012). Also, the information required for this research is obtainable only from a set of people-the relevant managers in the Nigerian O&G industry. Therefore, the primary data source is the most appropriate type for this research. Saunders, Lewis and Thornhill (1989) noted that selecting the proper sample is crucial in primary data-based research since a researcher cannot obtain data from the entire population. For this purpose, the sampling technique adopted in this research is discussed in section 4.7.6.1.

4.7.5 Ethical consideration

Ethical consideration is crucial in any social research because it concerns the researcher's exhibition of acceptable and appropriate behaviour about the research subjects (Saunders, Lewis and Thornhill, 1989). Also, critical issues such as voluntary participation, informed consent, respondents' anonymity, potential risk, and harm traceable to a research work are some of the ethical considerations that must be addressed by a social science researcher (Bryman and Bell 2011). Therefore, it is a widespread practice for Universities to develop standard guidelines to ensure the highest ethical conduct by researchers in their institutions (Phillips and Pugh 2007). In this study, the standard ethical guidelines of Coventry University are followed throughout the research process.

4.7.6 Population

This research investigates the link between the antecedents of GSCM practices and competitive advantage in the Nigerian O&G industry. Hence the population of this research is the firms operating across the supply chain of the Nigerian O&G industry. This includes the suppliers and contractors in the industry. The list of the operators in the industry was obtained from the DPR, the primary regulator of the Nigerian O&G industry. This list contains 2,750 firms of various sizes and operations across the industry's upstream and downstream sectors. The targeted respondents are the top and middle management staff knowledgeable in supply chain management at the strategic level. Previous studies in SCM have equally investigated sustainability practices in the O&G using questionnaire surveys administered on the top management staff of O&G companies (Yusuf et al. 2012). Also, the diversity of the firms in the population creates a ground to also integrate diverse perspectives to enhance the generalisability of the findings of this research.

4.7.6.1 Sampling techniques

Sampling aims to select the correct individuals, events, and objects that can provide the required information in empirical research (Bryman and Bell 2011). The impracticability of obtaining data from the entire population places responsibility on researchers to employ appropriate sampling techniques to reduce the amount of data to be collected to a manageable size that can adequately represent the population (Saunders, Lewis and Thornhill 1989).

There are two main types of sampling techniques in social research. These are probability and non-probability sampling techniques (Saunders, Lewis and Thornhill 1989). In a probability sampling technique, each sample has a probability of being selected based on a statistical method. In contrast, all population elements have no equal chance of being selected in a non-probability sampling. While qualitative research is usually based on non-probability sampling techniques, probability sampling is generally applied in survey-based research (Saunders, Lewis and Thornhill 1989; Bryman and Bell 2011). Since the data collection method in this phase of the study is a survey strategy, the probability sampling technique is appropriate for this thesis stage. There are four main types of probability sampling. These are simple random, systematic, stratified, and cluster sampling.

In this research, a stratified random sampling strategy is adopted. According to Gakuu, Kidombo and Keiyoro (2016), Stratified random sampling requires a researcher to divide a heterogeneous population into various groups based on homogenous characteristics and apply a simple random sampling technique to select sample size from each group. As stated in section 4.7.6, the list of O&G firms in the Nigerian O&G industry obtained from the DPR comprises heterogeneous firms operating across the industry's upstream and downstream sectors. To ensure that the two sectors of the industry (upstream and downstream) are equally represented in the research sample, the population was examined for operational characteristics and stratified into two groups: upstream and downstream. The number of firms in each stratum is provided in table 4.4.

Table 4.4: Population distribution across stratas.

Group/Strata	Number of firms	Percentage in population
Upstream	1100	40%
Downstream	1650	60%
Total (Population)	**2750**	**100**

Based on the sample frame discussed in section 4.7.6.3, the random sampling technique was proportionately applied to each stratum to draw the research sample in this study. This approach is in tandem with Adedeji et al. (2016) who adopted a stratified sampling method to examine the role of local content policy in the Nigerian O&G industry. This technique provides many advantages in this study, including higher statistical precision and reflection of the population as each stratum is treated as a population for sample selection (Gakuu, Kidombo and Keiyoro 2016). More importantly, the stratified random sampling technique is compatible with the SEM technique adopted for data analysis in this research (Adedeji et al. 2016). Further details on how the sample has been randomly selected from the strata are provided in section 4.7.6.3.

4.7.6.2 Sample size

Since a researcher cannot obtain information from the entire population, the usual practice is to conduct research using a sample size that shares the exact characteristics of the population, thereby generalizing the findings across the population (Bryman and Bell 2011). According to Saunders, Lewis and Thornhill (2009), several factors such as type of data analysis techniques, size of the population, number of questions, the required level of certainty, and many more influence the sample size in research. Other practical considerations, such as available resources and other limitations, are crucial in sample size (Bryman and Bell 2011). In this research, upon review of practical issues, credence is given to the statistical technique adopted in this study to determine the sample size. As stated in the data analysis section, SEM analysis is adopted as the statistical technique in this study because of its compatibility with the research objectives. According to Kline (2011), the recommended sample sizes for SEM analysis range between 150-400 responses/dataset, depending on the complexity of the structural model. Furthermore, Hair et al. (2014) suggest that five responses should be used for each observed variable in a structural model. Thus a structural model with seven constructs having an average of five measurement items (as designed in the refined conceptual framework in section 6.5) requires 175 responses (i.e. 7 constructs *5 items* 5*responses=175 sample size). Other scholars have also recommended a minimum of 200 sample sizes for SEM Analysis. Based on this, this research targeted a minimum of 200 responses for this research.

4.7.6.3 Sample frame

Upon determining the sample size, as discussed previously, the next step is to address how the sample frame was determined in this research. Sample frame is the list of all population representatives included in the samples (Bryman and Bell, 2011). According to Saunders, Lewis and Thornhill (2009), a research sample frame comprises the targeted population list from which research samples are selected. Bryman and Bell (2011) assert that researchers can determine sample frames by applying the expected response rate to the required sample size. While sample response rates could differ across industries and empirical studies, Klassen and Jacobs (2001) noted that the average response rate for online surveys in operations management research is 11%. Applying the above to the targeted 200 responses in the current research, the sample frame of this study is calculated as *200/11%, which equals 1,818.* Thus for a sample size of 200 responses to be achieved, a sample frame of 1,818 potential respondents must be targeted based on 11% response rate. Therefore, the sample frame of this research is pegged at 1820 to possibly generate the potential 200 responses required as the sample size of this research.

Following the above, the sampling frame is represented by 1,820 firms operating across the supply chain of the Nigeria O&G industry. To ensure that the sample frame effectively represents the two sectors (upstream and upstream), the sample frame of 1820 was proportionately categorised into the stratified groups earlier depicted in table 4.4, upon which random sampling was applied to each stratum as indicated in table 4.5.

Table 4.5: Sample frame distribution across stratified groups.

Group/Strata	**Strata population**	**Percentage in population**	**Proportional sample frame**
Upstream	1100	40%	728
Downstream	1650	60%	1092
Total	**2750**	**100**	**1820**

Based on the above, 728 firms were randomly selected from the 1,100 firms in the upstream sector. In comparison, 1,092 firms were selected from the population of 1,650 firms in the downstream sector as the proportionate sample frame. The selected companies were contacted to participate in the main survey through questionnaires administered through Qualtrics online survey software. The response rate based on the above is provided in section 7.2.

4.7.7 Main survey

The main survey commenced by applying random sampling techniques to the population of this research. Chapter two indicates that the Nigerian O&G supply chain comprises two distinct but interlinked sectors: Upstream and downstream. The operators in these sectors are also firms of different sizes. In the upstream sector, the IOCs dominate exploration and production, with many Nigerian companies operating in the sector. The IOCs still have operational existence in the downstream sector, but many Nigerian-owned companies are also very functional. Also, the NOC has a remarkable presence in the downstream sector. Apart from operating retail outlets across the nation, the main refineries in the country are also managed and operated by the Nigerian National Oil Company (NOC). Also, the supply chain partners are primarily Nigerian companies in both sectors due to the Nigerian local content act. The above suggests a well-diversified industry which comprises of:

- The IOCs
- The NOC
- Nigerian owned companies
- Small and medium enterprises.

As a supply chain research, the diversity in this industry is of particular interest to this study. Since the study focuses on the entire industry, there is a need to correctly classify operators in the industry to ensure adequate representation in the survey sample. Sequel to engagement with the operators during the exploratory study, operators were categorised into:

- Company
- Contractors
- Sub-contractors

The companies comprise the IOCs, NOC and Nigerian companies that focus on core O&G operations such as exploration and production, refinery, O&G logistics, Gas station retailing, etc. Contractors are technical partners such as engineering firms, well-head suppliers, and many others that provide core technical assistance. Finally, the sub-contractors are very similar to the contractors but with a distinguishing feature of being engaged by the contractors rather than the company.

As earlier mentioned, the details of the operators in the industry were obtained from the DPR. Also, the sponsor of this research, PTDF, officially introduced this research to the operators. The above made it easy for the researcher to gain access to the industry. Nigeria is an emerging economy whose foreign earnings depend mainly on the O&G industry. Also, the status of the targeted respondents (Top-level managers and operations managers) requires the need to build trust to obtain the relevant information. According to Hokkission et al. (2002), the top-level managers in developing countries tend to be more monopolistic of information about their companies than their counterparts in developed countries. To earn the participants' trust, the researcher utilised the period spent in Nigeria for exploratory data collection to contact some of the respondents while in Nigeria. Also, the recommendations from their colleagues who participated in the research process enhanced the trust issue between the researcher and the respondents. Furthermore, the assurance of anonymity and right of withdrawal removed any concerns the participants might have. Besides, the questionnaire items did not require any sensitive information but the personal views of the respondents about the research constructs.

A total of one thousand eight hundred and twenty (1,820) questionnaires were distributed based on the sampling frame discussed in section 4.7.6.3, using Qualtrics online survey software. Qualtrics online software is selected in this research because it allows the survey hyperlink to be sent directly to the respondents' e-mail addresses. Also, data collected can easily be exported to data analysis software such as SPSS. Furthermore, to guide against missing data, the forced response feature that prevents a respondent from submitting the questionnaire without completing the questions was enabled. Within the first two weeks, ninety-eight (98) responses were received from the participants. After that, a follow-up e-mail was sent to those whose responses were still awaited. Another 116 responses were received four weeks later, bringing the total responses to 214. This represents about 12% of the questionnaires distributed. As noted earlier, a low response rate is one of the main challenges of an online survey. Besides, research in operations management is generally known for low response rates (Yusuf et al., 2013). Nonetheless, since 200 responses were the initial target for this research, 214 were considered sufficient for the study.

4.7.7.1 Non-response bias

Non-response bias can negatively affect the generalisability of a survey study (Forza 2002). A major concern in this capacity is identifying the significant difference in respondents between two groups: the early waves and the late wave (Lambert and Harrington 1990). To assess the non-respondent bias in this research, groups were created to evaluate their response characteristics. The first group comprises the responses collected during the first two weeks of administering the survey. The second group includes the responses received after the first e-mail follow-up, two weeks after launching the survey. A two-tailed t-test was performed on the two groups, and the variables were compared ($P<.05$). The results show that there is no significant difference between the two groups. This confirmed that this research is not prone to non-response bias between the early and late respondents.

4.7.8 Quantitative data analysis

The refined conceptual framework in chapter 6 suggests that the research constructs are positioned to test the causal relationship between government regulations and supply chain continuous innovation in the first instance. It also purports to validate causality between government regulations and the three strategic environmental capabilities (pollution prevention, product stewardship, and clean technology). Furthermore, it aims to test causal relationships between supply chain continuous innovation and NRBV strategic capabilities. Finally, it hypothesizes a causal relationship between the NRBV strategic environmental capabilities and the competitiveness of the firms in the Nigerian O&G industry's supply chain. In a nutshell, the framework is designed to test causal relationships among multiple variables.

In the first instance, the nature of the refined conceptual framework suggests that a multivariate analysis technique is the most appropriate method for assessing this study's research model (Hair et al. 2014). Whereas various multivariate analysis techniques such as multiple regression, logistics regression, path analysis, and many others are available to a researcher, the most appropriate technique for analysing the quantitative data of this research is structural equation modelling (SEM). SEM technique is beneficial in an environment where the research is associated with multiple variables analysed for more than one statistical outcome per time, as conceptualised in this study (Kline 2011; Schumacker and Lomax 2010).

Mainly, SEM technique can simultaneously test multiple relationships between a set of independent variables and a set of dependent variables (Kaplan 2000). It can also consider the interaction effects among the posited variables in a model (Hair et al., 2014), which is in line with the focus of this study. Furthermore, SEM is known for its ability to analyse all the relationships among the dependent and independent variables, with less biased results expressed in a series of equations (Kaplan 2000; Kline 2011). In this study, for instance, the multiple and complex relationships among various constructs (where a dependent variable in a relationship becomes the independent in another relationship) require advanced statistical techniques with a capacity to seamlessly evaluate all the hypothesised relationships. SEM techniques are inbuilt with this functionality.

Based on the above, the adoption of SEM techniques in social research has continued to grow over the years in analysing structural models that incorporate exogenous and endogenous variables (Bagozzi and Yi 2012). Within the operations management and SCM domain, many studies have adopted SEM to investigate the cause-and-effect relationships among various variables. For example, Green et al. (2008) adopted the SEM technique to measure the impacts of logistics performance on the organizational performance within a supply chain context. Also, Sarkis, Gonzalez-Torre and Adenso-Diaz (2010) tested the causative effects of stakeholders' pressure on environmental practices with the SEM technique. Similarly, Inman et al. (2011) investigated the link between sustainable manufacturing and firm performance through the SEM technique. Furthermore, Seo, Dinwoodie and Kwak (2014) adopted the SEM technique to investigate the impacts of innovativeness on supply chain performance through supply chain integration. Similarly, Green et al. (2015) applied the same technique to investigate the causative effects of green supply chain practices on environmental performance. Again, Kwak, Seo and Mason (2018) adopted the SEM technique through the theoretical lens of the RBV theory to investigate the relationship between supply chain innovation, risk management capabilities, and competitive advantage within the context of global supply chain management. Interestingly, further evidence abounds that more studies are adopting the SEM technique in SCM-related research.

This growing adoption of the SEM technique might not be divorceable from the numerous advantages of the SEM technique over other multivariate methods such as factor analysis, multiple regression, conjoint analysis, path analysis, and many others. One of those advantages (which is not available to other techniques) is its ability to simultaneously examine separate causal relationships in a model (Kaplan 2000; Bagozzi and Yi 2012). The above advantage is of particular interest to the current research because of its focus on simultaneously testing hypotheses between the antecedents of sustainability practices, strategic environmental capabilities, and competitive advantage in the context of the Nigerian O&G industry. In this wise, Bagozzi and Yi (2012) assert that the SEM technique creates an integrative umbrella of methods for testing causal hypotheses and measurements in a more parsimonious way than running separate regressions models in multiple regression.

Another significant advantage of SEM over other multivariate techniques lies in its ability to identify new relationships within the existing model and suggesting potential relationships that can exist based on the modification of indices (Kaplan 2000; Schumacker and Lomax 2010). This capability can be beneficial in assisting a researcher in theorizing all potential relationships in a model. It can also open up new research opportunities that were not considered initially through the newly suggested hypotheses. Beyond the above, perhaps one of the most significant advantages of SEM is its ability to enable a researcher to test or confirm a theory and examine how well the data fits the model (Hair et al. 2014). The model diagnosis and model fit capability are very relevant to the current study considering its objective of testing and confirming the theory. The same is also suitable for achieving a better model improvement that minimises multi-collinearity problems often associated with bivariate techniques such as multiple regression. Furthermore, the applicability of SEM to latent constructs that cannot be directly measured (Kaplan 2000) justifies its appropriateness for this study. Since the variables considered in this study are mainly latent, it is believed that SEM will provide a mechanism for their investigation through the observed variables.

Notwithstanding the above, the SEM technique is not devoid of limitations. According to Hair et al. (2014), adoption of SEM in research requires a thorough understanding of its computational intensity, the peculiarity of its language and operationalisation of the SEM software programs. In this regard, the authors portend that the complexity of SEM techniques demands a researcher's level of SEM quantitative skills and expertise. Another limitation of the SEM technique is the requirement of a large sample size for analysis (Kaplan 2000). Generally, SEM studies are deemed suitable for a sample size of 150-400 responses (Hair et al. 2014; Kline 2011), which can vary according to the complexity of the underline model. Indeed, Kaplan (2000) portends that the SEM technique is generally more effective with large samples.

Regarding the current study, it is believed that the advantages of the technique, as earlier discussed, far outweigh its limitations. Moreover, the limitations identified above are not insurmountable. In the first instance, the researcher has acquired sufficient training and skills to deepen the understanding and application of SEM techniques and the operationalisation of the software. Secondly, the availability of many firms operating within the SC of the O&G industries in Nigeria is beneficial in meeting the minimum sample size requirement by expanding the sample frame within the industry. With this in mind, the adoption of SEM is further justified as an appropriate technique for this study.

Having justified the appropriateness of the SEM technique for this research, it is essential to note that SEM technique can be executed through two distinct approaches: the Covariance-based SEM (CB-SEM) and the Partial Least Square SEM (PLS-SEM). Conceptually, the decision to adopt either of the approaches is determined by the research objective of the study from its theoretical foundation (Kaplan 2000). The CB-SEM is appropriate for a research objective that confirms or tests a theory (Hair et al. 2014). In contrast, PLS-SEM is majorly suitable for a research objective that tends to develop or build a theory (Hair et al. 2014). To this end, Bagozzi and Yi (2012) argue that while PLS-SEM is more appropriate for exploratory research, CB-SEM is better considered for explanatory research. However, considering the dual characteristics of mixed-methods research, it can be thought to be compatible with many data analysis techniques, including CB-SEM. Furthermore, one of the significant advantages of CB-SEM over the PLS-SEM is that the former is prone to the benefits of the universal Goodness of Fit (GOF) than the latter (Hair et al. 2014; Schumacker and Lomax 2010). Considering the above and the theory testing focus of this study, the CB-SEM is regarded as the most appropriate technique for this study because of its ability to test/confirm theories and provide a GOF for the structural model. The process of CB-SEM, including model fits, validity, reliability, and multicollinearity, is discussed in chapter 7 of this thesis.

4.7.8.1 Unit of analysis

The popular units of analysis in operations and supply chain management are individuals, firms, plants, groups, systems, and projects (Flynn et al. 1990; Slack, Chambers and Johnston 2010). According to Bryman and Bell (2011), the type of research questions is critical in determining the unit of analysis in a study. The essence of this research is to provide an answer to how Nigerian O&G firms can derive competitiveness from strategic environmental capabilities fuelled by strategic resources and stakeholder pressures drivers. Therefore, the unit of analysis in this research is the focal companies operating within the Nigerian O&G supply chain, with the relevant top-level and middle-level managers as the respondents. Malhotra and Grover (1998) noted that individual respondents in survey research could act as their personal representatives, their expertise, or the company they stand for. Hence, using the individual managers to represent the focal companies is justifiable as this is also very common in operations and supply chain management research.

4.8 Chapter conclusion.

This chapter presented the methodology of this study. It started from the philosophical position of the study, looking at available choices and the justification for the selected options. The study is based on pragmatic philosophy, using an abductive approach with a sequential-exploratory mixed method. Therefore, the exploratory study results were presented to revise the conceptual framework, of which the measurement items of constructs, based on existing literature, were developed. The remaining part of the chapter focused on survey research that discussed sampling and survey participants. In all, this chapter gave a graphic picture of how the investigation proceeded and how the data analysed in the subsequent chapters were gathered.

Chapter 5: Empirical Analysis and Findings of Qualitative Research

5.1 Chapter Introduction

The literature review in chapter two reveals that a solid theoretical alignment exists between GSCM and NRBV. However, this theoretical proposition lacks empirical validation. Since the initial conceptual framework proposed in chapter 3 is based on this theoretical assumption, there is a need to first explore the existence of the theoretical constructs before embarking on a full assessment of the model. This is very crucial in the context of the O&G industry, where less research attention has been dedicated to GSCM and NRBV. Hence the proposed conceptual framework in chapter three is deemed generic as the application of the theorised variables in the industry cannot be contextualized from the extant literature. Therefore, the purpose of this chapter is to identify the specific industry-based constructs for the refinement of the proposed conceptual framework with the empirical findings of the qualitative research aspect of this study. This chapter is structured as depicted in figure 5. 1.

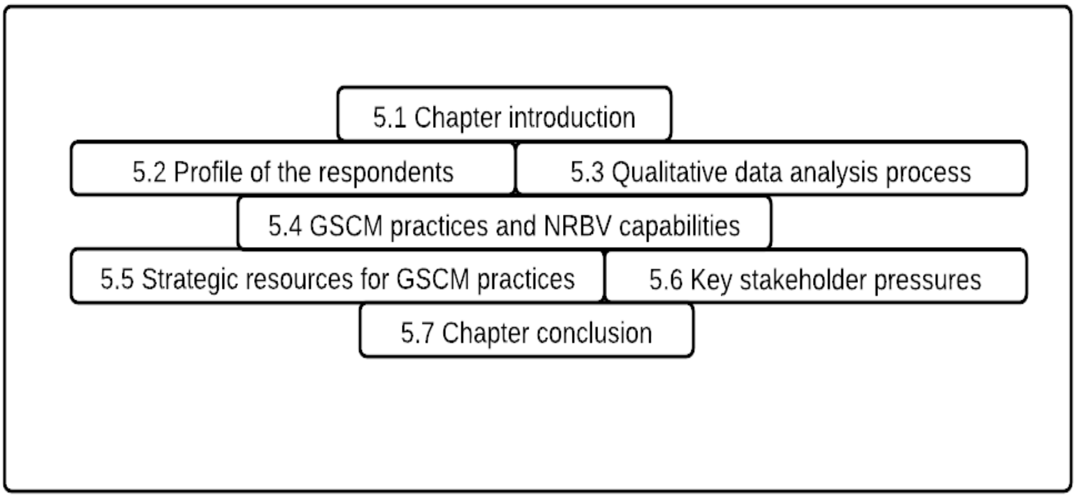

Figure 5.1: The structure of chapter 5.

Specifically, the results in this chapter are targeted at attaining the RO1, RO2, and RO3 of this study, as stated in chapter 1.

5.2 The profile of the respondents

As highlighted in section 4.7.1, the findings presented in this chapter are based on a thematic analysis of twenty-nine (29) semi-structured interviews conducted among the selected relevant top management staff of various firms operating across the SC of the Nigerian O&G industry. To this end, Table 5.1 presents the profile of the participants in this phase of the research

Table 5.1. The profile of the respondents

Interview code	Current position	Firm's operations	Industry experience
The Upstream sector			
IN1	Logistics operations manager	Exploration &Production	18
IN2	Local content suppliers manager	Exploration &Production	13
IN3	Operations manager	Exploration &Production	17
IN4	Local content suppliers manager	Exploration &Production	17
IN5	Local content suppliers manager	Exploration &Production	12
IN6	Local content suppliers manager	Exploration &Production	13
IN7	Assistant General Manager (AGM)	Exploration &Production	18
IN8	SCM and operations manager	Exploration &Production	15
IN9	Assistant General Manager (AGM)	Oil and gas servicing	18
IN10	Director	Oil and gas servicing	25
IN11	Assistant General Manager (AGM)	Oil and gas servicing	15
IN12	Assistant General Manager (AGM)	Oil and gas servicing	21
IN13	Operations manager	Oil and gas servicing	15
IN14	Director	Oil and gas servicing	22
The Downstream sector			
IN15	Logistics and Fleet manager	Logistics &Distribution	17
IN16	Chief compliance officer	Logistics &Distribution	19
IN17	Director	Logistics &Distribution	25
IN18	General manager (GM)	Logistics &Distribution	18
IN19	Director	Marketing and retailing	15
IN20	Director	Marketing and retailing	17
IN21	Supply Chain Manager	Marketing and retailing	17
IN22	Supply Chain Manager	Marketing and retailing	18
IN23	Procurement manager	Marketing and retailing	14
IN24	Logistics manager	Marketing and retailing	20
IN25	Logistics manager	Marketing and retailing	17
IN26	Assistant General Manager (AGM)	Marketing and retailing	17
IN27	Operations manager	Refinery	15
IN28	Operations manager	Refinery	13
IN29	Procurement manager	Refinery	14

This table shows that the respondents are senior management officers with a minimum of thirteen years of experience in the industry, cutting across a wide range of roles and responsibilities, both at the industry's upstream and downstream sectors. In line with Yusuf et al. (2013), senior executive officers have sufficient knowledge of O&G operations from strategic and operational levels. Also, a comprehensive approach with a wide range of managerial positions as adopted in this research can improve the triangulation of data sources, thereby enhancing the study's external validity. This is because a wide range of managerial perspectives can help with data generalisability (Scandura and Williams 2000). Therefore, the varieties of sampled opinions provided in this research offer solid findings of the research questions.

5.3 Qualitative data analysis process with NVivo

The current research employed the use of NVivo 12 software to carry out the qualitative data analysis. Although NVivo software cannot develop an automatic coding system for data, it has the capabilities of enabling a researcher to quickly identify common themes and apply them to appropriate codes (Edwards-Jones 2014). Therefore, the software was employed to break down participants' narratives on GSCM practices, NRBV strategic capabilities, strategic resources, and stakeholder pressures (as the driving forces). The above created an avenue for identifying themes to develop relevant concepts towards attaining the research objectives while answering the research questions (Boyatzis 1998; Vaismoradi et al. 2016). In the current study, figure 5.2 depicts the process of themes exploration for thematic analysis, using NVivo for qualitative data analysis.

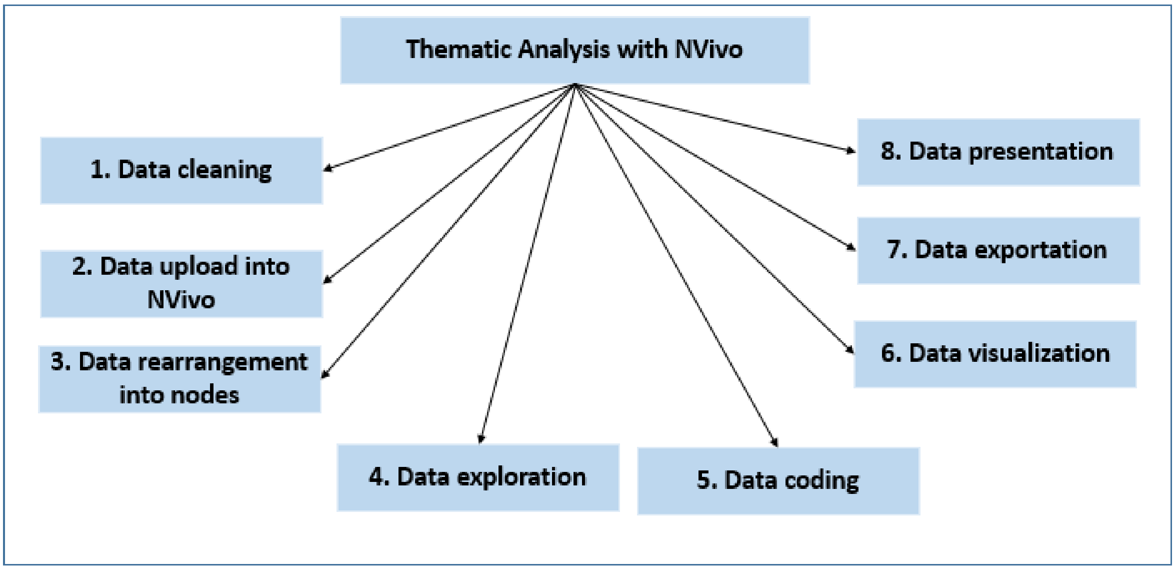

Figure 5.2: Thematic analysis on NVivo.

The first stage of analysis was data cleaning. This was carried out to develop familiarisation with the interview transcripts in a word document. This process facilitated a deep understanding of the content and context of the participants' responses. It also aided in identifying various themes that are relevant for subsequent labelling, sorting, and data synthesis. After this, the interview transcripts document was uploaded into NVivo 12 for further processing in stage 2.

The third stage is the arrangement of data into nodes. Here, the relevant research questions guided the development of anchor codes that form the basis of nodes creations. Code creation is an essential part of thematic analysis, which provides a conceptual foundation for classifying themes to understand the research phenomenon (Joffe and Yardley 2004). Coding is helpful for sense-making and sorting of collected data (Basit 2003; Fereday and Muir-Cochrane 2006) so that additional inquiry and evaluation can be carried out (Catterall and Maclaran 1997). The coding process in this research follows a template approach that enables a researcher to classify themes based on a priori codebook to organize texts for subsequent interpretation (Fereday and Muir-Cochrane 2006). The codebook in this study combines information sieved from theory with the research questions and initial data exploration (Crabtree 1999; Fereday Muir-Cochrane 2006; Miles and Huberman 1994; Gibbs et al. 2007). More importantly, careful attention was dedicated to ensuring that coding is primarily data-driven to enhance the validity of the developed codes (Boyatzis 1998). Based on this procedure, the apriori codebook applied in the thematic analysis of the twenty-nine interview conducted in this study is presented in table 5.2.

Table 5.2. Coding framework for data analysis.

Parent code	Sub-code
GSCM practices linked with NRBV capabilities	GSCM practices and pollution prevention capabilities • Intra-organizational environmental practices • Environmental management systems • Lean supply chain management practices
	GSCM practices and product stewardship capabilities • Green purchasing • Green distribution • Design for environment • Sustainable supply chain collaboration • Closed-loop supply chain management
	GSCM practices and clean technology capabilities • Adoption of environmental technology across the supply chain • Corporate environmental responsibility
	GSCM practices and Base of Pyramid capabilities • Socially responsible supply chain • Supply chain in developing economies
Key strategic resource driver of GSCM practices/NRBV capabilities	• Tangible resources within the supply chain • Intangible resources within the supply chain
Critical Stakeholder pressures	• Internal pressures (Top management and shareholders) • Market pressures (suppliers, customers, industry associations and competition) • Coercive pressures (Government regulatory institutions) • Normative pressures (NGO, media, public, host community)

As indicated above, the codebook covers three principal parent codes depicted from the literature and the research questions. The sub-codes are based on the literature review in chapter 2 and the data collected in this research. Thus, the codebook represents a meeting point of the research questions, theory, and data. The thematic codes presented above are based on elements of good codification (Botatzis 1998), where identifiable code names are generated with a focus on the potentiality of associated themes. Furthermore, the developed codes were tested for reliability by asking two doctoral researchers and an academician in operations management to independently code the documents containing the interviews, the summary of the literature review, and the research questions. The feedback from this process was incorporated for the modification of the codebook. After developing the apriori codes that guided the arrangement of data into nodes, data was explored on NVivo for possible themes related to the nodes, focusing on the research questions. At this stage, a general overview of themes about nodes was highlighted.

A more rigorous coding of themes was carried out to position emerging themes into the proper nodes. At this stage, the coding system was data-driven, which enabled the discovery of similar experiences of each participant (Leedy and Ormrod 2010). This is a critical stage where data were explicitly related to the theoretical proposition of the linkage between GSCM and NRBV strategic capabilities, strategic resources and the Stakeholder drivers of GSCM. The emergent codes at this stage were further classified into themes and sub-themes that identified the specific findings of this research.

After the above, visual aids were activated to depict the relationships among themes and sub-themes concerning nodes. Specifically, project maps were used to show how parent themes emerged into 'child' themes that provide answers to the relevant research questions. The findings and the visual presentation were exported from NVivo and stored appropriately on cloud storage to prevent data loss. Finally, the findings from this process are communicated in this chapter, forming the results of the exploratory phase of this research. These findings are presented below.

5.4 GSCM practices linked with NRBV capabilities in the Nigerian O&G industry

Establishing the links between GSCM and the four (4) NRBV strategic capabilities (pollution prevention, product stewardship, clean technology, and the base of the pyramid) commenced with an attempt to determine the degree of GSCM awareness in the Nigerian O&G industry. Accordingly, the twenty-nine (29) participants drawn across the SC of the Nigerian O&G industry (Please see respondents profile in section 5.2) were asked to share their thoughts on sustainability and how it is applied in their companies.

Respondents demonstrated a good understanding of GSCM and awareness of its practices in their companies. Although environmental sustainability awareness varies slightly between the upstream and downstream sectors, the participants demonstrated good knowledge of sustainability and their supply chain management implications. In this vein, IN7, an AGM in an exploration company, said:

> *"…Here, we take issues of sustainability seriously, and it is a philosophy that we practice across all our supply chains. Our suppliers and contractors are made to provide evidence of commitment to environmental and societal protection before we engage them".*

The literature suggests that sustainability awareness is high in the O&G industry following the global clamour for GHG emissions reduction to address climate change (Ahmad, de Brito and Tavasszy 2016). This position is validated in the Nigerian O&G industry with a high degree of sustainability awareness. This research also found that sustainability awareness is more heightened among the upstream sector participants than downstream. Arguably, higher sustainability awareness among practitioners from the E&P companies may be easily linked with the volatile nature of their operations. Over the years, the exploration companies have attracted criticism and pressure from stakeholders, including the media, government, NGOs, and the public, concerning the negative impacts of their operations on the environment (Yusuf et al. 2016). Therefore, it is logical to expect a high degree of awareness of sustainability among the E&P companies. However, it is instructive to note that all the six (6) participants from the oil servicing firms (Upstream suppliers and contractors) also demonstrated a high degree of sustainability awareness. IN13, an operations manager in an oil servicing company, stated that:

> *"For us to remain in business, we must comply with the requirements of our clients, I mean the petroleum companies. Most of them expect us to show that our businesses do not damage the environment. They even ask for our HSE policies. You know…, this is somehow funny to me because even the oil companies damage the environment….."*

The above suggests that one of the critical reasons for adopting GSCM practices by the upstream sector's suppliers and contractors is the business requirements of their clients (the E&P companies). The finding is consistent with Carter and Rodgers (2008), who posit that the environmental sustainability standards of a focal company could drive their supply chain partners to implement GSCM practices. A sector-by-sector analysis indicates that sustainability awareness is higher among operators in the upstream sector than downstream, as shown in figure 5.3.

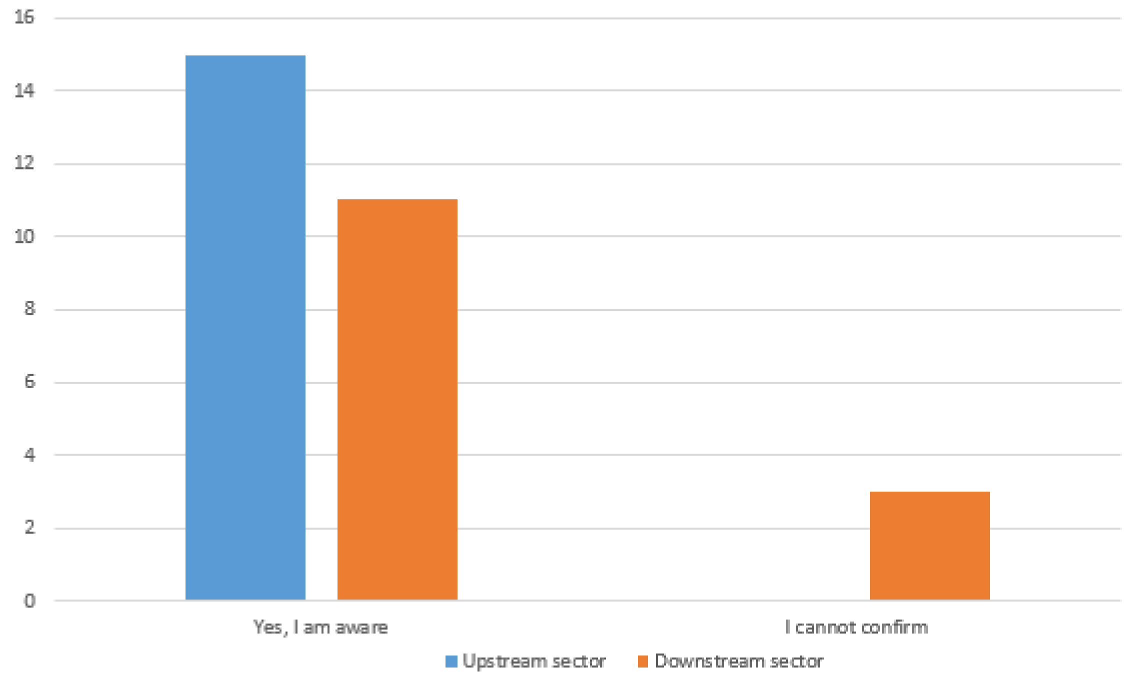

Figure 5.3: Awareness of SSCMGSCM in the Nigerian O&G industry.

The Figure above shows that while all the fourteen participants from the upstream sector confirmed and described the GSCM practices in their companies, only twelve out of the fifteen members from the downstream sectors confirmed that their firms are involved in GSCM practices. This indicates that Green practices (if any exist in these organizations) are generally considered part of general operational policies. For example, IN18, a GM in a distribution and Logistics company, stated that:

> "*We have many practices that help us in our operations, but I cannot think of any specific practices on sustainability. All we do is to comply with relevant laws that guide our operations.*"

In effect, this participant could not effectively confirm the extent of the adoption of GSCM practices in her company. Two other participants in the downstream sector also shared similar views. Since the participants are top management staff involved in strategic issues in their companies, it could be reasonably assumed that there is generally poor awareness of GSCM in these companies. Nevertheless, empirical results show that 80% of the participants from the downstream sector were able to demonstrate a good understanding of environmental sustainability implementation in their company's supply chain. With these results, the current study empirically confirms that the awareness of GSCM is high in the supply chain of the Nigerian O&G industry.

Upon establishing the degree of sustainability awareness in the industry, the following sections explore the specific GSCM practices in the Nigerian O&G industry and how they are linked with the NRBV strategic capabilities of pollution prevention, product stewardship, clean technology and the base of the pyramid. This is aimed at answering the RQ1 of this research.

5.4.1 GSCM practices linked with pollution prevention capabilities of the Nigerian O&G firms

In this study, pollution prevention capabilities indicate the ability of O&G firms to continuously minimize waste, effluents, and emissions from operational processes (Hart 1995). Previous studies suggest that GSCM is theoretically related to NRBV pollution prevention capabilities in the areas of intra-organisational environmental practices**, e**nvironmental management systems, and lean supply chain management practices (Guang Shi et al. 2012; Yunus and Michalisin 2016). Generally, pollution prevention implementation appears to be the most commonly discussed issue among the participants. This is not surprising as the O&G industry is notorious for its polluting operations, for which operators have been seriously criticised. All participants in this research demonstrated awareness of pollution prevention strategies in their firms and the need to enhance their capabilities. Following the existing framework, three aspects of NRBV pollution prevention capabilities (environmental management, intra-organisational environmental practices and lean supply chain management) were coded as they emerged from the qualitative data analysis. The specific themes and sub-themes that culminated into the findings of this research are presented in figure 5.4.

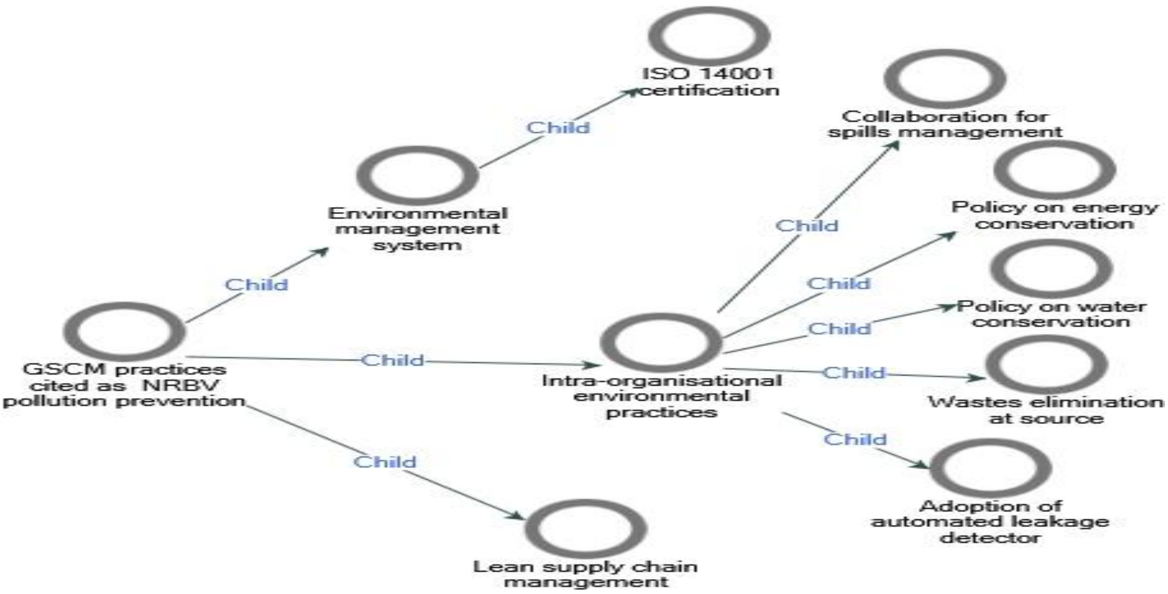

Figure 5.4: GSCM practices and NRBV pollution prevention capability in the Nigerian O&G SC.

Intra-organizational environmental practices cover many internal ecological management measures such as corporate environmental policies, removal/substitution of polluting materials, process optimization for solid waste prevention, and high-level prevention and safety methods (Guang Shi et al. 2012). The current study identifies five specific green practices that align with the definition of Intra-OEP in the Nigerian O&G industry. These are presented below.

- **Dedicated efforts to eliminate waste at source:** Participants in this research generally reiterated their companies' commitment to developing new approaches to eradicate operational waste rather than disposing and cleaning. In the opinion of an operation manager of an E&P company (IN8), *"Waste dispensing is part of our operations, but there are wastes that we can eliminate at source if we plan. It will save us money. What we do here is to work with operational consultants to identify new areas we can focus on eliminating wastes".* Also, in his comment, IN27, an operations manager in a refinery, asserted that: "*our approach to waste management is preventive. Where possible, we avoid using hazardous materials, and we embark on continuous training of staff on the best approaches in operational management"* This practice is common to both the upstream and the downstream sectors, even though approaches adopted differ across companies and sectors.

- **Policy on energy consumption reduction:** Energy supply is deficient in Nigeria (Ogunlowo, Bristow and Sohail 2015) despite her position as the 6th largest producer of crude oil and 7th largest natural gas reservoir globally (EIA 2013). Interestingly, O&G firms also incorporate energy consumption minimization into their GSCM practices. This is validated by IN23, a procurement officer in a petroleum marketing company, who said: *"My Company has a target to reduce the level of energy consumed in operations. Every operational staff is aware of this, and we work assiduously towards it. It is a matter of policy. Here, the cost of energy consumption is high, and we have to minimize it. As you can see, all electricity bulbs here are energy conserving. This is the same thing you find in all our branches. We don't joke with it."* From another perspective, IN 12, an AGM of an oil servicing company, .stated that *"Here, it is prohibited to consume energy when it is not absolutely necessary. Power and lighting constitute a large chunk of our operational costs, and we are out to reduce them.* Also, adopting a policy on energy consumption reduction is common to both upstream and downstream operators. It is pertinent to note that this practice is fostered in collaboration with suppliers.

- **Targeting water consumption reduction:** Water is used in all aspects of the O&G supply chain and thus has implications for water available for human consumption. Consequently, stakeholders have emphasised the need for the industry to adopt measures for water management (IPIECA 2020). For example, a local content manager in an E&P company (IN5) stated that *"Reducing water consumption is very critical to my company, considering that the host community lacks insufficient access to potable water."* This view is also shared by the practitioners in the downstream sector as explained by IN28, who opined that *"We practice serious water reuse here. The idea is to minimise water as much as possible".*

- **Collaborating for oil spill minimization:** Oil spillage is a prevalent problem in the O&G industry. While spillage is majorly associated with upstream operations, spillages also occur in refineries, logistics networks, and gas stations in the downstream sector. According to IN2, *"Spillages are either accidental or caused by vandalism. We know we cannot address this alone. We consistently seek collaboration with stakeholders to manage spills"* Despite the presence of spillage in the downstream sector, this study cannot identify the specific GSCM practices adopted by the companies at the downstream sector to minimize oil spillage. This finding suggests that the companies in the downstream sector of the industry channel less attention to spill management and control. The above position is consistent with previous studies that indicate that oil spillage in the downstream sector is largely unpublicised despite an increasing environmentally damaging spillage through refinery and logistics activities (O'Rouke and Connolly 2003; Jernelov 2010).

- **The use of automated leakage detectors:** By its nature, the O&G industry's operations are susceptible to leakages at the upstream and downstream sectors. Participants emphasized the need to timely detect leakages of all types to prevent severe environmental hazards. In this vein, many participants mentioned that their companies adopt leak detectors to minimize the ecological risks of operations. The words of IN7 are very apt in this regard. The participant stated that *"the risk of our operations is very high. If we do not take proactive measures, we will continue to harm the environment because of our operations' leakages. We have therefore invested in digital leak detectors that proactively report gas and liquid leakages."*

The issues identified above provide empirical evidence to Guan Shi et al.'s (2012) GSCM-NRBV framework specifying that intra-organizational environmental practices are vital representatives of pollution prevention strategies in the context of GSCM.

This research further finds evidence of GSCM practices related to the *environmental management system (EMS)* aspect of pollution prevention capabilities. Generally, EMS is related to total quality management (TQM) and international standard organization (ISO) systems in the context of GSCM (Guan Shi et al. 2012; Hajimohammed et al. 2012). The specific GSCM practice linked to EMS for pollution prevention in the Nigerian O&G industry is presented below.

- **ISO 14001 Certification:** Participants in this research consistently highlighted ISO 14001 certification as evidence of adopting global best practices to minimise the environmental impacts of their operations. For example, IN1 stated that *"We comply with global best practices* *in our environmental management. We have got ISO 14001 in place, evidencing that we take issues of environmental management seriously".* Similarly, IN20 opined that *"We don't just do things here. We comply with international standards. For your information, we are ISO 14001 certified".* The views expressed above conform with seminal papers on NRBV where issues of TQM and ISO certifications are repeatedly discussed as evidence of EMS (Hart 1995; Russo & Fouts, 1997)

Lean supply chain management is the third classification of GSCM practices linked with the NRBV pollution prevention capabilities. As indicated in table 5.2, none of the participants in this research cited the specific lean supply chain management practices adopted by their companies. However, inferences that agree with the lean definition (Hajimohammad et al. 2013) can be drawn from the interviewees' discussions. The participants generally indicated issues relating to lead time reduction, improved turn-around time and TQM. The above points perfectly align with the concept of lean operations (Narasimhan et al. 2006; Shah and Ward 2007; Vondererembse et al. 2006).

5.4.2 GSCM practices linked with Product stewardship capabilities of the Nigerian O&G firms

In this study, product stewardship capabilities relate to the ability of O&G firms to adopt measures that reduce the environmental impacts of products on society throughout the product life-cycle (Hart 1995; Fowler and Hope 2007; Hart and Dowell 2011). From the apriori codebook in table 5.2, five aspects of GSCM practices are compatible with the NRBV product stewardship capabilities. These are green purchasing, green distribution, design for the environment, sustainable supply chain collaboration, and closed-loop supply chain management. The specific practices related to each of the above in the Nigerian O&G industry are depicted in figure 5.5. The discussions are also presented below.

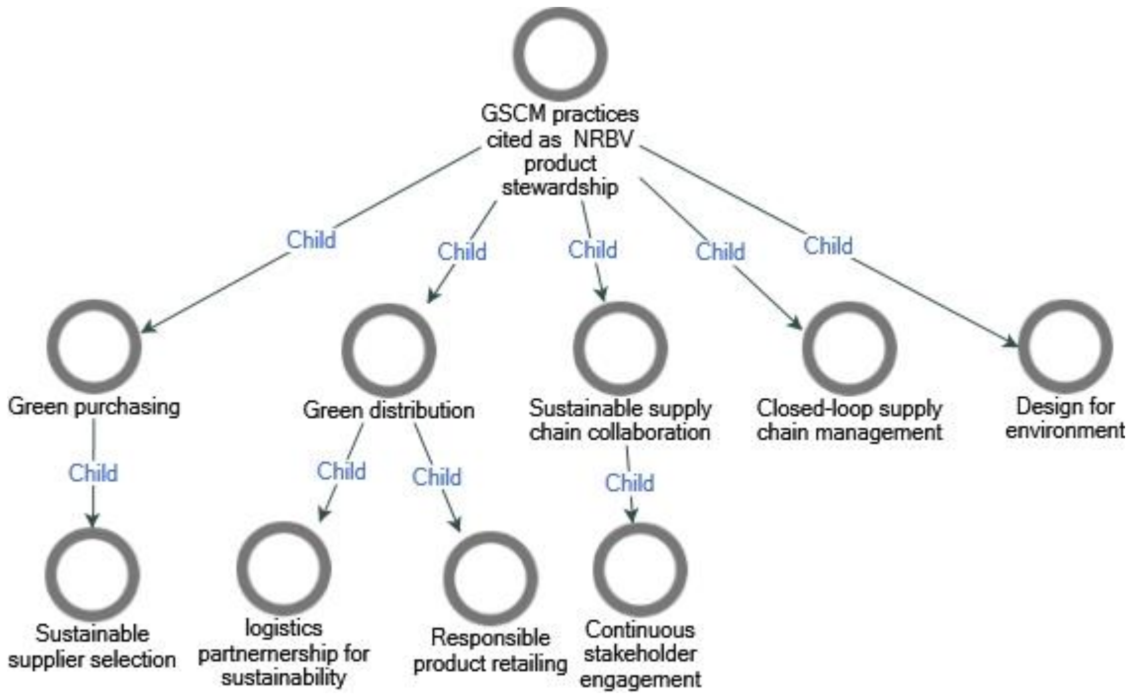

Figure 5.5: GSCM practices and NRBV product stewardship capability in the Nigerian O&G SC.

First, the participants' discussions on green purchasing highlight the role of the focal company in selecting suppliers with green orientations. The thematic issue identified in this regard is that Nigerian O&G firms place a premium on **Patronising only suppliers that comply with their sustainability policies.** As highlighted by IN5, a local content manager in an E&P company, "*We have developed sustainability codes of conduct for our suppliers. We are strict about this. Any supplier that cannot meet our sustainability requirements cannot win our patronage".* Similarly, IN 29 .stated that *" we accredit our suppliers and ensure they meet our standards."* In line with Guang Shi et al. (2012), the above views reinforce the argument that inter-organizational collaboration at the supplier's level enhances a firm's product stewardship strategies.

Second, regarding green distribution, participants emphasised the role of transportation and logistics in reducing the environmental footprints of products. While stressing the need to deploy technology to achieve safe product distribution through pipelines between the upstream and downstream sectors, participants also highlighted the need to build capabilities in **partnering with distributors to reduce the environmental impacts of products.** *"Logistics management is a crucial aspect of our operations, and we are channelling efforts to strengthen the relationship with logistics partners to ensure product safety" (IN8.).* Participants acknowledge the negative impacts of petroleum transportation on the environment in the upstream and downstream sectors. For example, IN13 stated that *" There are many environmental issues in the petroleum distribution channels, majorly caused by pipeline vandalism and* *weak logistics infrastructure. Also at the downstream sector, transporting petroleum product with tankers on our poorly constructed roads are great hazards to the environment. We hope the government will build infrastructures to help us in this area. As a company, we require the support of all stakeholders to ensure that our products seamlessly get to the consumers".*

Another issue raised by participants in the green distribution aspect of product stewardship is the need to foster **effective and safe product dispense at depots and outlets.** In the words of IN25, a logistics manager in a petroleum marketing company, *"Petroleum products are hazardous and safe handling is required at all stages, especially at the depots and gas stations." Also*, *IN17* asserted that "*Depots and gas outlets are our point of contact with consumers. We focus serious attention on training the officers in charge of these facilities on safety."* The research findings show that operators highlight green transportation and green storage in their green distribution strategies in line with previous studies (Jumaidi and Zailani 2010).

This research cannot find specific references to the practice of design for the environment (DfE) during the interviews with all participants. Nevertheless, respondents consistently raised issues of process improvement to enhance product safety. Such problems are also related to the concept of DfE (Hart 1995; Markeley and Davis 2007).

Furthermore, sustainable supply chain collaboration featured prominently in all discussions. All participants emphasised that they consistently collaborate with supply chain partners and other stakeholders to achieve sustainability in product management. For example, IN3 stressed that *"We cannot achieve sustainability in isolation. We collaborate with supply chain partners and other stakeholders to ensure product safety".* This result is consistent with a body of literature that asserts that developing capabilities for environmental management require inputs from supply chain members (Vachon 2007; Seuring & Müller 2008; Abbasi and Nilsson 2012; Giminez and Tachizawa, 2012; Miemczyk 2012; Jensen et al. 2013). It also aligns with the literature on NRBV that conceptualizes product stewardship capabilities as a function of stakeholder engagement (Hart 1995; Hart and Dowell 2011).

Finally, participants in this study could not provide explicit practices related to closed-loop supply chain management. Although references were occasionally made to the promotion of circular economy, this concept is not well-emphasised by the respondents. The specific practices are not mentioned, despite follow-up questions to elicit information in this regard. Therefore this research concludes that CLSCM is not a viable area of linkage between GSCM and NRBV product stewardship capability in the Nigerian

O&G industry. Nevertheless, the results above confirm a verifiable direct link between GSCM practices and NRBV product stewardship capabilities in the Nigerian O&G industry.

5.4.3 GSCM practices linked with clean technology capabilities of the Nigerian O&G firms

Clean technology is defined as the ability of O&G firms to adapt to disruptive changes in the industry by adopting technologically inclined options that could cause drastic changes or diversifications in operational processes or product portfolio (Hart and Dowell 2011: Pernick and wilder 2007). The aspects of GSCM practices related to clean technology, as indicated in figure 5.6, are the adoption of environmental technology across the supply chain and corporate environmental responsibility.

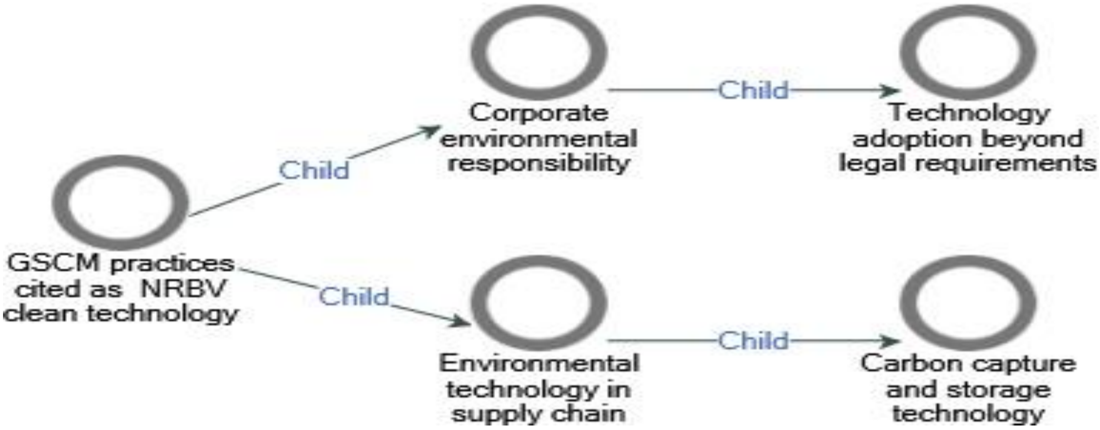

Figure 5.6: GSCM practices and NRBV clean technology capability in the Nigerian O&G SC.

The specific GSCM practices regarding the above are discussed below.

Participants emphasized the adoption of environmental technology in operations to combat sustainability issues. Regarding this, participants mainly from the upstream sector stated that the industry targets **investment in carbon capture and storage infrastructure** to achieve a low carbon future. Many respondents from this sector emphasized that their companies seek funding partners to acquire carbon capture and storage infrastructures. "*There are technologies that can help us to manage effectively and significantly reduce our environmental impacts by capturing carbon at source and storing them permanently under the ground. These facilities require huge investment. My company is seeking investment in these infrastructures (*IN8). The participants also mentioned software deployment to assess the environmental impacts of operations proactively. The findings on the discussion of environmental technology agree with Schrettle et al. (2014) that environmental technologies in supply chains are channelled towards enhancing performance and reducing damaging production processes.

Furthermore, all participants expressed their firms' commitment to applying technologies beyond legal requirements or economic benefits and making societal impacts in ecological spheres regarding corporate environmental responsibility. This is an empirical validation of the nexus between corporate environmental responsibility and clean technologies (Kogg and Mont 2012; Kovács 2008). Therefore, these results reinforce the position of Maloni and Brown (2006) that the practice of corporate environmental responsibility may boost firms' capabilities for the adoption of clean technologies.

5.4.4 New area of linkage between GSCM and NRBV clean technology identified

Mcdougal et al. (2021) posit that GSCM and NRBV align in the area of the adoption of environmental technology across the supply chain and corporate environmental responsibility. The specific GSCM practices that align with the above are validated in the previous section. However, the thematic analysis results in this study identified a new area of alignment between NRBV and GSCM, which is not considered in the previous framework (McDougall, Wagner and MacBryde 2021). Figure 5.7 presents the emerging area of alignment between the NRBV clean technology capability and GSCM. The specific practices are discussed below.

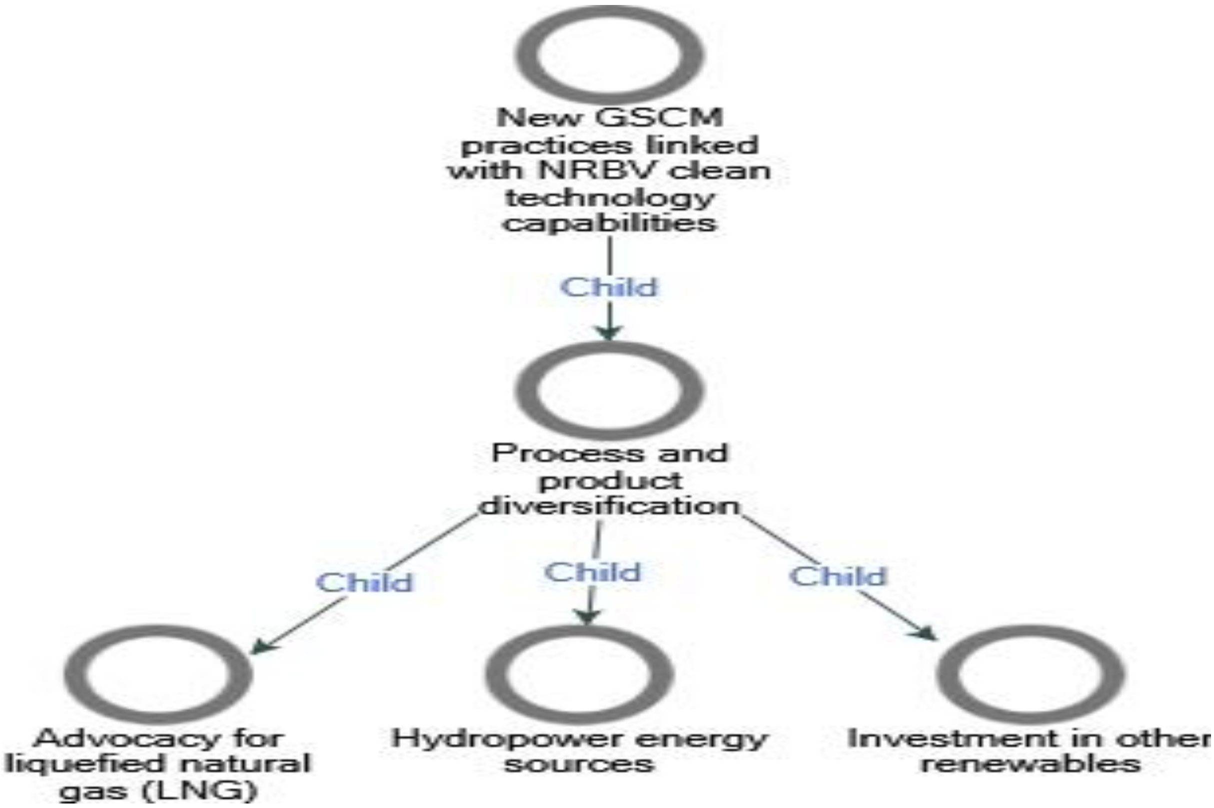

Figure 5.7: New Areas of linkage between GSCM and NRBV clean technology capability in the Nigerian O&G SC.

- **Advocacy for liquefied natural gas (LNG):** A theme that operators widely emphasized in the Nigerian O&G is the need to promote liquefied natural gas in Nigeria. It is on record that Nigeria is one of the largest gas flaring nations globally. The implications of this in terms of environmental, economic, and human costs have been discussed in chapter 2. Considering that natural gas is a form of cleaner gas, firms in the country continuously seek collaboration for gasification projects to close the energy gap in the country. As mentioned by IN4, *"We are deemphasizing the use of the conventional fuel. Our emphasis now is on gas. We are committed to reducing gas flaring. We realize that one way to achieve this is to seek collaboration for the gasification projects and sensitize the public that natural gas is cleaner. To us, liquefied natural gas is the future"*

- **Adoption of hydropower sources:** All participants in this research stated that they adopt hydropower sources to power their operations. Hydro energy is a renewable source of energy that is environmentally friendly. However, despite acknowledging the use of hydro-energy power in their operations, the participants could not confirm that their companies are presently embarking on the commercialization of hydro-energy.

- **Seeking collaborative investment in renewables:** Collaborative investment in renewable and alternative energy sources was consistently highlighted by participants, mainly from the upstream sector. As expatiated by IN3, "*In this company, we are looking beyond oil. We recognize that oil will outlive its relevance in the future energy mix. At the strategic level, we are collaborating with relevant partners to deepen investment in renewables". T*his expression highlights the participant's company's focus on exploring developing and commercialising alternative and renewable energy. The participants from the upstream sector commonly express this type of view.

The above findings are not surprising as the NRBV literature greatly emphasises product and process diversification. For example, Hart (1995) suggests that firms may diversify into the production of eco-friendly products to reduce their environmental impacts. Also, Wicki and Hansen (2019) also assert that firms can develop their green innovations capacity by engaging in diversification. Interestingly, the role of process and product diversification in the context of GSCM has not been explored. With these findings, the current study effectively extends the existing frameworks on GSCM and NRBV clean technology capability with product and process diversification.

5.4.5 GSCM practices linked with the base of pyramid capabilities of the Nigerian O&G firms

Following its conceptualization by Hart and Dowell (2011), this study defines the base of the pyramid (BoP) capabilities as the totality of strategic approach adopted by firms to make positive impacts on the lives of people who are highly alienated from global capitalism (London and Hart 2010). In this research, participants have reiterated their practices concerning the CSR projects executed in the host community. While the above are related to the social dimension of TBL, which is also interlinked with sustainable development capabilities (Hart 1995; Hart and Dowell 2011), BOP goes beyond CSR but emphasises addressing global issues among the most disadvantaged in the world (Khalid and Seurin 2019). The participants in this research could not establish their firm's practices concerning alleviating global social menaces and contributing to global poverty alleviation, which are the critical elements of BOP strategies.

Therefore, this research cannot find elements of the Base of the Pyramid strategies in the Nigerian O&G industry. Hart and Dowell (2011) noted that the sustainable development strategies, especially the BoP, are generally neglected in literature and practices. The results are also consistent with McDougall, Wagner and MacBryde (2019), who found that the base of the pyramid capability lacks empirical evidence in the UK Agro-food industry.

5.4.6 Summary of findings on NRBV-GSCM practices

Following the literature-based, apriori codebook in table 5.2, the thematic analysis of the semi-structured interviews conducted among top management staff of firms operating across the supply chain of the Nigerian O&G industry reveals a high level of awareness of GSCM practices in the industry. Furthermore, the results show that all aspects of GSCM practices related to NRBV pollution prevention capabilities are in existence in the Nigerian O&G industry. Regarding GSCM practices and the NRBV product stewardship capabilities, empirical evidence supports practices consistent with green purchasing, green distribution, and sustainable supply chain collaboration. Evidence of GSCM practices related to design for environment (DfE) and closed-loop supply chain cannot be empirically verified. Moreover, this research found various GSCM practices linked with NRBV clean technology capability in the Nigerian O&G industry. In contrast, this study cannot empirically validate GSCM practices related to the industry's base of the pyramid capability. These findings are consistent with McDougall, Wagner and MacBryde (2019), who empirically validated the existence of the GSCM relationship with NRBV in the UK Agri-food industry, except for the base of the pyramid capability. Table 5.3 presents the empirically validated GSCM practices represented by the NRBV strategic capabilities (pollution prevention, product stewardship and clean technology) in the Nigerian O&G industry

Table 5.3. GSCM practices and NRBV strategic capabilities in the Nigerian O&G industry

	Aspects of GSCM	GSCM practices
Pollution Prevention	Intra-organizational practices	Dedicated efforts to waste elimination at source
		Corporate policy on energy consumption reduction
		Targeted policy on water consumption reduction
		Collaboration for spillage minimisation
		Adoption of automated leakage detectors
	Environmental management systems (EMS)	ISO 14001 certification
	Lean supply chain management	Total quality management (TQM) and improved turn-around time (TAT)
Product Stewardship	Green purchasing	Patronizing only suppliers with verifiable compliance with sustainability policies
	Green distribution	Partnering with product distributors for the reduction of environmental impacts of products.
		Effective and safe product dispenses at depots and retail outlets.
	Sustainable supply chain collaboration	Building continuous working relationships with stakeholders for sustainability improvement
Clean Technology	Environmental technology	Targeted investment in carbon capture and storage infrastructure
	Corporate environmental responsibility	Deployment of technologies beyond legal requirements or economic benefits.
	Product/process diversification	Preferential adoption of liquefied natural gas (LNG)
		Adoption of hydro-power sources
		Collaborative investment in renewables.

Based on the above, therefore, the above results confirm that the operators in the Nigerian O&G industry are focusing their GSCM practices on the development of three NRBV strategic capabilities of pollution prevention, product stewardship, and clean technology with no supportive findings for the BOP.

Consequently, these results shall refine the proposed conceptual framework in the next chapter. In effect, these results have led to the attainment of the RO1 of this study which is:

'To explore and identify the specific GSCM practices that constitute the NRBV strategic capabilities of pollution prevention, product stewardship, clean technology and base of the pyramid in the Nigerian O&G industry'.

The next section of this chapter presents the most critical strategic resources that drive the NRBV strategic capabilities (GSCM practices) in the Nigerian O&G industry to address the RQ2 of this study.

5.5 Strategic resources enhancing GSCM in the Nigerian O&G industry

Participants in this research were asked to discuss the most critical resources that enhance their firms' capabilities for GSCM implementation. First, all participants asserted that the availability of essential resources impacts their sustainability practices. According to IN7, "*Companies need resources to implement sustainability practices. Not only that, you need to develop the necessary capabilities. You need staffs that are trained in the area of sustainability practices and many more"* Similarly, IN23, a procurement manager in an independent marketing and distribution company, posits that "*everyone is talking about sustainability. Do you know what it means for companies? It means most companies have to change their entire process. It means we have to acquire relevant resources and develop core competencies. It requires innovation and new ways of doing things."* The above is also reinforced by IN10, who said that "m*any O&G servicing companies are not adopting some sustainability initiatives because of the cost of the resources and capacity required to make the system work."*

Data analysis reveals that both tangible and intangible resources are considered necessary for implementing green practices by the participants. Thematic analysis reveals nine types of resources that the participants in this research highlighted, as shown in table 5.4.

Table 5.4. Strategic resources for NRBV capabilities and GSCM in the Nigerian O&G industry.

Resources	**Tangibility**	**Relevant quote**
Finance	Tangible	*"The major resources required here is finance. There are numerous sustainability ideas that we can execute, but we need funding to achieve this" (IN15)*
Technological assets	Tangible	*"Our industry is technologically driven. To improve our capabilities for effective sustainability practices, we need to acquire state-of-the-art technological equipment"(IN6)*
Logistical infrastructures	Tangible	*"Let me tell you; logistical failure contributes a lot to negative environmental impacts of our*

		operations. To enhance our sustainability, we need reliable logistics infrastructure" (IN1).
Green distribution channels	Tangible	*"You see, the O&G industry in Nigeria still relies on traditional distribution channels. Can you imagine that people still buy fuel inside gallons from petrol stations? Do you know how many accidents and loss of lives such practices has caused? There is no pipeline supplying gas directly to homes, as seen in developed countries. People buy gas in cylinders, some of which are expired. We need to green our distribution channels to achieve sustainability ((IN25)*
Knowledgeable employees	Intangible	*"The knowledge of our human capital is a critical resource for the implementation of sustainability practices. Sustainability is a strategy, and since strategies do not implement themselves, we need highly knowledgeable employees to make them work"(IN7)*
Continuous innovations	Intangible	*"The only way you can enhance your sustainability implementation capabilities is to continuously innovate your practices. Here, we always seek a better way to do things. Our philosophy is that you cannot do the same thing in the same way and expect a different result" (IN10)*
Strategic supply chain collaboration	Intangible	*"There is no way we can achieve enhanced sustainability competence alone. Sustainability is a global issue, and here we treat it as such. A major approach is that we seek collaborative approach with suppliers, customers, partners, and other stakeholders to develop the best practices for implementing sustainability strategies" (IN5)*

The above findings are very instructive because it constitutes one of the earliest attempts at unravelling the resource commitment of the Nigerian O&G industry to the implementation of proactive environmental practices. A further analysis was carried out to identify the importance of the resources identified in this study. Figure 5.8 presents the rating of these resources based on their frequency.

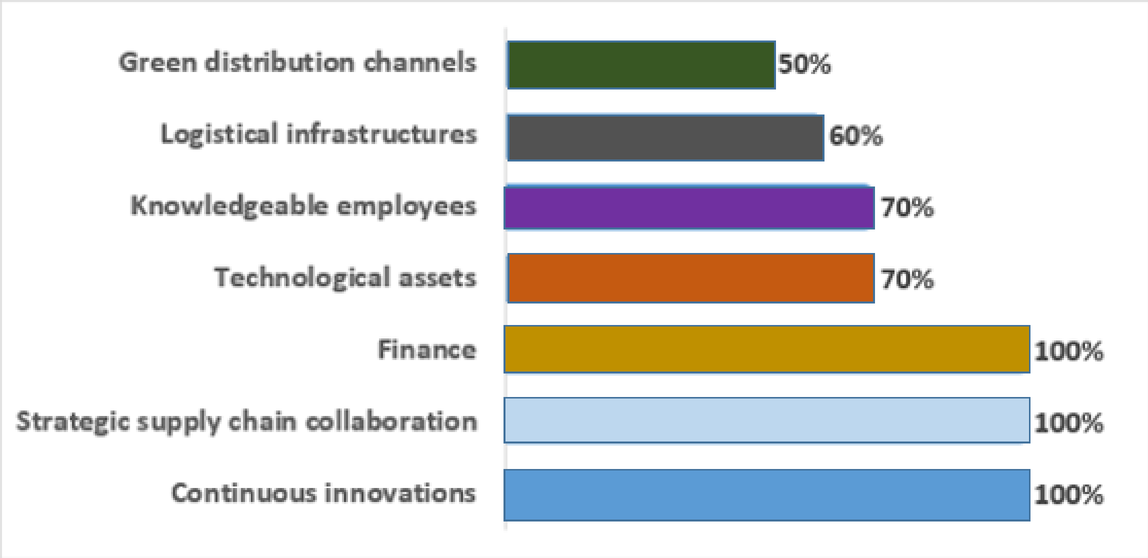

Figure 5.8: Ranking of strategic resources for GSCM implementation in the Nigerian O&G industry.

As seen above, all participants mentioned finance, continuous innovations, and strategic supply chain collaboration as the most critical strategic resources required by their companies to enhance their capabilities to implement sustainability practices. These findings are consistent with the position of the NRBV literature that continuous improvement and stakeholder collaborations are strategic resources for implementing pollution prevention and product stewardship strategies (Hart 1995). Furthermore, knowledgeable employees and technological assets are the second most popular strategic resources highlighted by the participants in this study. These factors are recognized by 70% of the participants as the critical resources needed to implement proactive environmental strategies. These findings are consistent with previous studies that validated employees' knowledge and technological infrastructures as critical resources for firms' sustainability practices (Ahmed, AlZgool and Shah 2019; Dashore, Sohani and Technology 2013). Also, 60% of the participants identified logistical infrastructures as strategic resources for implementing sustainability practices. In comparison, 50% of the respondents in this research mentioned green distribution channels as the strategic resources required by their firms to implement sustainability practices. These respondents generally acknowledged that archaic gas stations, poor 'well to wheel' practices, and risky gas distribution to final consumers impedes the development of sustainability in the O&G industry. The opinion of these respondents is that O&G firms that invest in green distribution channels can enhance their sustainability practices.

As shown in figure 5.8, finance, continuous innovations, and strategic supply chain collaboration are regarded as the most critical resources the Nigerian O&G firms require to enhance their capabilities to implement proactive environmental practices, as highlighted by 100% of the respondents. However, in line with the tenets of the NRBV that only socially complex and tacit resources can sustain competitive advantage (Hart 1995; Hart and Dowell 2011). It is argued that continuous innovations and strategic supply chain collaboration are the two main strategic resources required by the Nigerian O&G firms to implement the NRBV strategic environmental management capabilities.

Undoubtedly, finance is a critical factor for implementing sustainability practices (Lindgreen et al. 2009; Walker et al. 2012); However, this study argues that competitors may replicate finance's availability. Thus, it may not easily align with the concept of strategic resources within the NRBV. In contrast, continuous innovations may not be easily replicable by competitors. This is because the ability to generate innovations continuously is socially complex, as innovations are usually developed based on comprehensive consultation with stakeholders (Hart 1995; McDougall, Wagner and MacBryde 2019). Similarly, strategic collaboration at the supply chain level is tacit and socially complex and not easily replicable by competitors (McDougall, Wagner and MacBryde 2019). The arguments presented above align with the views expressed by most participants in this study. For example, IN8 stated that *"we need finance, infrastructures and physical resources to implement sustainability strategies. However, I think what we need majorly is innovations. I feel that our company can improve our sustainability strategies if we can work with our supply chain members to generate innovations".* Similarly, IN15, a fleet manager in a logistics and distribution company, states that *"as a logistics company, we need to come out with new ways of doing things. We need innovations to reduce our environmental impacts. Such innovation can emanate from our suppliers, customers, even our employees, and it must be consistent. Over the years, the distribution of fuel has caused a lot of environmental pollution, including road accidents and loss of products in millions……."*

In the light of the foregoing, it is argued that strategic collaboration with supply chain members can also constitute a source of innovations for firms. Indeed, the concept of supply chain innovations is based on the philosophy that collaborative relationships among supply chain partners can create continuous innovations that boost the supply chain's competitiveness (Soosay, Hyland and Ferrer 2008). Interestingly, the idea of continuity of innovations through supply chain collaboration appears to have been downplayed in the literature that examines supply chain innovations. Therefore, continuous innovations generated in collaboration with supply chain partners are inimitable strategic resources in the Nigerian O&G industry (Grant 1991; Barney 1991). Such ability may help firms to develop or enhance the strategic capabilities required for competitiveness in the industry. Therefore, this study conceptualises *'Supply chain continuous innovations'* as the strategic resources needed by the Nigerian O&G firms to develop their capabilities for sustainability practices. While previous studies have separately examined the role of continuous innovations, supply chain innovations, and supply chain collaboration in enhancing firms' capabilities, this study is arguably one of the earliest attempts to empirically relate continuous innovations to supply chain collaboration.

5.5.1 Summary of findings on strategic resources for NRBV-GSCM practices

The empirical results of the strategic resources highlighted by the participants in this research were presented in this section. A total of seven (7) tangible and intangible strategic resources were identified in the industry. All participants in this research cited finance, supply chain collaboration, and continuous innovations as the strategic resources enhancing GSCM implementation in their firms. The NRBV environmental management strategies linked with GSCM in section 5.4 are dynamic capabilities (Teece 2003; Hart and Dowell 2011) driven by tacit and socially complex resources. This research acknowledges finance as a critical factor in sustainability implementation. Arguably it does not fall within the conceptualisation of strategic resources within the NRBV framework because of the possibility of replicability. In contrast, continuous innovations and strategic supply chain collaboration are tacit and socially complex resources developed collaboratively in a supply chain. Considering that continuous innovations are generated through supply chain collaboration (Soosay, Hyland and Ferrer 2008), this study conceptualises *'supply chain continuous innovation'* as the most critical strategic resources required by the Nigerian O&G operators to develop strategic capabilities for GSCM implementation. The findings in this section shall be applied to refine the proposed conceptual framework in chapter 5. The results in this section have successfully addressed the RO2 of this study which is:

> **"To explore and identify the critical strategic resources that enhance GSCM implementation in the Nigerian O&G industry."**

Having achieved the stated objective, the following section presents the empirical findings of this research regarding the role of stakeholder pressures in strategic capabilities for GSCM adoption in the Nigerian O&G industry.

5.6 Key Stakeholder pressures antecedent of GSCM practice in the Nigerian O&G industry

The results presented in this section relate to the stakeholder drivers of strategic capabilities for GSCM implementation in the Nigerian O&G industry. As highlighted in chapter two, many studies have examined the role of strategic resources in firms' development of strategic capabilities (Barney 1991; Hart 1995). However, the driving forces behind the interaction of strategic resources and capability are unclear. Therefore, to achieve the RO3 of this study, the empirically validated stakeholder driving forces of the strategic capability for GSCM implementation in the O&G industry are presented below.

Government regulations: All participants in this research highlighted compliance with government regulations as a driving force behind their firms' proactive environmental practices. IN7 .said that "*the law mandates us to comply with certain sustainability standards. These are enforced by various regulators, including the Department of Petroleum Resources (DPR). Here, if you want to remain in business, the fear of the DPR enforcement task force is the beginning of wisdom. In my opinion, compliance with the law is the most cogent antecedent of sustainability practices in this industry".* The position is corroborated further by IN25, who stated that *"We are a highly regulated industry. You have a limited choice where the regulations require you to take action to protect the environment. Many companies in this industry commit resources to sustainability practices in response to the fear of enforcement of government regulations".* Previous studies have government regulations as a critical driving force behind the firms' sustainability practices (Esfahbodi et al. 2017). However, it has also been established that mere compliance with the law may not necessarily be sufficient to develop a culture of sustainability practices in an organization.

- **Customers' sustainability requirements:** Participants highlighted the role of their customers' sustainability standards in developing capabilities to implement sustainability standards. According to IN15, *"our main client* (*mentioned the customer company's name) is rigorous in their suppliers' recruitment. After signing their sustainability policy, they also monitor compliance. So as long as you want to retain them as your client, you have to comply with their requirements"*. An exciting finding regarding the above is that the downstream operators and the E&P participants did not refer to the role of customers' requirements in their adoption of sustainability practices. This may be due to the homogeneity of the O&G products, where product differentiation may not necessarily constitute a pivotal factor in a final consumer's purchase decision.
- **Competition:** This research identifies the activities of leading competitors as one of the driving forces behind the development of capabilities for the implementation of sustainability practices by Nigerian O&G firms. As noted by IN11, *"our experience is that the leaders in this industry portray themselves as environmentally-conscious organizations, and it works for them. We competition, believe they get higher patronage from the E&P companies because of this image. We also adopt a similar approach for us to be attractive to the E&P companies".* The O&G servicing firms and suppliers commonly expressed this type of view.
- **Host community interests:** Participants highlight the host community's interest as a critical factor driving GSCM implementation. The Nigerian O&G upstream operators have a history of conflicts with their host communities due to unsustainable exploration and production

activities. Perhaps, this is why the host community's interest is a commonly cited factor among participants from the industry's upstream sector.

- **Media and press:** A good number of the respondents in this study highlighted the role of media and press in their firm's efforts towards sustainability practices. *"Bad press is bad for our business. This industry has a bad reputation for environmental management, and the press wants to feed on this continuously. We don't want this to happen" (IN6).* Generally, this view is commonly expressed by the operators in the upstream sector. This might not be divorceable from the fact that the media have consistently criticised the Nigerian upstream operators for unsustainable practices. One such example is the alleged unsustainable activities of SPDC in Ogoni land, leading to the agitation of the host community. This crisis is eventually linked with the death of a leading human rights activist, Ken Saro Wiwa, in November 1995, resulting in global media criticism against SPDC and other upstream operators in the Nigerian O&G industry (Obi 1997).
- **Top management support:** Another commonly cited driving force behind the development of capabilities for implementing sustainability strategies by the operators in the Nigerian O&G industry is the support of the company's top management. Unlike the previous factors, top management support is an internal driving force of sustainability practices. Indeed, all participants in this research acknowledge the role of top management in their implementation of sustainability practices.

Following the theoretical conceptualization of this study, Freeman's (1984) stakeholder theory is applied to classify these findings into stakeholder pressures, as presented in table 5.5.

Table 5.5. Stakeholder drivers of GSCM in the Nigerian O&G industry.

Stakeholder Pressures	**Specific stakeholder**
Internal pressures	Top management support
Market pressures	Customers sustainability requirements
	Competition
Coercive pressures	Government regulations
Normative Pressures	Host community interest
	Media and Press

As seen above, this research identifies internal, market, coercive and normative pressures emanating from various stakeholders as the driver of GSCM implementation in the Nigerian O&G industry. These findings are consistent with Zhu and Sarkis (2007), who empirically validated the positive impacts of stakeholder pressures on GSCM implementation in the Chinese manufacturing sector. A further analysis was carried out to determine the importance of each of the factors identified above among the participants. The purpose of this is to refine the proposed conceptual framework with the most significant stakeholder pressures that drive GSCM adoption. Figure 5.9 presents the ranking of the GSCM-NRBV stakeholder pressures forces based on their frequency of occurrence in the semi-structured interview.

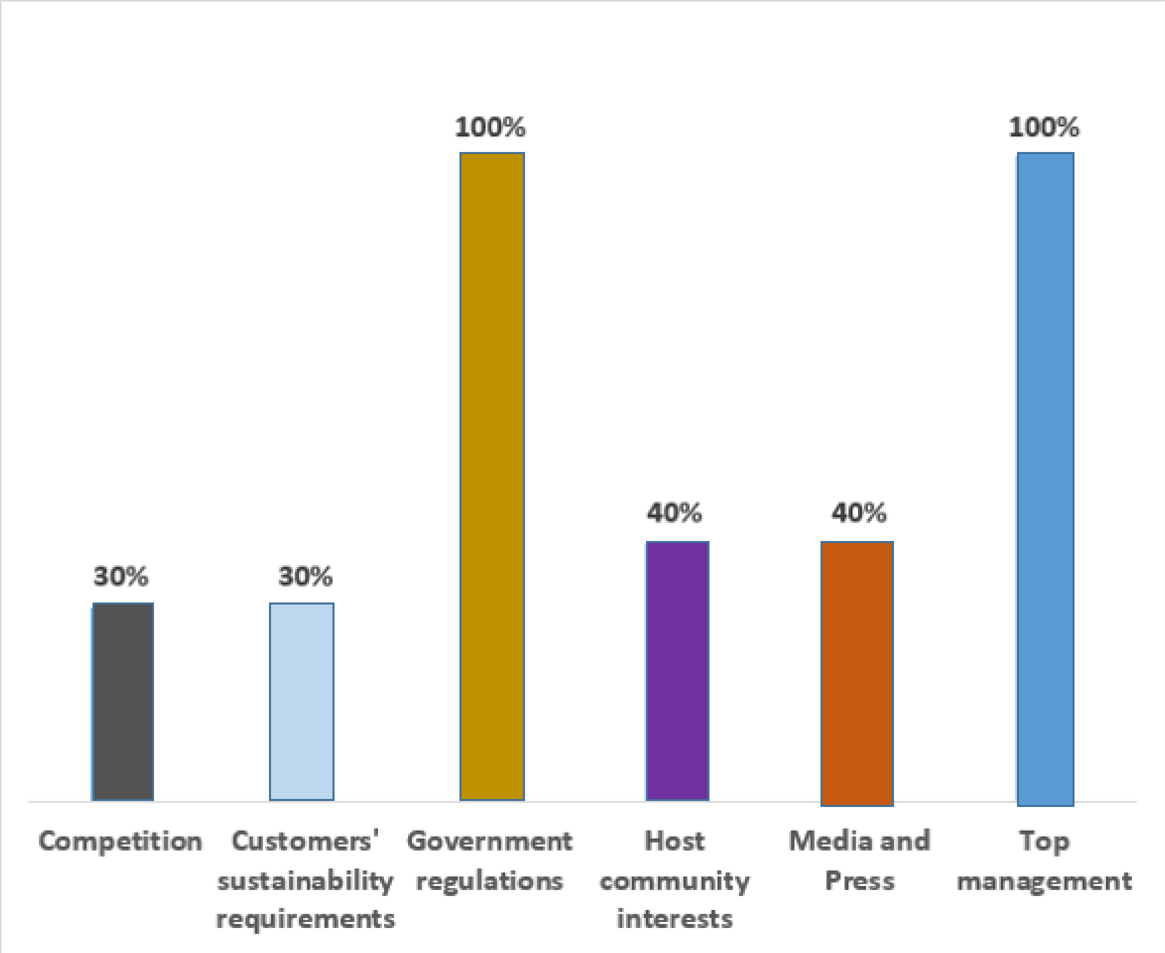

Figure 5.9: Ranking of the stakeholder pressures behind GSCM implementation.

The results above reveal that government regulations and top management support are the most cited driving forces of GSCM. Top management support is considered an internal driver of sustainability practices adoption (Karra and Affes 2014). The extant literature agrees that firms cannot successfully implement green practices without the support of the top management (Diabat and Govindan 2011; Seuring and Müller 2008). In this vein, the current study argues that government regulations, a form of coercive pressure, are the most significant stakeholder pressures behind GSCM adoption in the Nigeria O&G industry. This is consistent with Esfahbodi et al. (2017), who depict governance pressures as the only stakeholder antecedent of GSCM in the UK manufacturing sector. Consequently, the current study refines the conceptual framework presented in chapter 3 with government regulations as the primary stakeholder driver of GSCM in the Nigerian O&G industry. The detail of this is presented in next chapter.

5.6.1 Summary of findings on stakeholder drivers of GSCM adoption

This section empirically identified six (6) internal and external stakeholder factors that drive the Nigerian O&G firms to develop capabilities to implement proactive green practices. In line with Freeman's (1984) stakeholder theory, the results in this section confirm the presence of internal, market, coercive, and normative pressures from various stakeholders. A frequency analysis reveals that 100% of respondents highlighted government regulations and top management support as the key reasons behind their firms' green practices. To put these findings in the context of the RO3 of this study, the coercive pressures, in terms of government regulations, are considered the most critical stakeholder pressure that influences GSCM implementation in the Nigerian O&G industry. With these findings, this study has attained its RO3, which is:

> **"To explore and identify the critical stakeholder pressures that drive the implementation of GSCM practices in the Nigerian O&G industry."**

5.7 Chapter conclusion

This chapter has empirically examined the generic constructs in the initial conceptual framework in chapter 3 to identify more specific variables in the Nigerian O&G industry. The chapter adopts an exploratory approach based on an inductive strategy to analyse twenty-nine semi-structured interviews conducted among the relevant management staff across the supply chain of the Nigerian O&G industry. The empirical findings in this chapter are instructive for the refinement of the initial conceptual framework. In the first instance, empirical findings indicate a high level of awareness of GSCM among operators across the Nigerian O&G industry. Furthermore, the study validated all NRBV strategic capabilities in the industry, except for the base of the pyramid capability. It further identifies various GSCM practices that are linked with each of the NRBV strategic capabilities. Moreover, this study identified seven (7) strategic resources related to GSCM implementation in the industry. Among these, finance, strategic supply chain collaboration, and continuous innovations are the most cited resources by all participants. Based on the implicit and socially complex nature of the conceptualised strategic resources in NRBV (Hart 1995), supply chain continuous innovations are deemed the most critical strategic resources that enhance the capabilities for GSCM adoption in the Nigerian O&G industry. Finally, the results on the role of stakeholder driving forces of green practices identified six (6) stakeholders that influence firms' adoption of green practices. The requirements and activities of these stakeholders constitute the internal, market, coercive and normative pressures that drive GSCM adoption. All participants cited top management support and government regulations as the most significant drivers of GSCM in the industry. However, the current study focuses on government regulations as the most critical stakeholder pressures because the role of internal structure in proactive environmental management practice is relatively settled in the extant literature. These findings culminated in the attainment of the RO1, RO2 and RO3 of this study. Furthermore, the findings in this chapter have provided the specific industry-based constructs for the refinement of the initial conceptual framework. Hence, the results of this chapter are applied to refine the proposed conceptual framework, with the necessary hypothesis developed in the next chapter.

Chapter 6: Refined Conceptual framework and hypotheses development

6.1 Chapter Introduction

The process of developing the conceptual framework for this research commenced in chapter 1 when the RO4 of this study was stated as *“to develop a refined framework of stakeholder pressure, GSCM implementation and competitiveness for the Nigerian O&G industry’s supply chain”.* The relevant constructs identified in chapter two were adopted to propose an initial conceptual framework in chapter 3. Following the lack of empirical evidence to support these constructs in the O&G industry, the initial conceptual framework was deemed too generic to address this study's research questions. Hence, exploratory research, based on an empirical analysis of semi-structured interviews, conducted among twenty-nine top management staff of firms operating across the supply chain of the Nigerian O&G industry was carried out in chapter 5. The purpose of this chapter is to refine the proposed initial conceptual framework in section 3.3 with the qualitative research findings in chapter 5. Specifically, this chapter aims to substitute the generic constructs presented in the proposed conceptual framework with the specific constructs derived from the qualitative analysis in chapter 4. This chapter further develops testable hypotheses to establish the relationships among the constructs in the research model. Finally, this chapter presents the measurement items to operationalise the constructs of the research model for subsequent assessment in the next chapter. For this purpose, this chapter is structured as depicted in figure 6.1.

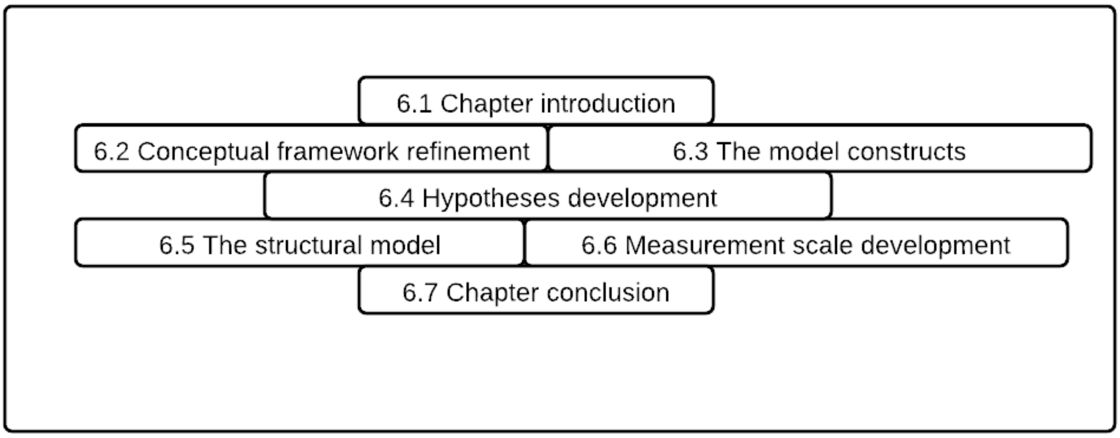

Figure 6.1: The structure of chapter 6.

6.2 Conceptual framework refinement

The NRBV and stakeholder theory underpin the proposed conceptual framework in chapter 3. All stakeholder pressures are assumed to drive the strategic resources and capabilities linked with GSCM practices in the framework. The interaction of the stakeholder pressures with the strategic resources and capabilities are expected to results in enhanced competitiveness of the Nigerian O&G firms. Based on the NRBV idea, strategic resources are all tacit, socially complex, and causally ambiguous resources in a firm. Furthermore, the NRBV strategic capabilities of pollution prevention, product stewardship, clean technology, and the base of the pyramid are conceptualised as the proxy for GSCM in the O&G industry. The competitive outcome is defined as environmental and economic competitiveness. Thus the initial conceptual framework designed stakeholder theory as the antecedent of the NRBV's resources-capabilities-competitiveness logic (Hart 1995). This position agrees with previous studies that conceptualise stakeholder pressures as the driving forces behind firms' adoption of sustainability practices (Esfahbodi et al. 2017b; Zhu, Sarkis and Lai 2013). Nevertheless, the paucity of knowledge in this area of research and the peculiarity of the O&G industry's supply chain necessitates a modification of the initial conceptual framework to ensure specificity to the Nigerian O&G industry.

The findings from chapter 6 revealed six stakeholders (top management customers, competition, government, host community and media and press) that pressure the Nigerian O&G firms to implement green practices in their supply chain. From the neo-institutional (Sarkis, Gonzalez-Torre and Adenso-Diaz 2010b; Wang, Li and Qi 2020), the presence of internal pressures (top management), market pressures (customers and competition), coercive pressures (government institutions) and normative pressures (host community and media) in the industry. As stated in section 3.3.4, conceptualising all the stakeholders as the driver of GSCM is out of the scope of this study. The focus is to identify the most critical stakeholder pressure in the industry and conceptualise it as the antecedent of strategic resources and capabilities for GSCM implementation (Esfahbodi et al. 2017). Although all stakeholder pressures are evident in the Nigerian O&G industry, coercive pressures from government institutions represent the most compelling stakeholder force behind GSCM implementation by the firms in the Nigerian O&G industry. Thus government institutions are the most critical stakeholders that pressure firms to adopt GSCM in the industry. This is consistent with Zeng et al. (2017), who portend that all stakeholder pressures have different degrees of impact on firms' strategic options. Therefore, instead of conceptualising all stakeholder pressures as the antecedents of strategic resources and NRBV capabilities proposed in the initial conceptual framework, this chapter refines the *'stakeholder pressures'* construct with '*government regulations'*, as validated in section 5.6. This aligns with the position of the literature that government institutions as a stakeholder can enact regulations that compel firms to reconfigure operations towards sustainability (Hanim Mohamad Zailani et al. 2012). Besides, the O&G industry is exposed to stringent national and international regulations due to its negative environmental impacts (Ahmad et al. 2017b).

The specific strategic resources that aid the capabilities for GSCM implementation in the Nigerian O&G industry could not be identified from the literature. Hence, all strategic resources were conceptualised in the initial conceptual framework. Section 5.5 identified seven tangible and intangible resources (finance, technological assets, logistical infrastructure, green distribution channels, knowledgeable employees, continuous innovations and strategic supply chain collaboration) as the catalysts of strategic capabilities for GSCM implementation in the Nigerian O&G industry. Among the above, this study validated the intangible resources of continuous innovations and supply chain collaboration as the most critical strategic resources. The above resources are considered tacit, socially complex, and causally ambiguous, therefore can generate competitive advantage (Hart and Dowell 2011). Stakeholder collaboration and continuous innovations are an integral part of the strategic resources features of the NRBV framework(Hart 1995; Hart and Milstein 1999; McDougall, Wagner and MacBryde 2019). Strategic collaboration at the supply chain level is arguably a source of innovations that may be difficult for the market to copy (Soosay, Hyland and Ferrer 2008; Walker et al. 2014). In many organisations, several functional resources such as human capital, finance, and other tangible resources are applied in operations. However, since these physical resources can be easily replicated, adapted, and adopted by the competition (Fowler and Hope 2007; Hart and Dowell 2011), they might not easily confer a competitive advantage on firms. Therefore, this study argues that those resources that may lead to the development of proactive environmental strategic capabilities are intangible resources that are tacit, causally ambiguous, and socially complex. Considering that supply chain collaboration fosters continuous innovations (Soosay, Hyland and Ferrer 2008; Walker et al. 2014), this study conceptualises *supply chain continuous innovations* as the strategic resources for GSCM implementation. Therefore, the generic specification of strategic resources in the proposed conceptual framework is substituted with *supply chain continuous innovations.* This agrees with Kwak, SEO and Mason (2018), who conceptualise supply chain innovation as an antecedent of risk management capabilities in the context of SCM.

In line with previous studies (Guang Shi et al. 2012; McDougall, Wagner and MacBryde 2019; Yunus and Michalisin 2016), the empirical findings in chapter three established linkages of the GSCM practices with three NRBV capabilities of pollution prevention, product stewardship, and clean technologies. Thus, the Nigerian O&G firms are targeting strategic capabilities in reducing/preventing pollution, minimising product hazards, and exploring cleaner energy. In contrast, no evidence of practices related to the fourth NRBV capabilities of the base of the pyramid was found in the industry. Following the existing theoretical proposition (Hart and Dowell 2011), the base of the pyramid capability included in the initial conceptual framework is expunged in the refined conceptual framework due to a lack of empirical justification for its inclusion (McDougall, Wagner and MacBryde 2019). Thus, the refined conceptual framework in this study conceptualises GSCM as the NRBV strategic capabilities of pollution prevention, product stewardship, and clean technology, which have been empirically verified in section 5.4. Apart from clean technology (which has not received sufficient attention within the NRBV framework), previous studies in the O&G industry have also adopted the same strategic capabilities above to investigate their research phenomena. (Hastings 1999; Michalisin and Stinchfield 2010).

The competitiveness constructs (environmental and economic competitiveness) are retained in the final conceptual framework because these constructs align with the objective of the NRBV (Hart 1995). Economic competitiveness is justified by the notion that firms are generally committed to cost minimisation to enhance shareholders' funds (Porter 1985). According to Hart (1995), directing continuous improvement resources to develop pollution prevention capability confers the economic competitiveness of cost minimisation on firms. However, organisations can also build an environmental reputation through NRBV strategic capabilities (Hart 1995; Hart and Dowell 2011). Environmental reputation is also a source of competitive advantage (Testa and Iraldo 2010). Hence, the retention of environmental competitiveness is justified in this study. The constructs of the refined conceptual framework are presented in the next section.

6.3 The model constructs

The refined conceptual framework comprises seven constructs: government regulations, supply chain continuous innovations, pollution prevention, product stewardship, clean technology, environmental competitiveness, and economic competitiveness. Although relevant literature regarding these constructs (apart from supply chain continuous innovations) has been reviewed in chapter 2, additional discussions are provided in this section. More details are also provided about *supply chain continuous innovations*, which is an evolvement of the current study.

6.3.1 Coercive Pressures (Government regulations)

DiMaggio and Powell (1983; 150) define coercive pressures as those exerted on organisations by other organisations on which they are dependent. Coercive pressures are from the government as a stakeholder with the power to enact and implement regulations and policies that usually attract penalties and fines for non-compliance (Zhu, Geng and Sarkis 2016; Esfahbodi et al. 2017). The primary element of government regulations as coercive pressures is the power exercised by the authority (Zailani et al. 2012). The activities of the government environmental agencies can influence the actions of organisations (Rivera 2004). Therefore, considering the high degree of pollution and ecological degradation traceable to the manufacturing/production industry (including the O&G), this industry is majorly targeted with increased environmental regulations and tax policy (Taylor and Taylor 2013; Yu and Ramanathan 2015). Specifically, Ahmad et al. (2017) argued that any law targeted at limiting carbon footprint in industrial activities, transportation, and energy generation is primarily targeted at the O&G industry since the industry's products are the root cause of these environmental issues. Therefore, in this study, coercive pressures are delineated as stakeholder pressures from government institutions to compel oil and gas firms to adopt ecological practices. This approach agrees with Esfahbodi et al. (2017), who delineate coercive pressures as government regulations that drive manufacturing firms to adopt sustainable supply chain management practices.

6.3.2 Supply chain continuous innovation (SCI)

Schumpeter (1934), cited in Dreja (2004), depicts Innovation as the introduction of new ideas or concepts in critical business areas such as product, process, market, inputs, and organisation. Through their engagement with suppliers, distributors, and consumers, firms can benefit from supply chain innovations that are valuable for improving organisational processes (Wong 2012; Wu 2013). Such improvement can be evident in reduced costs and lead time, enhanced operational strategies, consistent quality assurance, and a developed capability to respond to turbulent changes in the business environment (Mandal and Scholar 2011b). Innovation can further enable competitive advantage through improved performance and reduced operational risks (Rabelo and Speller 2005; Chen and Huang 2009; Pietrobelli and Rabellotti 2011; Berghman et al. 2013). Innovations are incremental or radical (Arlbjorn et al. 2011). Incremental Innovation fosters less fundamental change in business operations. It could be targeted at attaining reduced delivery periods or updated versions of processes and products. In contrast, radical innovations focus on developing and applying new ideas and novel technologies, resulting in novel products, processes, and services (Dewar and Dutton 1986).

Strategic collaboration with stakeholders is a source of innovations for firms (Soosay, Hyland and Ferrer 2008). Through supply chain innovation, firms can improve their operational efficiency by effectively combining information and related technology developments with their logistics and marketing procedures (Bello, Lohtia and Sangtani 2004). The above is evident in companies such as Apple, Ikea, Walmart, Zara, HP, and Amazon that have utilised the resources of Supply Chain Innovations to activate effective disruptions in their respective industry and enhance business performance (Caniato, Caridi and Moretto 2013). Also, supply chain innovations can impact changes in products, processes, or services, leading to the commercial success of an invention (Roy et al. 2004). This can occur through the transfer of information upstream and downstream of the supply chain, resulting in the diffusion of Innovation across the entire supply chain (Christopher 2016). Similarly, other studies suggest that a supply chain network with the upstream and downstream partners constitutes a great source of Innovation for companies to develop capabilities to enhance competitive advantage (Batenburg and Rutten 2003; Lau et al. 2010). Thus, supply chain innovation can also drive firms' capabilities for competitive advantage. According to Kwak, Seo and Mason (2018), supply chain innovation is positively associated with risk management capabilities that enhance the competitiveness of firms in global supply chain operations. Similarly, Afraz et al. (2021) found a positive impact of supply chain innovation on the capability for competitive advantage in Pakistan's construction industry.

The extant literature on supply chain innovations seems to deemphasise the concept of continuity in supply chain innovations. Interestingly, the distinguishing feature of innovations as strategic resources within the NRBV framework is its continuity characteristic (Hart 1995; Hart and Dowell 2011; McDougall, Wagner and MacBryde 2019). Considering that NRBV strategies are dynamic capabilities (Hart and Dowell 2011; Mandal and Scholar 2011a), this study argues that the capacity of a supply chain collaboration to generate innovations *continuously* is the right resource that can enhance a firm’s capabilities for competitiveness. As conceptualised in the NRBV, (Hart 1995) recognises that continuous innovations are the critical resources for pollution prevention. The author further argues that stakeholder collaboration enhances a firm’s product stewardship capabilities. Previous studies have confirmed that supply chain collaboration can serve as a source of continuous innovation, leading to the concept of supply chain continuous innovations. For example, Soosay, Hyland and Ferrer (2008) analysed twenty-three semi-structured interviews conducted among managers from ten case studies and confirmed that supply chain collaboration is a source of continuous innovation. Similarly, Nguyen et al. (2019) examined how cognitive proximity in supply chain collaboration relates to innovations using structural equation modelling. Their findings reveal that supply chain collaboration can serve as a source of continuous radical and incremental innovations for firms. On this note, this study delineates Supply chain Continuous Innovation as a proactive collaboration with the supply chain partners to generate sustainability innovation for the supply chain members in terms of technology adoption, process designing, product development, and market development (Soosay, Hyland and Ferrer 2008).

6.3.3 Pollution prevention capabilities

Pollution prevention is a process-based approach to eliminate unnecessary pollution within internal operations (Christmann 2000; Hoque and Clarke 2013). One of its key objectives is to proactively and effectively minimise emissions, effluents, and wastes from operations (Meguc and Ozanne 2005). Conceptually, the NRBV depicts pollution prevention as the starting point of performance improvement through green practices (Hart 1995). This position is further entrenched through the dynamic capability characteristics of pollution prevention (Hart and Dowell 2011; Graham and McAdam 2011). To this end, pollution prevention practices are the most popular NRBV capability in practice (Schoenherr 2012; Thoumy and Vachon 2012).

Although the pollution prevention strategy is depicted initially as an intra-firm capability in NRBV (Hart 1995; Hart and Dowell 2011), subsequent studies have suggested that supply chain collaboration is also required for effective pollution prevention techniques (Graham and McAdam 2016). Whereas pollution prevention within the intra-firm operational level has received substantial research attention from the literature (Hart and Dowell 2011; Schoeherr 2012), much attention has not been focused on pollution prevention capabilities at the supply chain levels (Graham and McAdam 2016). Indeed most studies in this regard focus on the impacts of general environmental practices implemented at the different stages of the supply chain on dimensions of performance (Zhu et al. 2012; Walker et al. 2014). In this study, pollution prevention capability is designated as a firm's collaborative activities to reduce emissions, waste, and effluents within the operations of O&G firms.

6.3.4 Product stewardship capabilities

The purpose of developing capabilities for product stewardship is to enable firms to address environmental and social concerns at every stage of the product and its production process, through the designing process to the disposal at the end of the product's life cycle (Hart and Dowell 2011). Product stewardship capabilities transcend beyond the internal boundaries of a firm (Hsu et al. 2013), but they include the inculcation of the views of all stakeholders into the life cycle of a product (Hart 1995I). To build capacity for product stewardship, Hart (1995) argues that a firm must develop an effective stakeholder integrative structure, including effective integration of the views of external advisors. The above suggests that any product stewardship strategy's success depends on the degree of corporation among the supply chain members and other stakeholders.

Strategic managers in the O&G industry emphasise product stewardship capabilities because of the environmental risk of petroleum products. IPIECA (2015) describes product stewardship in the O&G industry as an approach for assessing and communicating product health, safety, and environmental (HSE) risks across the value chain. According to Ahmad et al. (2013), O&G firms adopt various approaches to achieve product stewardship. These include effective product risk communication, safety education for logistics partners, product lifecycle management and supplier screening for sustainability. Also, many IOCs are increasingly recognising the role of stakeholder collaboration for product stewardship. For example, Shell Petroleum Development Company (SPDC) states that its product stewardship strategy focuses on assessing potential product harms, evaluating market-based product suitability, and good stewardship for new products, technologies, businesses, and supply chain (Shell, 2021). Similarly, oil companies are fostering product diversification into cleaner energy as a product stewardship strategy. As the world embraces renewables, many O&G firms are channelling investment towards cleaner gas and renewables. For example, the Norwegian Statoil/Equinor invested over $12 billion in renewables worldwide in 2017 (Equinor 2018). The above aligns with the views of Hart (1995) that proactive environmental strategy can also include a total diversification from polluting business segments. Therefore, for the current study, product stewardship is designated as O&G firms' collaborative strategy to reduce the life cycle impacts of products on society and the environment.

6.3.5 Clean technology capabilities

As earlier mentioned, clean technology within the NRBV framework is a sub-category of the sustainable development strategy (Hart and Dowell 2011). It is a concept that defines the techniques and technologies adopted by firms to reduce pollution and emission at source, rather than end-of-pipe management (Belis-Bergouignan, Oltra and Jean 2004). Such technologies can further translate into the production or adoption of cleaner energy (Sadorsky 2012). In response to pressures from stakeholders requiring O&G companies to rethink their operations in light of climate change and global warming, many leading O&G companies are gradually investing in clean technology to foster the energy transition. For instance, Shell increased its original annual clean energy budget in 2016 from $200 million to $1.2 million in 2017. Similarly, Total energy invested $1.4 billion to acquire a 60% stake in a US CleanTech company in 2011. Total invested in clean technology in Tanzania by acquiring two CleanTech companies specialising in generating solar energy (IPIECA 2018). Beyond acquisition and take-overs, many of the IOCs are equally adopting various clean technology techniques in operations. For example, BP adopted a state-of-the-art clean technology to design its Khazzam gas project in Oman as an inherently low-emission structure (IPIECA 2018). Also, in 2014, ENI invested in technology that converted the Porto Marghera refinery in Venice into a high-grade biofuel producing plant (IPIECA 2018). The above suggests that firms in the O&G industry are investing in developing their capabilities for clean technology as a way of future positioning (Hart and Dowell 2011). This study conceptualises clean technology as a firm's ability to adapt to disruptive change in the industry by adopting technology that can cause changes or diversification in processes and products.

6.3.6 Environmental competitiveness

To some extent, the extant literature suggests that green practices enhance an organisation's environmental performance and competitiveness (Rao 2005; Vachon and Klassen 2006; Zhu et al. 2007). Environmental competitiveness is the ability of a firm to effectively develop a culture of ecological consciousness ahead of the competition (Rao 2005). Such culture can be manifested in sustainable procurement, eco-friendly products, ISO 14001 certification, and many more (Hart and Dowell 2011). The substantial financial commitment required for green initiatives discourages firms from developing strategies that foster GSCM implementation (Rajeev et al. 2017). However, the advocates of ecological investment argue that the benefits of environmental competitiveness transcend beyond mere economic gains but include the capability to enhance a firm's reputation in society. Therefore, this study views environmental competitiveness as eco-reputation acquired due to a firm's ability to implement environmental management practices ahead of the competition.

6.3.7 Economic competitiveness

Economic competitiveness is manifested in the ability of a firm to effectively and efficiently meet its customers' demands more than the competition. With economic competitiveness, a firm operates in a more advantageous position to compete favourably in the market (Helfat 2007). According to Porter (1985), a firm can achieve economic competitiveness through differentiation and cost. Such competitiveness can be targeted by utilising firms' resources to develop unique capabilities (Barney 1991). Since O&G firms are generally known for supplying similar goods, product differentiation might not be easily adaptable in the industry. However, this does not preclude organisations from differentiation in terms of strategic orientation. For example, Equinor/Statoil has a strategic direction to function as the most sustainable O&G firm globally. Interestingly, while the literature suggests that environmental practices can enhance environmental competitiveness, findings relating to economic competitiveness have yielded conflicting results. This study conceptualises economic competitiveness as economic benefits arising from implementing green practices in a supply chain.

Based on the foregoing discussion, the conceptualised definitions of the constructs of this study are presented in table 6.1 below:

Table 6.1. The working definitions of the research constructs

Constructs	Definition	Reference
Government Regulations	Regulatory pressures exerted on firms by governments and their agencies fostering compliance with environmental standards.	DiMaggio and Powell (1983); Esfahbodi et al. (2017).
Supply chain continuous innovation (SCI)	Any continuous incremental or radical change within the SC network, SC technology or SC processes that influences firms' sustainability practices.	Arlbjorn et al. (2011); Hart and Dowell (2011); Soosay, Hyland and Ferrer (2008).
Pollution Prevention capabilities	Capacity to develop process innovation for reducing emissions, effluents, and waste	Hart (1995); Fowler and Hope (2007); Hart and Dowell (2011).
Product stewardship capabilities	Ability to develop measures for reducing the environmental impacts of products on society throughout their lifecycle	Hart (1995); Fowler and Hope (2007); Hart and Dowell 2011; IPIECA (2017).
Clean technology capabilities	The ability to adapt to disruptive change in the industry by adopting or commercialising green technologies that causes changes or diversification in firms' processes and products.	Hart and Dowell (2011); Sadorsky (2012).
Environmental competitiveness	Reputational benefits derived from effectively managing the environmental impact of activities more than the competition	Hart (1995); Rao (2005).
Economic competitiveness	Economic benefits arising from taking proactive environmental measures ahead of the competition	Porter (1985); Hart 1995; Hart and Dowell (2011).

6.4 Hypotheses development

This section develops the hypotheses that stipulate the expected relationships among the constructs of the refined conceptual model. The structural model of stakeholder pressures-strategic resources-strategic capabilities (GSCM practices)-competitiveness to be assessed in this research is later presented based on the stipulated hypotheses.

6.4.1 Coercive pressures (Government regulations) and supply chain continuous innovations

The traditional economist's views on the relationship between government regulations and firms' innovativeness argued that policing and regulations stiffen organisational innovations (Freeman and Haveman 1972). This is because compliance with regulations is considered an additional cost on firms, leading to an erosion of business performance (Ford, Steen and Verreynne 2014). However, in his 1991 seminal article, Porter (1991) argued that well-tailored environmental regulations could spur organisations' innovations which can outweigh the cost of compliance. This argument is popularly known as *Porter's hypothesis.* Porter's hypothesis has been examined in different contexts, with conflicting results. Some studies found a positive relationship between government regulations and innovations (Ford, Steen and Verreynne 2014; Horbach, Rammer and Rennings 2012; Ramanathan et al. 2017), while other authors found non-existing relationship (Triebswetter and Hitchens 2005), and some others recorded a negative relationship (Walker et al. 2008). The inconsistency in results has been linked with the regulatory style adopted in the enforcement of regulations. Generally, while flexible regulations are considered innovation-friendly (Porter 1991; Porter and Van der Linde 1995), 'command and control' regulations are deemed to stiffen Innovation (Managi et al. 2005; Purvis 1995). However, Sharma (2001) compare the impact of the USA *'command and control'* type of regulations with the Canadian flexible, collaborative regulatory style on innovations and found no significant difference in the effects of the two styles of regulations on innovations. . The above highlights the need for further inquiry into the relationship between regulations and innovations.

The beginning of the current millennium witnessed increased regulations that encourage and require companies to implement environmental, health, and safety (EHS) systems and cleaner production in developed countries (Nourai et al. 2001). Unlike in the past when regulations were geared towards command-and-control mechanisms, the arguments for more flexible regulations with a capacity to enhance Innovation motivated governments in the developed countries to enact laws that improve organisations' ability to develop Innovation (Zhu, Geng and Sarkis 2016). According to Horbach et al. (2012), such regulations have pushed firms in Germany to create innovative resources needed to reduce emissions and avoid using hazardous substances to increase product recyclability. Similarly, evidence from Europe suggests that firms are motivated to gravitate towards eco-innovation due to coercive forces of regulations.

Arguably, the extent to which innovations diffuse continuously in a supply chain is unclear. Nevertheless, scholars have suggested that firms adopt supply chain collaboration for Innovation to comply with environmental laws. For example, the extant regulations in Europe, such as the European Union directives on the restrictions of Hazardous Substances (RoHS, 2006) and Waste Electrical and Electronic Equipment (WEEE, 2005), contemplates a supply chain approach to environmental regulations (Zhu, Geng and Sarkis 2016). Such regulations have been linked with supply chain innovations for the focal firms. The impacts of these regulations on supply chain innovations are found in the Taiwan IT industry, where IT producers have assisted their clients in Europe in complying with RoHS and WEEE regulations by developing innovative products that comply with environmental standards across the entire supply chain (Karakayali et al. 2007). In the same vein, many studies have also suggested that continuous innovations are boosted through supply chain collaboration and integration (Soosay, Hyland and Ferrer 2008). For example, Flint et al. (2008) assert that organisations can develop better innovations by incorporating customers' inputs into their business process. Also, Li et al. (2008) argue that outsourcing partners' knowledge base can serve as a resource for firms to develop radical and incremental innovations. Similarly, Bellingkrodt and Wallenburg (2013) found that logistics service providers play crucial roles in enabling organisations to acquire the requisite knowledge required for innovations. Based on the foregoing, it is assumed that coercive pressures (government regulations) can motivate firms to collaborate with supply chain partners to develop Innovation for proactive environmental capabilities. Thus, the first hypothesis is posited below:

> *H1: Coercive pressures (government regulations) positively impact supply chain continuous innovations in the O&G industry.*

6.4.2 Government regulations and strategic environmental capabilities

Government regulations can influence organisations' actions, including the resources and capabilities needed for GSCM practices. This study argues that such regulations can influence firms' decisions to develop the three NRBV strategic capabilities of pollution prevention, product stewardship and clean technology. Relevant literature-based arguments in respect of the above are hereafter presented.

6.4.2.1 Coercive pressures (government regulations) and pollution prevention capabilities

The need to respond to growing stakeholder pressures has compelled organisations to continuously rethink, redesign and re-engineer operational processes and procedures to accommodate social and environmental management practices (Sarkis et al. 2010; Simpson 2012; Wu et al., 2012). Traditionally, costs associated with pollution caused by companies in their operations are generally regarded as externalities to organisations (Van-Egteren 2002; Demeritt 2009). However, through the imposition of coercive mandatory regulations, which often include incentives, fines, tax, and other penalties, companies are increasingly held accountable for the costs of pollution caused by their operations.

Consequently, many firms adopt green practices to prevent operational pollution to avoid such environmental penalties (Zhu, Geng and Sarkis 2016).

Traditionally, environmental regulatory pressures appeared to be geared towards the end-of-the pipe pollution control measures (Hart 1995). More recently, regulations are enacted to encourage organisations to shift attention from pollution control to a more holistic pollution prevention approach (Hart and Dowell 2011). Regulations such as the 'take back' law in Germany incentivise companies to adopt a proactive approach to pollution prevention (Hart 1995). Many organisations are shifting towards cleaner production and more efficient house cleaning techniques in response to regulations (Jaffe and Palmer 1997). In the O&G industry, Sharma (2001) found that many firms in the North-American O&G industry are adopting pollution prevention techniques in response to environmental regulations. On this note, it is hypothesised that:

H2a: Coercive pressures (government regulations) positively impact the development of pollution prevention capabilities by the firms in the O&G industry

6.4.2.2 Coercive pressures (government regulations) and product stewardship capabilities

In response to external pressures, many organisations quickly realise the need to extend their internal environmental practices and capabilities to product development and stewardship to minimise their supply chain activities (Li et al. 2005). Such external pressures include regulatory pressures (DiMaggio and Powell 2000). Such an example is found in Germany, where the 'take-back law allows customers to return spent products to manufacturers at no charge, while the manufacturers are prevented from disposing of the 'junk' products. According to Hart (1995), the objective of the law is to compel organisations to build capabilities in the area of product stewardship through the reuse and recycle process.

Hart (1995) argues that product stewardship capabilities can be acquired by exiting environmentally hazardous products, redesigning existing product systems, or developing new products with lower life circles. By nature, the O &G firms' products are generally considered hazardous and toxic (Yusuf et al. 2013). Hence, many firms in the industry are beginning to communicate their product stewardship strategies and intention in their reports (Ahmad et al. 2016). According to IPIECA (2015), product stewardship in the O&G industry, which focuses on risk management of products across the supply chain and the product life cycle, includes product HSE risk characterisation, effective communication of product hazards product development' HSE management systems. Also, many O&G firms are developing renewable energy production capacities and cleaner fossil fuels such as natural gas because of stricter regulations on environmental protection. Therefore, this study hypothesises that:

H2b: Coercive pressures (government regulations) positively impact the development of product stewardship capabilities by the firms in the O&G industry

6.4.2.3 Coercive pressures (government regulations) and clean technology adoption capabilities

Beyond the product-related issues, firms are facing increasing pressures to adopt eco-friendly technology in operations. Although such pressures for change in technological adoption can emanate from many external sources such as competitors, consumers, and suppliers, coercive pressures through environmental regulations are commonly held as a critical driver of clean technology adoption among firms (Gonzalez 2005). Generally, developing capabilities for the adoption or production of clean technology is capital intensive (Shi et al. 2019). Such a huge investment in clean technology is found in Apple, which invested about $1.657 billion in various clean technologies like renewables in 2016-2017 (Apple Group 2018). Even though clean technologies can help firms reduce their environmental impacts, the huge investment outlay could hinder their adoption unless policy frameworks and regulations are put in place to encourage firms to consider investment in clean technology. On this note, Da-Silva et al. (2017) found that lack of regulatory incentive is a critical restrictive factor of clean technology adoption in Brazil. In this wise, government worldwide introduces various regulations and policies such as environmental tax, fines, subsidies, and cap-and-trade mechanisms to encourage firms' adoption of clean technology (Dong et al. 2016). Such an example could be seen in the US, where environmental emission tax in solar investment tax credit (ITC) has been used to induce firms to adopt clean technologies (Shi et al. 2017). Similarly, the US environmental tax on chlorofluorocarbons (CFCs) has increased organisations' adoption of clean technology, resulting in over 70% reduction in the consumption of CFCs (Krass et al. 2013). In the O&G industry, the Norwegian Statoil/Equinor has invested over $12 billion in renewables across the world (Equinor 2018) in response to regulatory pressures. Based on the above, this research further hypothesises that:

H2c: Coercive pressures (government regulations) positively impact the development of clean technology capabilities by the firms in the O&G industry

6.4.3 Supply chain continuous innovations and strategic environmental capabilities

The decision to acquire the necessary capabilities for sustainability practices usually involves active collaboration with relevant stakeholders, including supply chain members. For example, the ability of a firm to acquire low emissions machines would depend on its ability to find innovative suppliers with a capacity to supply such equipment. Therefore, this research argues that supply chain continuous innovations can enhance firms' ability to develop the NRBV strategic capabilities.

6.4.3.1 Supply chain continuous innovations and pollution prevention capabilities

Previous studies have suggested that innovations can enhance the capabilities of manufacturing firms (Choi et al. 2001; Frohlich and Westbrook 2001; Gawer and Cusumano 2002; Choi and Krause 2005). According to Ramus (2001), firms with the capacity to develop innovations are likely to be positioned to create proactive problem-solving capabilities that improve traditional inefficient business processes and products. Such problem-solving capabilities can include strategic environmental and social capacity to achieve sustainability objectives across the triple bottom line (Elkington 1998; Hart and Dowell 1995). Similarly, other authors suggest that the development of environmental capabilities necessary for the conferment of competitive advantage on firms is mainly dependent on the degree of the resources of Innovation available to firms (Hart 1995; Elliot 2011; Beske 2012). Thus, environmental management capabilities reflect a firm's ability to develop innovative resources while adapting to market needs (Klassen and Whybark 1999; Quak and de-Koster 2007). Although organisations pursue environmental Innovation as a way of competitive positioning (Sharma and Vredengurg 1998; Hofer, Cantor and Dai., 2012); to achieve this, firms tap into the innovative resources that are available at the level of their supply chain network (Roy et al. 2004; Arlbjorn et al. 2011). The above suggests that the environmental capabilities needed by organisations for competitive performance can be enhanced through supply chain continuous innovations. Consequently, many manufacturers worldwide are increasingly collaborating with supply chain members to develop innovations to improve their environmental practices across the supply chain (Krut and Karasin 1999; Rao 2002).

As a strategic capability, pollution prevention is initially considered a firm-based capability within the Natural Resource-Based View Theory (Hart 1995). As such, its development is based on causally ambiguous resources of continuous improvement, learning, and experience (Guang Shi et al. 2012). However, collaboration with supply chain members is often activated to support an organisation's intra-firm pollution prevention capabilities (Klassen and Whybark 1996; Klassen and Vachon 2003). According to Grant (1996), knowledge integration and cooperation among organisations are sources of innovative resources that can enhance organisations' pollution prevention capabilities. Such a collaborative approach can manifest in the areas of sustainable logistics management and sustainable procurement. For example, Kaur et al. (2016) found that collaboration for innovative logistics management and sustainable procurement is critical in reducing emissions from operations. Furthermore, several studies have suggested that lack of cooperation from customers and poor knowledge transfer from suppliers can hinder an organisation's pollution prevention capabilities

(Ashford 1993; Kemp 1993; Vachon and Klassen 2006). Based on these arguments, this study hypothesises that:

> *H3a: Supply chain continuous innovations positively impact the development of pollution prevention capabilities by the firms in the Nigerian O&G industry*

6.4.3.2 Supply chain continuous innovation and product stewardship capabilities

The management of products' environmental impacts transcends beyond an organisation's internal environment but involves active collaboration with external stakeholders (Bhupendra and Sangle 2017). This is because hazardous impacts of products may spread across the entire lifecycle, of which sufficient knowledge may not be available to firms (Hart 1995; Hart and Dowell 2011). Therefore, many organisations are forging effective collaboration with supply chain partners and other stakeholders to continuously generate Innovation for product hazards management (Carvalho and Barbieri 2012). Such Innovation can help develop eco-friendly products and their lifecycle management strategies (Wagner 2013). Indeed, supply chain continuous innovations are manifested in creating new knowledge at each stage of the product development process (De Stefano, Montes-Sancho and Busch 2016). Thus, supply chain continuous innovations may lead to a change in the critical attributes of a product (Bhoovaraghavan, Vasudevan and Chandran 1996; Henderson and Clark 1990).

However, the impacts of the technological aspect of supply chain continuous innovations may not necessarily result in disruptive changes in the attribute of the existing products offered in the energy industry (Rowlands et al. 2003). Nevertheless, impacts of supply chain continuous innovations can be manifested in marketing activities, such as eco-labelling, leading to awareness of the ecological attributes of products (Bhupendra and Sangle 2017). Furthermore, supply chain continuous innovations can innovate firms' advertising content by articulating the environmental benefits of products (Dechant and Altman 1994; Reinhardt 1998; Shrivastava 1995; Stead and Stead 2017). Moreover, supply chain continuous innovations can further enhance a firm's reverse logistics functions (Richey et al. 2005).

In the O&G industry, earlier studies have highlighted product stewardship as a function of collaborative innovations, continuously generated alongside stakeholders, from the exploration and production stage, through the transportation and marketing in an O&G project (Hastings 1999). More recently, Ahmad et al. (2016) argue that O&G firms can improve their product stewardship capabilities by continuously collaborating with stakeholders to generate innovations that foster proactive communication with customers, innovative transport and logistics, and effective supplier screening for innovativeness. The above suggests that O&G firms that activate supply chain continuous innovations can enhance their product stewardship capabilities.

H3b: Supply chain continuous innovations positively impact the development of product stewardship capabilities by the firms in the O&G industry

6.4.3.3 . Supply chain continuous innovation and capabilities for clean technology adoption

According to McDougall, Wagner and MacBryde (2019), supply chain continuous innovations, in terms of technological advancement, is the bedrock of the diffusion of clean technology in a supply chain. This is because firms that target the benefits of competitive advantage in terms of future positioning require active collaboration with their supply chain networks to develop and deploy innovations (Hart and Dowell 2011). Generally, the idea behind the development, adoption, and commercialisation of clean technology is annexed with technological innovations emanating from stakeholders' partnerships (Bell et al. 2012; Jensen et al. 2013). External stakeholders such as suppliers, contractors, and customers can disseminate new knowledge and ideas that influence firms' technology adoption (Cohen Levinthal 1990; lane and Lubatkin 1998). Therefore organisations can activate their absorptive capacity to assimilate Innovation from their supply chains and commercialise the same for technological development and adoption (Tsai 2001; Silvester et al. 2013). For example, a plethora of research in the automobile industry suggests that the development of technology in the industry does not depend solely on the manufacturer's willingness but mainly on the coevolution of action and interaction among various parties such as car drivers, policymakers, and supply chain partners, leading to innovation creation (Budde et al. 2012; Dijk, Orsato and Kemp 2013; Dijk, Yarime and Change 2010; Penna and Geels 2015; Rothenberg and Ettlie 2011; Zapata and Nieuwenhuis 2010) Based on the foregoing, the following is further hypothesised:

H3c: Supply chain continuous innovations positively impact the development of clean technology capabilities in the O&G industry

6.4.4 Strategic environmental capabilities and sustained competitiveness

As earlier hypothesised, government regulations can drive organisations to acquire the necessary resources and capabilities needed for GSCM practices. However, whether organisations will invest in sustainability resources and capabilities beyond the legal requirement will depend mainly on their perception of the competitive advantage emanating from such investment. Consequently, this research argues that each strategic environmental capability (pollution prevention, product stewardship, and clean technology) will enhance firms' environmental and economic competitiveness, as discussed below.

6.4.4.1 Pollution prevention capabilities and firms' competitiveness

Enormous challenges in manufacturing organisations resulting in massive material consumption, waste generation, and environmental pollution create an avenue for firms to design pollution prevention strategies that lower operational costs (Deimone and Popoff 1997). At the preliminary stage, firms can develop a hybrid portfolio of pollution prevention and control to manage the environmental impacts of operational processes (Guang Shi et al. 2012). However, more proactive firms concentrate on developing capabilities to implement pollution prevention strategies (Hart 1995). This is because pollution control activities such as waste disposal can cost companies millions of dollars while consuming managerial time and causing other financial burdens related to environmental management. In contrast, pollution prevention investment results in cost savings in the long run (Esty and Winston 2009). Furthermore, for absorption costing, cost savings emanating from pollution prevention through reuse and recycling are recognised at the material recovery stage (Nash 1997).

While recycling techniques focus on creating competence for reprocessing certain materials for subsequent use for their original purpose or another, reuse techniques do not require any reprocessing for materials to be used for their initial purpose. However, one fundamental advantage of both methods is that they create opportunities for cost savings by reducing materials need (Guang shi et al. 2012). This is consistent with the original conceptualisation of the pollution prevention capabilities NRBV, where the intangible resources of continuous improvements are depicted as the catalyst of firms' wastes prevention strategies, leading to the competitive advantage of cost minimisation (Hart 1995). Thus, firms can improve their bottom line through the cost savings from pollution prevention practices, thereby improving the shareholders' values (Bhupendra and Sangle 2015).

In addition to the above, companies that invest in the development of their pollution prevention capabilities through reuse and recycling techniques can also achieve environmental benefits through a closed-loop production system that returns outputs to the natural system for the creation of further inputs for the production system (Tsoulfas and Pappis 2006). Furthermore, such practices can enhance firms' compliance with environmental standards (Guang shi et al. 2012). Indeed failure of firms to comply with accepted sustainability standards through pollution prevention can attract sanctions from stakeholders, which can also negatively impact the reputation and image of firms (Porter and Van der Linde 1995; Reuter 2010). Therefore, the development of pollution prevention capabilities not only generates positive impacts on firms' economic competitiveness but can also enhance their environmental competitiveness (Sarkis and Cordeiro 2001; Granek and Hasanali 2006). Based on the foregoing, this research hypothesises that:

H4*a: Pollution prevention capabilities positively impact firms' environmental competitiveness in the O&G industry.*

H4b: Pollution prevention capabilities positively impact firms' economic competitiveness in the O&G industry.

6.4.4.2 Product stewardship capabilities and firms' competitiveness

Product stewardship capabilities enable firms to integrate the voice of the environment into the product lifecycle and enjoy the competitive advantage of pre-empting the competition (Hart 1995). Through an effective product stewardship strategy, firms can actively engage with stakeholders and intensify their views on their products, starting from the designing to the disposal or reuse stage (Hart and Dowell 2011). Since stakeholders are famous for holding organisations responsible for their supply chain environmental issues, integrating the stakeholders' views into firms' product lifecycle can help organisations to avoid reputational loss traceable to adverse impacts of products on the environment, thereby enhancing the focal firms' eco-reputation (Handfield et al. 1997; Linton 2007 et al.; Lozano 2015; Epstein et al. 2015).

In advancing the benefits of product stewardship, a firms' ability to minimise the environmental impacts of products can significantly improve a firm's reputation among stakeholders and consumers (Dechant and Altman 1994; Reinhardst 1998; Shivastava 1995; Stead and Stead 2017; Bhupendra and Sangle 2017). The same can also appeal to customers who are willing to associate with the eco-reputation of such a firm through increased patronage, thereby improving the firm's turnover and profitability (Hoefler and Keller 2002). Even though the O&G industry is known for being a homogeneous product with limited differentiation (Ahmad et al. 2017), Hastings (1999) found that oil firms that minimise their products' environmental impacts can enhance their competitiveness. This study further hypothesises that:

H5a: Product stewardship capabilities have a positive impact on environmental competitiveness in the O&G industry.

H5b: Product stewardship capabilities are positively related to the economic competitiveness of the O&G industry.

6.4.4.3 Clean technology capabilities and firms' competitiveness

Hart and Dowell (2011) portend that capability for the adoption/production of clean technology is capable of conferring a competitive advantage of future positioning on firms. Through clean technology adoption, firms can reduce emissions from operations Belis-Bergouignan, Oltra and Jean (2004). Consequently, firms reputed for clean technology adoption can benefit from an advantage of an enhanced environmental reputation (Petkova et al. 2013). Although adoption of clean technology requires a huge investment outlay (Shi et al. 2019), various incentives in terms of subsidy and tax credits can relieve the financial burden attributable to clean technology. Besides, such companies can attract ethical investors and benefit from the advantage of green finance (Sengupta 2015). Based on the above, this research hypothesises that.

H6a: Clean technology capabilities positively impact firms' environmental competitiveness in the O&G industry.

H6b Clean technology capabilities positively impact firms' economic competitiveness in the O&G industry.

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6.4.5 Environmental competitiveness and economic competitiveness

According to Ismail, Talukder and Panni (2006), organisations that are perceived as environmentally friendly can experience higher patronage from consumers. Thus, a higher environmental reputation has a positive relationship with revenues accruable to firms. In practice, companies involved in environmental issues are exposed to cash flow distortion (Klassen and McLaughlin 1996). Such occurrences also affect the competitiveness of their value in the stock market. For example, the share price of BP dropped sharply by over 50% upon the Deepwater Horizon oil spills in 2010 (Fodor and Stowe 2015). In contrast, firms with a higher level of eco-reputation can generate a competitive advantage in cost reduction (Klassen and McLaughlin 1996). Stemming from the above, this research hypothesises that:

H7: *Environmental competitiveness positively impacts the economic competitiveness of the firms in the O&G industry*.

Based on the foregoing, the summary of all the testable hypotheses proposed in this chapter is presented in table 6.2.

Table 6.2. The hypotheses of this research.

	STATED HYPOTHESES
H_1	*Government regulations have a positive impact on supply chain continuous innovations in the O&G industry.*
H_{2a}	*Government regulations have a positive impact on the development of pollution prevention capabilities by the firms in the O&G industry*
H_{2b}	*Government regulations have a positive impact on the development of product stewardship capabilities by the firms in the O&G industry*
H_{2c}	*Government regulations have a positive impact on the development of clean technology capabilities by the firms in the O&G industry*
H_{3a}	*Supply chain continuous innovations have a positive impact on the development of pollution prevention capabilities by the firms in the O&G industry*

H_{3b}	*Supply chain continuous innovations have a positive impact on the development of product stewardship capabilities by the firms in the O&G industry*
H_{3c}	*Supply chain continuous innovations have a positive impact on the development of clean technology capabilities by the firms in the O&G industry*
H_{4a}	*Pollution prevention capabilities have a positive impact on the environmental competitiveness of the firms in the O&G industry*
H_{4b}	*Pollution prevention capabilities have a positive impact on the economic competitiveness of the firms in the O&G industry.*
H_{5a}	*Product stewardship capabilities have a positive impact on the environmental competitiveness of the firms in the O&G industry*
H_{5b}	*Product stewardship capabilities have a positive impact on the economic competitiveness of the firms in the O&G industry.*
H_{6a}	*Clean technology capabilities have a positive impact on the environmental competitiveness of the firms in the O&G industry*
H_{6b}	*Clean technologies capabilities have a positive impact on the economic competitiveness of the firms in the O&G industry.*
H_7	*Environmental competitiveness has a positive impact on the economic competitiveness of the firms in the O&G industry.*

6.5 The structural model

In the preceding section, theoretical arguments were presented to establish the hypothetical relationships among the constructs of this research. Then, based on the hypothesis shown in table 6.2, the refined research model (structural model of stakeholder pressures-strategic resources-strategic capabilities (GSCM practices)-competitiveness) is depicted in figure 6.2.

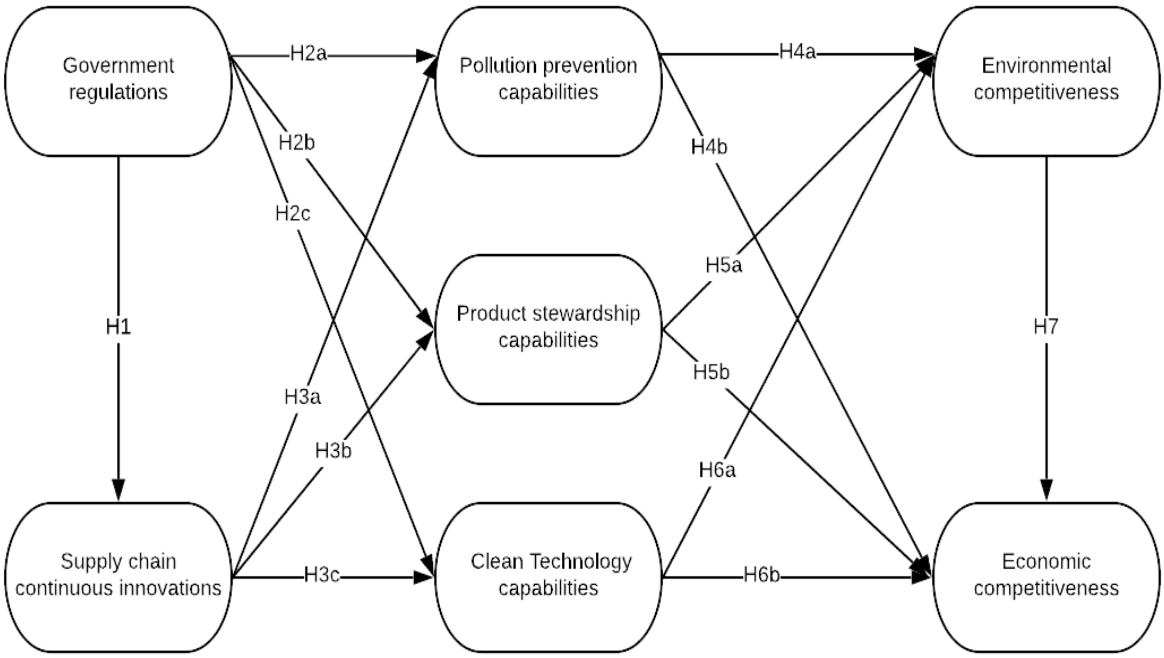

Figure 6.2: The structural model of stakeholder pressures-strategic resources-strategic capabilities (GSCM practices)-competitiveness.

In this research, the primary exogenous construct (government regulations) serves as the antecedent of the endogenous variables (supply chain continuous innovations) and the three NRBV strategic capabilities (pollution prevention, product stewardship, and clean technology) in different relationships. Also, supply chain continuous innovations function as the independent variable in a relationship with NRBV strategic capabilities. Furthermore, concerning the competitiveness constructs (environmental and economic), NRBV capabilities function as the independent variables, while environmental competitiveness serves as the independent variable in a relationship with economic competitiveness. Thus, a dependent variable in a relationship also functions as the independent variable in another relationship. This is consistent with the principle underlining structural equation modelling (SEM) (Hair et al. 2014) as presented as the appropriate quantitative technique for this study in chapter two.

6.6 Measurement scale development

According to Hair et al. (2014), the operationalisation of latent constructs is achieved either by developing measurement scales for the constructs or adapting existing ones from the literature. Adjusting existing scales from the literature has the advantage of time-saving and improved content validity, resulting in a higher level of acceptability (Esfahbodi et al. 2017). However, where sufficient research has not been conducted, the researcher may have to develop measurement items and adopt necessary measures to ensure the validity of the developed measurement scales (Hensley 1999). As indicated in figure 6.2, the conceptual model in this study comprises seven constructs. A review of the extant literature suggests that sufficient and relevant measurement scales are available to be adapted for this study's constructs. Thus, the development of new scales is not considered necessary in the current study.

While it is acknowledged that a possibility of measurement errors might be inevitable, it is argued that the adoption of available validation techniques for measurement items could significantly reduce the impact of measurement errors on research findings (Malhotra and Grover 1998). In this study, a rigorous process of pretesting the adapted measurement scales was carried out among academicians and practitioners who are considered knowledgeable in sustainability and O&G management. Specifically, the definitions of constructs were produced, and the selected measurement items, alongside the definitions of constructs, were given to five academicians and five managers across the supply chain of the Nigerian O&G industry. The feedback from this process was used to modify the adapted measurement items to suit the context of this study. Based on this process, the adapted measurement items are presented below:

6.6.1 Measurement scale of Government regulations (Coercive pressures)

Government regulations were operationalised with five items adapted from Zhu, Sarkis and Lai (2013). These items are considered appropriate for this study because a more recent study has adopted the same items to study the impacts of government regulations on GSCM practices and organisational performance (Esfahbodi et al. 2017). Some of the datasets for their study were partly collected from the chemical/petroleum industry, where the current research is focused. This further justifies the relevance of the measuring items for the current study. The item scales are presented in table 6.3.

Table 6.3. Measurement scale of government regulations.

Code	Government regulations (coercive pressures)	Sources
Reg1	My company considers national environmental regulations (such as waste emission, cleaner production, etc.) in its operations.	*Zhu and Sarkis(2013)*
Reg2	My company considers national resources saving and conservation regulations in its operations.	
Reg3	My company considers regional environmental regulations (such as waste emission, cleaner production, etc.) in its operations.	
Reg4	My company considers the possibility of sanctions against products' potential conflict with the law in its operations.	
Reg5	My company considers the effects of regulatory supervision and monitoring in its operations.	

6.6.2 Measurement scale of supply chain continuous innovations

Supply chain continuous innovations emerged from the findings of the qualitative studies in chapter 4, based on the identification of supply chain collaboration and continuous innovations as the most critical strategic resources for enhancing firms' capabilities to implement proactive environmental strategies. Therefore, measurement scales that directly operationalise this construct are not available. However, existing measurement scales on supply chain innovations present an excellent basis for adaptation. In the first instance, measurement items from three studies (Flint et al. 2008; Parnaby and Towill 2008; Lee et al. 2011) were identified. These items were reworded during the pretesting stage, and items considered irrelevant to the context of this research were removed. The final items validated for this research are presented in table 6.4.

Table 6.4. Measurement scale of supply chain continuous innovations.

Code	Supply chain continuous innovations	Sources
SCI1	My company continuously collaborates with its supply chain partners to pursue continuous innovations in core processes.	*Flint et al. (2008); Parnaby and Towill (2008); Lee et al. (2011).*
SCI2	My company continuously collaborates with its supply chain partners to pursue continuous innovations for cost reduction.	
SCI3	My company continuously collaborates with its supply chain partners to pursue continuous innovations for more effective processes	
SCI4	My company continuously collaborates with its supply chain partners to pursue continuous innovations in technological advancement.	
SCI5	My company continuously collaborates with its supply chain partners to pursue continuous innovations for product management.	

6.6.3 Measuring scales of pollution prevention capabilities

Pollution prevention capabilities are measured with the items adapted from Sharma and Vrendenburg (1998). The appropriateness of these items is based on the fact that the items were administered in the context of the Canadian O&G industry. Furthermore, these items have also been adopted in previous studies to measure environmental practices in the context of GSCM (Zhu, Sarkis and Lai 2013; Green et al. 2012). These items are presented in table 6.5.

Table 6.5. Measurement scale of pollution prevention capabilities.

Code	Pollution prevention capabilities	Sources
PPC1	My company focuses on enhancing its capacity for the safe disposal of solid wastes.	*Sharma and Vrendenburg (1998)*
PPC2	My company focuses on enhancing its capacity for the safe disposal of hazardous wastes.	
PPC3	My company focuses on modifying its processes for reducing wastes at the source.	
PPC4	My company focuses on enhancing its capacity for water reuse and recycling process.	
PPC5	My company focuses on enhancing its capacity for reducing energy consumption.	

6.6.4 Measurement scale of product stewardship capabilities

The measurement items for product stewardship capabilities were adapted from Wan-Ahmad et al. (2016). The items are considered appropriate for the current research because they are originally validated in the O&G industry. Also, the measurement items agree with IPIECA's guideline on the definition of product stewardship in the context of the O&G industry. They are also consistent with the findings of Yusuf et al. (2013) on the performance outcome of sustainability practices in the UK O&G industry. These items are presented in table 6.6.

Table 6.6. Measurement scale of product stewardship capabilities.

Code	Product stewardship capabilities	Sources
PSC1	My company builds and enhances its capacity to evaluate, monitor, and issue information about the health and environmental risks of products.	*Ahmad et al. (2016)*
PSC2	My company builds and enhances its capacity to effectively provide specific information about products' transportation and usage hazards.	
PSC3	My company builds and enhances its capacity to design product packaging that is safe and ecological friendly.	
PSC4	My company builds and enhances its capacity to use environment-friendly alternatives.	
PSC5	My company builds and enhances its capacity to deploy a lifecycle approach to product safety management.	

6.6.5 Measurement scale of clean technology capabilities

Clean technology capabilities are operationalised with the items adapted from Sharma and Vrendenburg (1998) and Bhupendra and Sangle (2015). While Sharma and Vrengengburg (1998) conducted their study in the context of the O&G industry, Bhupendra and Sangle's (2015) measurement items incorporated the role of organisational policy on the adoption of clean technology. The above justifies the appropriateness of these items in this study. The final indicators of clean technology capabilities are presented in table 6.7.

Table 6.7. Measurement scale of clean technology capabilities.

Code	Clean technology capabilities	Sources
CTC1	My company builds the capacity to develop, adopt or commercialise photovoltaics/solar energy	*Sharma and Vrendenburg(1998); Bhupendra and Sangle (2015)*
CTC2	My company builds the capacity to develop, adopt or commercialise wind power sources	
CTC3	My company builds the capacity to develop, adopt or commercialise new technology for cleaner energy.	

CTC4	My company builds the capacity to implement a cleaner production process.	
CTC5	My company perceives clean technology as a continuous long-term policy.	

6.6.6 Measurement scale of environmental and economic competitiveness

To measure environmental and economic competitiveness, measurement items were adapted from Zhu, Sarkis and Lai (2013) and Moreno and Reyes (2013). Although the items in Zhu Sarkis and Lai (2013) measured environmental and economic performances, their wordings have been changed to reflect the objective of the current construct, which is focused on measuring competitiveness. These items are considered relevant to this study because they were validated in the chemical/petrochemical industry. The relevance of the items adopted from Moreno and Reyes (2013) is based on their specific validation as metrics for economic and environmental competitiveness. The adopted measures of these constructs are presented in table 6.8.

Table 6.8. Measurement scale of Environmental and economic competitiveness.

Code	Environmental competitiveness	Sources
EVC1	My company has built a better relationship with the regulators than our competitors.	*Zhu and Sarkis(2013); Moreno and Reyes (2013)*
EVC1	My company has a better reputation as an eco-friendly firm than our competitors among stakeholders.	
EVC2	My company has improved employees' environmental consciousness through training and evaluation more than competitors.	
EVC3	My company considers environmental issues in process, products and technology Innovation more than the competitors.	
EVC4	My company has decreased the frequency of environmental accidents more than the competitors.	
	Economic competitiveness	
ECC1	My company has lowered the cost of environmental compliance than competitors	
ECC2	My company generates more income from selling usable wastes (e.g. Cardboard, plastics, scraps) than competitors	
ECC3	My company cost of material purchasing has decreased more than the competitors'	

ECC4	My company has decreased fine for environmental accidents more than the competition.	
ECC5	My company has decreased the fee for waste discharge more than the competition	

6.7 Chapter conclusion

In this chapter, the proposed initial conceptual framework in chapter two was refined with the findings from the qualitative studies in chapter four. In effect, generic constructs (stakeholder pressures factors and strategic resources) were respectively replaced with the context-specific constructs of government regulations and supply chain continuous innovations. Furthermore, the base of the pyramid construct, which lacks empirical evidence in chapter 4, was expunged from the refined research model. After that, the chapter presented and discussed the seven empirically verified constructs (government regulations, supply chain continuous innovations, pollution prevention capabilities, product stewardship capabilities, clean technology capabilities, environmental competitiveness, and economic competitiveness) of the refined research model and developed literature-based hypotheses to establish causal relationships among constructs. Thus, seven hypotheses (with sub-hypotheses) were presented in this chapter. Finally, the seven constructs of the research models were operationalised through the development of measurement scales which were adapted and modified from the extant literature.

Therefore, this chapter has attained the RO4 of this study which is '*to develop an integrative framework of Stakeholder pressures driving forces-GSCM-NRBV strategic resources/capabilities-competitiveness for the Nigerian O&G industry.'* Hence, this has created a basis for examining how Nigerian O&G firms can enhance their competitiveness by investing in the strategic resources of supply chain continuous innovations and NRBV capabilities of pollution prevention, product stewardship, and clean technology in relation to the driving forces of government regulations. However, whether the hypothesised relationships are true is a subject of empirical verification examined in the next chapter.

Chapter 7: Empirical Analysis and Findings of Quantitative Research

7.1 Chapter introduction.

This chapter presents the empirical results of the questionnaire survey of this study. Upon refining the research model in chapter 6, the model is ready for assessment to ascertain whether the hypothesised relationships among constructs are valid. This chapter addresses the final research question of this study (RQ4): *"What is the impact of GSCM practices (pollution prevention, product stewardship, clean technology and the base of the pyramid) on the competitiveness of the firms operating in the SC of the Nigerian O&G industry?"* Thus, all the hypotheses in the research model are statistically evaluated to answer this question in this chapter. Therefore, this chapter first assessed the impact of government regulations on supply chain continuous innovations and three strategic capabilities (pollution prevention, product stewardship and clean technology) earlier validated in chapter 5. It also assesses the effect of supply chain continuous innovations on all strategic capabilities.

Furthermore, the impacts of the three strategic capabilities (GSCM practices) on the environmental and economic competitiveness of the Nigerian O&G firm are assessed. Finally, this chapter evaluated the impact of environmental competitiveness on the economic competitiveness of firms in the industry. The outline of this chapter is presented in figure 7.1.

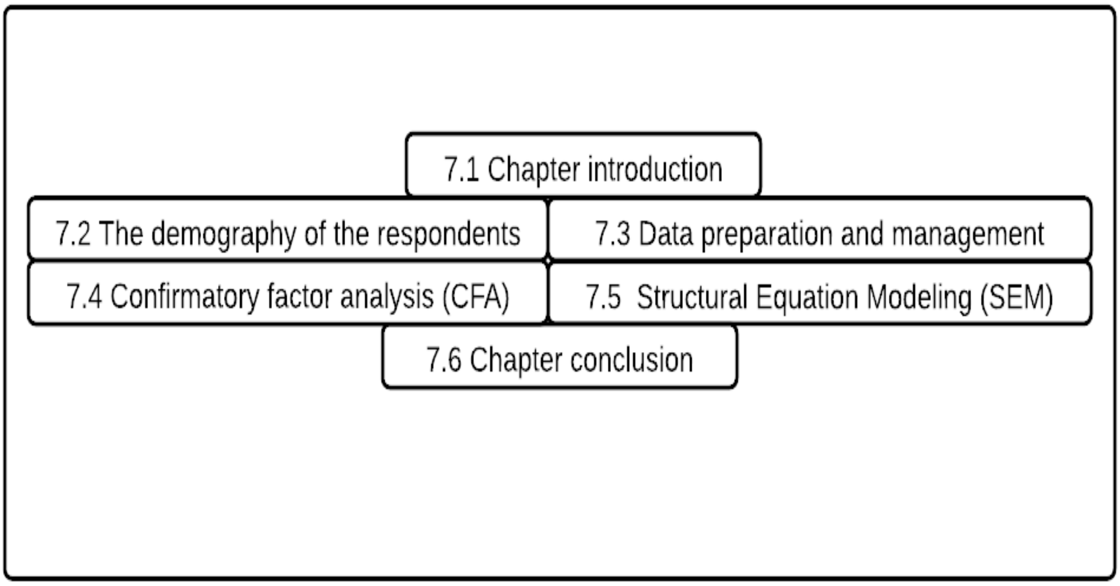

Figure 7.1: The structure of chapter 7.

As highlighted in chapter 4, the analysis and results of the quantitative research are from the structural equation modelling (SEM) analysis of two hundred and fourteen (214) questionnaire responses collected from the relevant managers of the firms operating in the Nigerian O&G SC. The demographic profile of the respondents are presented in the next section.

7.2 The Demographic Profile of the respondents.

As asserted in chapter 2, the oil and gas industry is vast and highly diversified, with different organizations carrying out various functions across its supply chain. The degree of diversity of the industry was a critical factor of consideration for data collection. In all, out of 1820 questionnaire surveys distributed to the management staff across the Nigerian O&G industry, 214 (representing 11.8%) were received and adjudged usable for this research. The demographic characteristics of these respondents are presented in table 7.1.

Table 7.1. Demographic profile of the respondents

Criteria	Frequency	Percentage
Demography by O &G sector		
Upstream	88	41.1
Downstream	126	58.9
Total	**214**	**100**
Size of the organization by the number of employees		
1-10	5	2.5
11-50	71	33.2
51-250	47	22.0
251-500	73	34.1
500 and above	18	8.2
Total	**214**	**100**
Job designation of the respondents		
CEO/Directors	23	10.7
Operations managers	64	30.4
Supply chain managers	37	17.2
Procurement managers	38	17.9
Logistics managers	35	16.1
Compliance managers	17	7.7
Total	**214**	**100**
Respondents' years of experience		
1-10	8	3.6
11-20	74	34.8
21-30	122	57.1
31 and above	10	4.5
Total	**214**	**100**

As could be seen above, the respondents' demographic profile and their organizations reflect the broadness and diversity of the industry. Therefore, the demographic criteria in table 7.1 are discussed below.

7.2.1 Demography by oil and gas sector

41% of the respondents' distributions are from the industry's upstream sector, compared with 56.9% from the downstream sector. Sustainability issues are generally prevalent across the entire supply chain of the O&G industry. Arguably the upstream sector constitutes greater environmental risk than the downstream. Hence, considerable attention has been dedicated to this sector by academics and stakeholders. However, the downstream sector has been less research despite its environmental risk, especially in Nigeria, where evidence of environmental destruction has been traced to the downstream sector (Ambituuni, Amezaga and Emeseh 2014; Anifowose 2008). Nevertheless, a ratio of 40:60 is arguably a good balance between the two sectors to take a holistic view of the industry.

7.2.2 Size of organizations by the number of employees

As earlier mentioned, the Nigerian O&G industry is made up of different organizations with different characteristics. In the upstream, there exist the E&P companies who are majorly international oil companies (IOCs) with huge assets and high staff strengths. However, many indigenous exploration companies whose capital base and staff strengths are not as high as the IOCs' also operate in this sector. In addition, there are small and medium (SMEs) scale firms that serve as contractors, sub-contractors, suppliers, and service providers in the upstream sector. The downstream operators include refineries, independent marketers, major marketers, O&G logistics companies, and service providers. This diversity is reflected in the staff strength of the firms in the industry, as shown in Table 7.1. Since this is a supply chain research, including all relevant industry members is considered necessary to improve the validity of this research. A similar approach was adopted by Yusuf et al. (2012) to investigate the impacts of sustainability practices on the performance outcome of the firms in the UK O&G industry.

7.2.3 Job designation of the respondents

Table 7.1 reveals that the respondents in this research cut across various managerial roles such as the CEO/directors, operations manager, supply chain managers, and many others in the industry. The highest frequency is the operations managers (30.4 %), followed by procurement managers (17.9%) and supply chain managers (17.9%). These core supply chain and operations management personnel account for more than 50% of the respondents' distribution. By the positions of all respondents, their job functions are involved with strategic management in their various organizations. The above indicates that the respondents have adequate knowledge to provide sufficient and valuable insights about this research's variables. This aligns with the recommendation of Scandura and Williams (2000) that the respondents' qualifications and job functions are critical factors in ensuring the reliability and validity of a questionnaire survey.

7.2.4 Respondents' years of experience

Table 7.1 indicates that 57% of the respondents in this research has work experience ranging between 21 and 30 years. Further, 35% of the respondents have work experience ranging between 11 and 20 years in the industry. The above further confirms that the respondents are persons with sufficient knowledge about strategic management in their organizations.

7.3 Data Preparation and Management

According to Smith (2011), data preparation and management constitute a significant precedent to any data analysis. In this study, data management was commenced at the inception of the data collection process. After developing the questionnaire items for this study, an online survey software, Qualtric, was used to administer the survey and collect the relevant data from the respondents. The adoption of the online survey software did not only help in obtaining the required responses for this research, but it also provided an advantage of better accuracy of data entry as the data collected through the software is easily exportable to SPSS for necessary analysis. Upon data collection, responses from 'non-managers and 'other managers' were excluded. The remaining relevant data, totalling 214 responses, were exported to the SPSS version 26 to prepare the data for further analysis. For this purpose, data were appropriately coded on the variable view of the SPSS, as shown in table 7.2:

Table 7.2. Constructs and items coding for quantitative analysis.

Constructs	Constructs Code	Measurements codes
Government Regulations	GovReg	Reg1—Reg5
Supply chain Innovations	SCInno	SCI1—SCI5
Pollution Prevention capabilities	PolPre	PPC1— PPC5
Product stewardship capabilities	ProStew	PSC1—PSC5
Clean technology capabilities	CleanTec	CTC1—CTC5
Environmental Competitiveness	EnvCom	EVC1—EVC5
Economic Competitiveness	EcoCom	ECC1—ECC5

In consideration of the views of Field (2009) that appropriateness of data collected in terms of missing data and normal distribution is central to any statistical data analysis, the processes of data analysis commenced with data evaluation for missing data and establishment of the normality of data distribution. This was carried out to identify any abnormal issues and resolve the same before outright data analysis. In this research, the risk of missing data was not a threat as it has been mitigated at the point of data collection by enabling a 'forced response' feature found on the online survey software-Qualtrics. Through this feature, a respondent is prevented from submitting his responses if any question remained unanswered. Sue and Ritter (2007) noted that this method of managing missing data is increasingly becoming more popular among researchers in recent times. However, the major challenge with this approach is that it can only be used with advanced software built with such features as found in Qualtrics. Despite relying on this approach to tackle missing data at the data collection point, a reconfirmation of the absence of missing data was further carried out on SPSS by sorting each research variable in ascending order. If there were missing data in any variable, SPSS would arrange them on the first cell of the variable. As expected, no missing data were found, indicating the 'force response' feature enabled on Qualtrics achieved its purpose. Having resolved the issue of missing data, the next step in the data cleaning process is to test for the normality in data distribution. This process of achieving this is reported in the next section.

7.3.1 Statistical test of data distribution

To check whether the data is normally distributed, descriptive statistical data analysis was carried out on SPSS. After exporting data from Qualtrics to SPSS, the variables were coded for ease of analysis, as highlighted in table 7.2. Since the responses are made up of the Likert's scale questionnaire of the measurement items, the value of each construct was firstly computed on SPSS using the 'compute variable' function located under the 'transform' tool. It was possible to sum up each construct's measurement items to compute the value through this. For example, the value of 'GovReg' was calculated with the formula: $\sum$ (Reg1, Reg2, Reg3, Reg5). Similarly, the value of 'SCInno' was computed with $\sum$ (SCI1, SCI2, SCI3, SCI4, and SCI5).

After that, the computed variables were selected for descriptive analysis to summarise the distribution of the data. More importantly, the Skewness and Kurtosis function was enabled on the descriptive analysis tool to compute the normality coefficients in the data distribution. According to Field (2013), Skewness and Kurtosis coefficients are valid indicators for examining the degree of normality in the distribution of a dataset. In this study, table 7.3 presents the descriptive statistics of the data (including the skewness and kurtosis coefficients) of the normality of data distribution.

Table 7.3. The descriptive statistics of the research constructs.

Constructs	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
GovReg	214	5.00	25.00	10.6729	4.26422	.688	.163
SCInno	214	5.00	25.00	14.9159	3.90527	.009	-.073
PolPre	214	5.00	24.00	13.9673	3.94491	.086	-.563
ProStew	214	6.00	25.00	20.0981	3.07568	-.910	2.838
CleanTec	214	9.00	25.00	16.7570	3.00029	-.147	.177
EnvCom	214	8.00	25.00	19.7757	2.66540	-.679	2.939

EcoCom	214	5.00	25.00	19.0047	3.28676	-1.207	3.840
Valid No.	214						

In its strictest form, Field (2009) recommends that the coefficients of Skewness and Kurtosis connote normal data distribution between -2 and +2. However, Kline (1998) suggests a threshold of -3 and +3 for skewness and +10 and -10 for Kurtosis. All the skewness values in table 7.3 fall within the stringent threshold of -2 to +2 recommended by Field (2009). However, some of the Kurtosis values are above this threshold, but they are still within a more relaxed threshold recommended by Kline (1998). Consequently, it is believed that the empirical data in this research is normally distributed.

7.3.2 Data Quality Test

Aside from dealing with missing data and examining the normality of data distribution as carried out above, another crucial issue to be addressed before further statistical analysis is testing for data quality. According to Kaplan (2004), testing data quality in quantitative and qualitative research in social science is necessary to enhance the credibility of results and articulate the robustness of research findings. A test for data quality is usually carried out using two complementary concepts: the validity and reliability test (Saunders, Lewis and Thornhill 2009).

The purpose of a validity test is to establish the truthfulness of the research concerning the degree by which the concepts been measured by the study showcases the reality (Bryman and Bell 2011). It is a test that focuses on determining the relevance of the research and the integrity of its findings (Saunders, Lewis and Thornhill 2009). In essence, establishing the validity of research helps make sense of the study and separate the findings from mere abstract. Consequently, validity is regarded as an essential criterion in determining the generalisability of the research findings. Emphasis is placed on face validity, content validity, and construct validity in quantitative research. Construct validity is categorized into convergent and discriminant validity, as explained further in Table 7.4.

Table 7.4. Aspects of validity test.

Aspect of validity	Overview	The approach in this study
Face validity	This is focused on determining whether the measurement items actually measure the constructs they purport to measure.	Pre-testing of the questionnaire items during the pilot study assured this.
Content validity	This is an assessment of the degree to which the full content of a construct's definition is encapsulated in a measure.	Since the measurement items adopted in this study are collated from previous studies that confirmed their validity, content validity is assumed in this study. It is further demonstrated through the pilot test.

Construct validity	Where multiple indicators are involved, this test establishes the validity of the indicators in terms of their coherence and consistency.	This is confirmed through convergent and discriminant validity tests.
Convergent validity	It shows the degree of correlation and coherence among the indicators measuring the same construct.	It is established through exploratory factor analysis (EFA) and Confirmatory factor analysis (CFA)
Discriminant validity	It establishes that indicators measuring two different constructs are uncorrelated.	It is established through confirmatory factor analysis (CFA).
Nomological validity	This demonstrates that the correlations and covariances among constructs are logical within the proposed theoretical framework.	It is established through the covariance matrix output of the Confirmatory factor analysis (CFA).

As shown above, the validity issue bothers the integrity of the research and its findings. According to Hair et al. (2014), validity helps the research community determine if the research actually measured what it claimed to measure. In table 7.4, both subjective and empirical approaches were taken to establish the validity of this research. In testing the research's face validity and content validity, subjective approaches such as the opinions of practitioners and professionals during the pilot test and the adoption of measurement items from the previous studies were used. Accordingly, many researchers have used a similar approach to establish their face validity and content validity. Besides, it is arguably logical to assume the content validity of measurement items that have been tested in previous research, as seen in this study where measurement items were adopted from previous studies. On the other hand, construct validity in terms of divergent and convergent validity was empirically tested using appropriate statistical techniques such as EFA and CFA. The results of these tests are extensively discussed in the relevant sections of this report.

Having dealt with validity, the next issue in checking data quality is the reliability test. The essence of the reliability test is to determine whether the research measures will yield the same outcome if repeatedly subjected to similar procedures (Bryman and Bell 2015). In other words, reliability is a measure of the consistency of the research in terms of its ability to be replicable following a similar process. Thus, it underlines the study's dependability, where a high degree of validity indicates a high degree of consistency (Saunders, Lewis and Thornhill 2009). Furthermore, Hair et al. (2010) posit that reliability indicates that the numerical results of the indicators of a variable do not vary in line with the characteristics of the measurement procedures or the measurement scale itself. Corroboratively, Field (2009) portends that reliability requires reasonably stable measures regardless of the respondent’s state or uncontrollable testing condition. Therefore, reliability is an important test that focuses on establishing the consistency, dependability, and repeatability of research measures.

To determine the reliability of research, Cronbach's **α** (alpha), which measures the degree of closeness of a set of indicators of a research constructs, is widely used by quantitative researchers (Kaplan 2004; Field 2009; Hair et al. 2010). As a standard, the recommended value of Cronbach's **α** for sufficient reliability is 0.6, with an ideal value of 0.7 (Hair et al. 2010; Field 2013). Hair et al. (2014) noted that a higher value of Cronbach's **α** indicates a higher level of reliability. If a research measure records poor Cronbach's **α**, the researcher may need to refine the measurement items by possibly deleting some of them to achieve the recommended level of reliability. In this research, the reliability test was carried out on the IBM SPSS version 26 statistical package. Precisely, the measurement items for individual construct were subjected to reliability analysis (with Cronbach's **α** activated) to determine their coefficients. For example, to compute the Cronbach's **α** for GovReg, reliability analysis was carried out on Reg 1…Reg5, being its measurement items. Based on this procedure, the results of the reliability test is presented in table 7.5.

Table 7.5. Constructs reliability test results using Cronbach's Alpha.

Constructs	Cronbach's Alpha
GovReg	0.943
SCInno	0.910
PolPre	0.841
ProStew	0.945
CleanTec	0.739
EnvCom	0.845
EcoCom	0.911

As indicated in the table above, all constructs' Cronbach's Alpha value sufficiently exceeds the ideal recommended value of 0.70 (Field 2013; Hair et al. 2014). Hence, with an average of 0.8763, the overall reliability of this research is considered good and satisfactory. In effect, this indicates a high level of reliability of the measurement items in terms of their internal consistency and representation of their specific latent variables (Kaplan 2004; Hair et al. 2014).

7.3.3 Exploratory Factor Analysis (EFA)

Conceptually, exploratory factor analysis (EFA) is a multivariate technique used in statistics to uncover the underlying structure of measurement items (Kaplan 2004). Predominantly, it enables researchers to determine whether all indicators represent and contribute to one underlying factor (Field 2009). Furthermore, it provides an underlying loading pattern of observed variables and how they converge under various factors as a measure of construct validity. According to Hair et al. (2010), in EFA, each indicator mostly relates to specific underlying factors through factor loading estimates, which serve to analyse loading patterns. It is also a correlation of observed variables and their corresponding factor (Kaplan 2004). In this study, the purpose of conducting an exploratory factor analysis (EFA) is to establish construct validity through convergent validity and prepare the data for further rigorous statistical analysis.

Through the EFA, this study can identify the group of distinct indicators that measure each construct without setting them a priori (Hair et al. 2014). Although the measurement items in this research were adopted/adapted/modified from previous studies, since some of them have not been tested together in a single research, it is considered necessary to carry out an EFA to establish the loading patterns of the measurement items on the constructs.

The 35 measurement items of this research were subjected to EFA on SPSS statistical package. To achieve this, the principal component analysis (PCA) with the Varimax rotation technique was used to determine the loading pattern of all measurement items on the relevant factors. Field (2009) noted that PCA is statistically reported through eigenvalues (the variances accounted for by the factor). For this purpose, Hair et al. (2010) portend that the acceptable number of eigenvalue is above 1. Also, to assess whether the data was appropriate for factor analysis, a data adequacy test was carried out, using the Kaiser-Meyer-Olkin (KMO) measure of sampling and Bartlett's test of sphericity (Tabachnick and Fidell 2001), as shown in table 7.6.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.851
Bartlett's Test of Sphericity	Approx. Chi-Square	5424.291
	Df	595
	Sig.	.000

Table 7.6. Data adequacy test with KMO and Barlett's sphericity test.

In line with Kaiser (1974), KMO of .0.89 reported the data is considered sufficient for EFA. Also, Bartlett's test of sphericity shows that the correlation matrix is proportional to the identity matrix as x^2 (595) =5424.291, P<001. The PCA results carried out on the measurement items indicate that the commonalities value of all items is above the 0.50 benchmark (Hair et al. 2014). Mainly, communality shows the degree of an item in relation to others, and higher communalities from 0.05 are considered great as a rule of thumb. Furthermore, the PCA reported a simple structure with seven factors extracted, as shown graphically in figure 7.2.

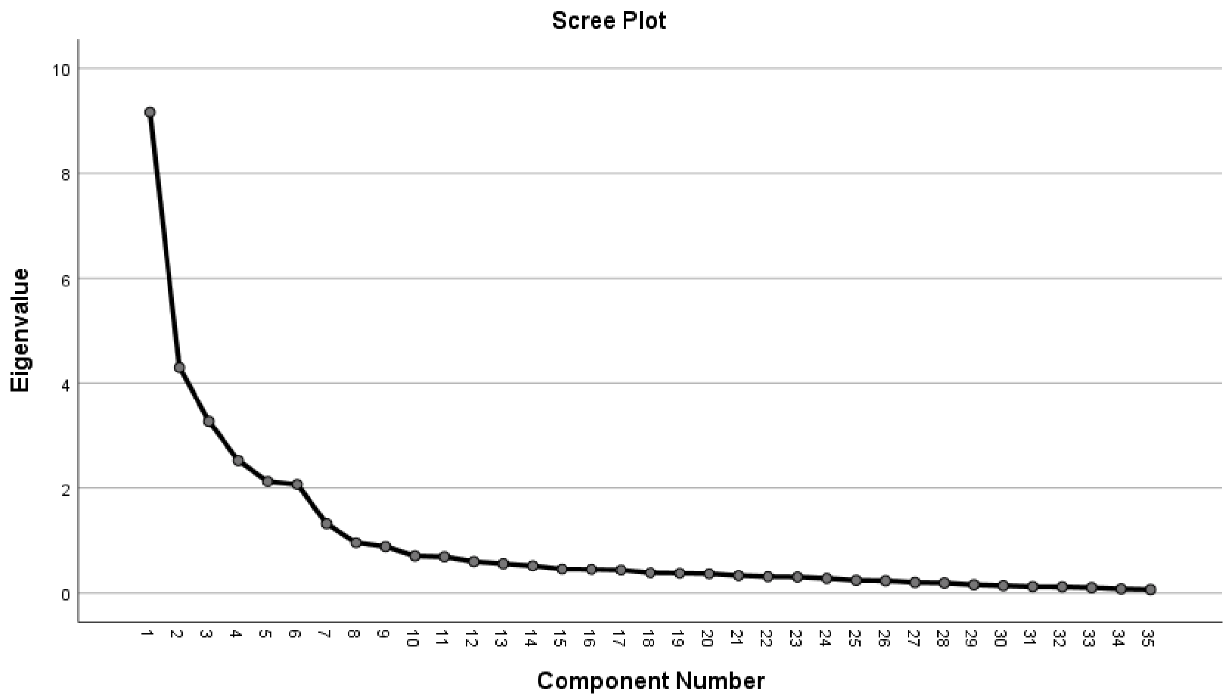

Figure 7.2: The Scree plot of Principal Components Analysis structure of the constructs

This is further depicted in table 7.7, which extracts only seven factors that explain 70.786% of the total variance. These are the only seven factors with an eigenvalue of a number greater than 1, as recommended by Hair et al. (2010).

Table 7.7. EFA Rotated Matrix of items loadings on the research constructs.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.165	26.186	26.186	9.165	26.186	26.186	4.193	11.980	11.980
2	4.300	12.284	38.470	4.300	12.284	38.470	4.174	11.924	23.904
3	3.273	9.352	47.822	3.273	9.352	47.822	3.721	10.632	34.536
4	2.522	7.205	55.027	2.522	7.205	55.027	3.667	10.476	45.012
5	2.126	6.074	61.101	2.126	6.074	61.101	3.243	9.266	54.278
6	2.070	5.915	67.015	2.070	5.915	67.015	3.171	9.061	63.338
7	1.320	3.770	70.786	1.320	3.770	70.786	2.607	7.447	70.786
8	.958	2.736	73.522						
9	.881	2.518	76.040						
10	.705	2.014	78.054						
11	.689	1.970	80.024						
12	.598	1.710	81.733						

In furtherance, table 7.8 reports the factor loadings of the measurement items based on the rotated component matrix for each component. This table also shows seven-factor solutions that represent the seven constructs of this research and a clean loading pattern of the measurement items on the relevant factors.

Table 7.8. Loading patterns of measurement items on Constructs based on EFA

Measurement items	**Components**						
	Factor 1 GovReg	**Factor 2 SCInno**	**Factor 3 PolPre**	**Factor 4 ProStew**	**Factor 5 CleanTec**	**Factor 6 EnvCom**	**Factor 7 EcoCom**
Reg1	.867						
Reg2	.925						
Reg3	.902						
Reg4	.908						
Reg5	.848						
SCI1		.841					
SCI2		.804					
SCI3		.747					
SCI4		.846					
SCI5		.853					
PPC1			.704				
PPC2			.662				
PPC3			.857				
PPC4			.861				
PPC5			.695				
PSC1				.811			
PSC2				.859			
PSC3				.882			
PSC4				.882			
PSC5				.825			
CTC1					.720		
CTC2					.665		
CTC3					.723		
CTC4					.641		
CTC5					.569		
EVC1						.695	
EVC2						.742	
EVC3						.774	
EVC4						.755	
EVC5						.653	
ECC1							.846
ECC2							.846
ECC3							.837
ECC4							.753
ECC5							.652

According to Hair et al. (2010), a minimum of 0.50 loading value is considered sufficient for an EFA. All the loading regression values above are higher than the recommended minimum level. The above indicates a good convergent of items on their respective factors. Besides, the results in table 7.8 show no cross-loading among all the observed variables, thereby signifying a discriminant validity. Following the above results, it can be concluded that the data in this research sufficiently shows evidence of face validity, content validity (both established through pilot test and previous studies), and construct validity from the perspective of EFA. Nevertheless, a confirmatory Factor Analysis (CFA) is carried out to further confirm the construct validity in terms of discriminant validity and to test the degree to which the data fit the overall model of this study. The process and the results of CFA are presented in section 6.4.

7.3.4 Common method variance (CMV)

Before carrying out SEM analysis to achieve the objectives of this chapter, issues of common method variance (bias) was addressed. Mainly, CMV is always an issue of concern when the same method (in the case, questionnaire survey) is used to collect data from respondents at the same time. According to Podsakoff et al. (2003), CMV is related to the effects of variance on measurement methods in evaluating research constructs. Therefore, CMV tends to produce a false internal consistency among research variables arising from the unrealistic correlation of variables through their common source (Chang et al. 2010). Thus, there is a possibility that asking survey participants to share their views on research variables sent out through a single survey instrument may result in false correlations among the measuring items of the research variables (Kamakura, 2010). This is because presenting multiple-item scales in a single instrument to measure several variables is likely to attract spurious effects that can generate incorrect conclusions (Kamakura, 2010). Therefore, it is important to assess and manage CMV to ensure that the common method bias does not constitute any problems to the research.

Podsakoff et al. (2003) suggest that common method bias is majorly caused by two factors, namely ‘item characteristic’ and common ‘rater.’ Item characteristic is concerned with the production of artificial covariance in the observed relationships, caused by the way items were presented to the respondents (Podsakoff et al. 2003:883). In contrast, common rater effects emanate from the respondents’ perceived need to give only consistent and socially desirable responses. According to the authors, these two factors can result in unreliable responses, which should be avoided. In this study, several measures were put in place to address common method bias emanating from any of the above sources. A rigorous pre-test of the research instrument was carried out to mitigate the' item characteristic' effects as discussed in section 4.6.3. The procedure yielded some minor modifications of the questionnaire items to make them clearer and well-understood. Concerning the ‘common rater’ effects, an assurance of confidentiality and anonymity provided to the respondents was used as a mitigating factor to elicit objective responses from the participants when deploying the online questionnaire. Furthermore, the fact that the measurement items in this study were adapted from pretested variables in previous studies enhances the quality of these items and help in reducing the risk of common method bias. Also, following the recommendations of Field (2009), the adoption of Likert-type scale questions in this study is also helpful for reducing the possibility of common method variance. As demonstrated above, issues of common method bias were considered at the point of conceptualising this study, and adequate measures were put in place from inception to mitigate this in line with the extant literature (Kamakura, 2010, Chang et al., 2010).

Beyond the procedures described above, the possibility of common method bias was also statistically assessed in this research. As recommended by Podsakoff et al. (2003), Harman's single factor test was carried out on SPSS software to determine whether common method bias is an issue in this study. Harman's single factor test is appropriate for this purpose because previous scholars have popularly adopted it to test the possibility of common method bias in their studies (Sarkis et al. 2010; Inman et al. 2011; Yu and Ramanathan 2015). To conduct this test, all measuring items for all variables are usually subjected to an EFA analysis on SPSS to examine whether a particular single factor accounts for the larger share of the total variance of all variables. For example, if a single factor is found to account for 50% of the total variance, then it can be concluded that there is a presence of common method variance in the dataset (Podsakoff et al., 2003).

For this purpose, all the 35 measurement items in this research were subjected to factor analysis by constraining the number of factors to one and using the unrotated factor solution. The results show that the maximum variance explained by a single factor is 26.1%, which is less than the recommended threshold of 50% (Podsakoff et al., 2003). The above confirms that there is no evidence that one single factor accounts for the majority (50% and above) of the variables in this research. Therefore, it is statistically confirmed that common method bias was not present in the survey data, and CMV is not a problem in this research.

7.4 Confirmatory Factor Analysis (CFA)

CFA is an integral part of the SEM process, aimed at testing the measurement model to determine how the measurement items represent the research constructs. While CFA is similar to EFA in the sense that they both relate measurement items to the relevant factors/constructs, the distinctive peculiarity of CFA is that the constructs to be measured are set a priori, based on the researcher's theory (Hair et al. 2014). Hence, CFA evaluates construct validity in the context of a full measurement model, while EFA does not consider the measurement model in assessing construct validity. Therefore, CFA was performed in this research to test whether the measurement model statistically fits the collected data. In addition, it further assesses the construct validity of the theoretical constructs within the context of the whole model. In other words, it is focused on testing the structural model of this study (the relationships among latent variables and measurement items) to determine the degree of the loading of measurement items concerning the constructs.

Beyond its ability to test for construct validity, CFA effectively serves as the first step in structural modelling by providing the necessary model fit indices that help a researcher determine the degree to which the data fits the model (Kaplan, 2000). As part of the SEM process, the CFA provides a researcher with several goodness of fit (GOF) indices to determine the model fit. Some of these indices are presented in the table below. Of great importance is that these GOF indices are used to test both the measurement and the structural models.

Table 7.9. Commonly adopted Goodness of fit indices and their thresholds. (Sources: Adapted from Kaplan 2000; Schumacker and Lomax 2010; Byrne 2012; Kline 2011; Hair et al. 2014).

GOF index	Description	Acceptable fit
	Absolute Fit Indices	
Relative Chi-square (X^2/degree of freedom)	Chi-Square statistics a regarded as meaningful indices that take into account the degree of freedom. This is concerned with a test of the fitness of the model and the data. It is the traditional measure for evaluating overall model fit that assesses the discrepancy between the sample and fitted covariance matrices. The test of the null hypothesis that the estimated variance-covariance matrix deviates from the sample	**Value of 3 or less**
Root mean square error of approximation (RMSEA)	This represents the square residual for the degree of freedom. It tells us how well the model, with unknown but optimally chosen parameter estimates, would fit the population's covariance matrix. In recent years, it has come to be regarded as one of the most informative fit indices due to its sensitivity to the number of estimated parameters in the model	**0.05<Value<0.08**
	Incremental fit indices	
Normed Fit Index (NFI)	This is a comparative index between the proposed and more retracted, nested baseline model (null hypothesis) not adjusted for the degree of freedom	**Value>0.90**
Non-normed Fit Index (NNFI) identical to Tucker-Lewis index	It is a comparative index between the proposed and null models adjusted for the degree of freedom. Can avoid extreme underestimation and overestimation and robust against sample size. It is highly recommended as the index of choice.	**Value >0.90**
Comparative Fit index (CFI)	Comparative index between proposed and null models adjusted for the degree of freedom. Interpreted similarly as NFI but may be less affected by sample size. It is highly recommended as the index of choice, mainly when a large sample size is not available.	**Value >0.90**
Incremental Fit Index (IFI)	Comparative index between proposed and null models adjusted for the degree of freedom. Highly recommended as the index of choice, mainly when a large sample size is not available	**Value >0.90**

It must be noted further that the list above is not exhaustive. Indeed, Hair et al. (2014) categorised the GOF indices into three classes. These are the absolute fit indices (such as the X^2 statistics, RMSEA, SRMR etc.), incremental fit indices (e.g. NFI, TLI etc.), and Parsimony fit indices (such as Parsimony Normed Fit Index-PNFI, Adjusted Goodness Fit Index etc.). To this end, the literature suggests with a consensus that a researcher should not determine the model fit of a research constructs based on a single GOF index, rather a combination of various GOF indices (Tnaka 1993; Bryne 2013). This is because a single GOF index cannot provide sufficient ground to determine the overall model fit of research. For instance, it is widely acknowledged that X^2 is a significant criterion for assessing model fit. Nevertheless, the same index has been widely criticised regarding its sensitivity to large sample sizes (Hair et al. 2014). Stemming from the previous studies, the five GOF indices in table 7.9 are considered crucial in determining the model fit of both measurement and structural models (Byrne 1998; Kaplan, 2000; Hair et al. 2010; Kline 2011). Therefore in this study, the above recommended five GOF indices are also adopted to measure the model fit of the measurement and the structural models of the research constructs.

Having provided the relevant background to CFA and the criteria assessment for model fit, it is imperative to depict how CFA and its model fit assessment was carried out in this study. Upon the completion of the data screening and preparation process, the measurement model (comprising all the seven constructs and their individual sets of observed variables) was specified on AMOS Graphics version 25 through a path diagram. The path diagram was made up of the constructs, their relative measurement items and error terms. As recommended by Bryne (2013), all the constructs were co-varied to test the measurement model. By default, Amos automatically fixes one of the regression paths to '1' to process the research data and determine model identification (Bryne 2013). Finally, the research data from SPSS were uploaded to AMOS, and the estimation criteria, including modification indices, were selected. Through the modification indices, AMOS software can suggest covariance between measuring items and errors that can reduce the Chi-Square and ultimately improve the model fit (Bryne 1998; Inman 2011).

The results of the initial measurement model in figure 7.3 show that the model returns some relatively good regression coefficients for all variables. Apart from PPC 2 and CTC 5, with a respective regression loading of 0.48 and 0.46, every other regression path has a loading regression value above 0.50. According to Hair et al. (2014), items with regression values less than 0.50 are candidates for deletion to improve the construct validity. Also, the model relative Chi-Square of 1.711 (calculated as 922.036/539) is below the maximum value of 3.00 recommended by Kline (2011). As part of the model fit indices, the RMSEA of 0.58 is below the maximum cut-off value of 0.80 (Schumacker and Lomax 2010). Other model fit indices such as TLI (0.917), CFI (0.924) and IFI (0.925) are above the minimum value of 0.90. However, the Normed Fit Index (NFI) of 0.838 is below the minimum recommended value of 0.90.

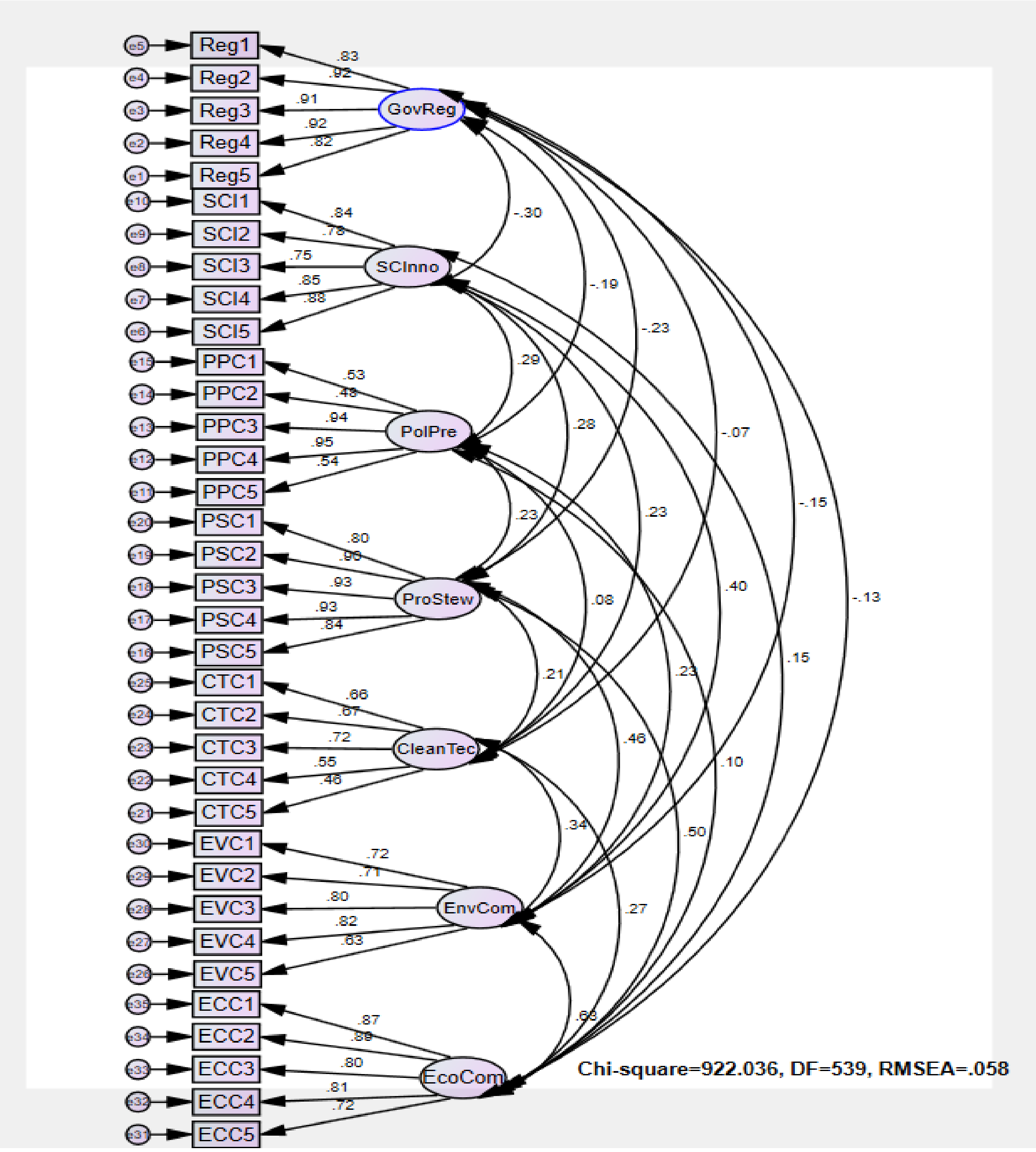

Figure 7.3: The first CFA results.

In essence, two main issues are noted in the initial measurement model of this research. First, some regression paths (PPC2 and CTC 5) have poor loadings below the minimum recommended value of 0.50. Second, one of the GOF indices, the NFI, is below the minimum recommended value of 0.90. Generally, this kind of scenario is not uncommon in business research as it is rare to produce a model that perfectly fits the data in the initial model output (Kaplan 2004; Hair et al. 2014). Therefore, when this occurs, the researcher is expected to take remedial action to improve the model.

Concerning the first problem, which is the poor loading of some items on their constructs, the recommended corrective action is the deletion of those items from the constructs (Byrne 2013; Hair et al. 2014). In this wise, PPC2 and CTC 5 were deleted from their respective constructs (PolPre and CleanTec) to improve construct validity. After running another estimation, the CFA output indicates that all items on PolPre have loadings estimate above the recommended minimum value of 0.50, meaning that all the measurement items have good loadings on the construct. In contrast, item CTC4 on CleanTec with the initial loading of 0.54 reduced to 0.47 after deleting item CTC5. Since CTC4 is now below the minimum value of 0.50, it was further deleted from CleanTech. Upon this action, all the remaining items loaded well on the construct, with the values ranging between 0.59 and 0.74, which are above the minimum value of 0.50. This action also increased the NFI from 0.838 to 0.862.

To resolve the second issue regarding the low value of the Normed Fit Index (NFI), the modification indices output from AMOS was utilised to identify items that could improve the model fit (Byrne 2013). Specifically, the modification indices suggest measurement items that could be co-varied to reduce the Chi-Square value and improve the model fit (Inman et al. 2013; Byrne 2013). It is important to note that adding covariance to measurement items based on the modification indices is often carried out through the trial and error method. However, it is often suggested to focus on items with a higher value on modification indices on the same construct (Byrne 2013). Therefore, based on the modification indices of this research, the following items were deemed the best possible co-varying suggestions to improve the initial model fit.

- Reg1 and Reg4→Covaried
- SCI1 and SCI2→Covaried
- SCI4 and SCI5→Covaried
- PPC1 and PPC5→Covaried
- PSC1 and PSC2→Covaried
- PSC1 and PSC5→Covaried
- EVC1 and EVC2→Covaried
- ECC1 and ECC2→Covaried

Upon applying the above adjustments to improve the model fit, the measurement model was modified, leading to the deletion of three measurement items (PPC2, CTC5 and CTC4) and co-varying the specified items. Thereafter, the CFA estimates were rerun on AMOS, leading to the output specified in figure 7.4. As indicated, the output reports a relative Chi-square of 1.344, which is below the maximum recommended value of 3.00. Also, the RMSEA model fit index is 0.40, which is far below the recommended value of 0.8. On the other hand, other model fit indices such as TLI (0.966), CFI (0.970) and IFI (0.970) are all above the minimum recommended value of 0.90. Although the Normed Fit Index of 0.893 is slightly below the recommended value of 0.90, this value is considered sufficient for this study. This is because the re-specified model shows a considerable improvement on NFI over the initial model in figure 7.4.

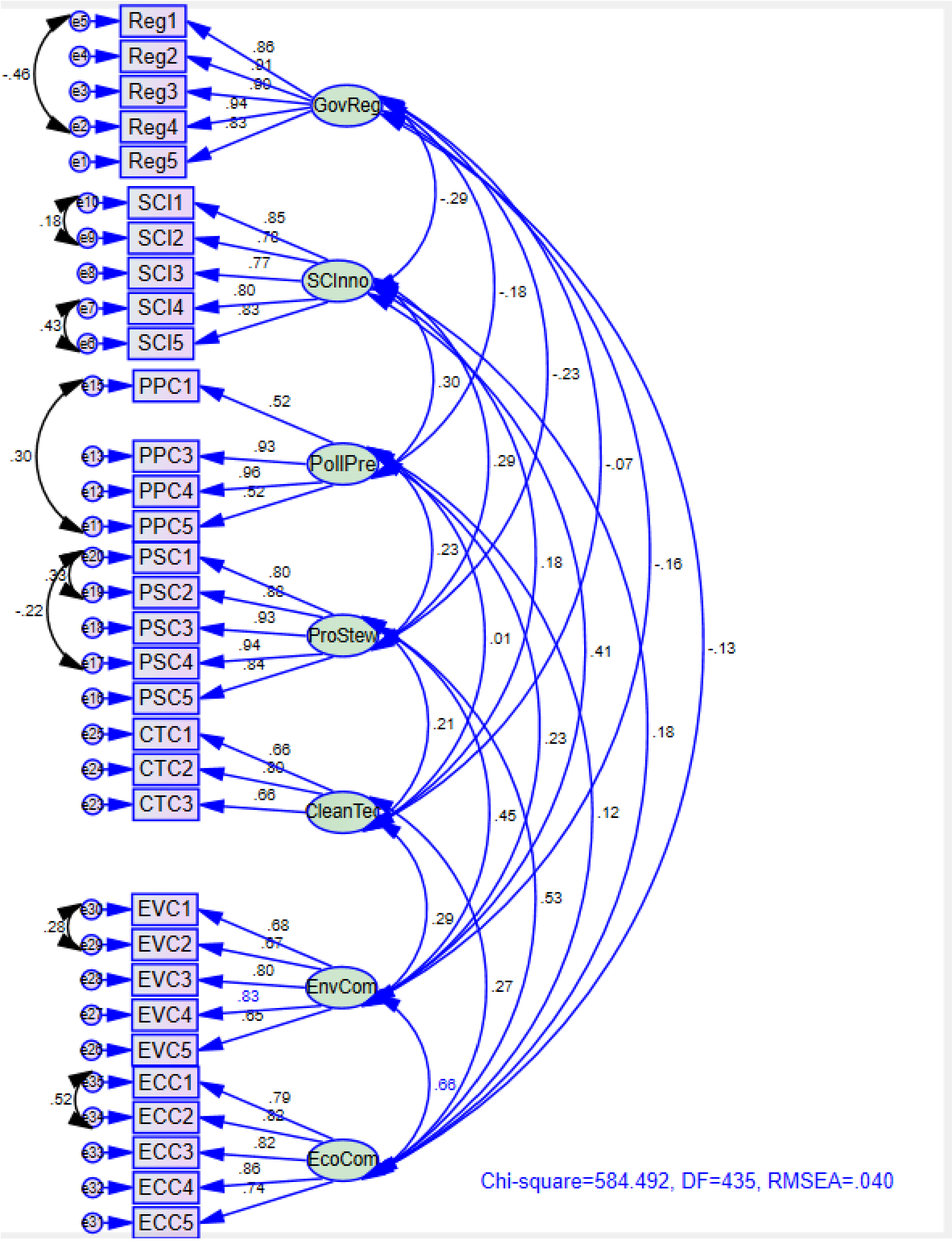

Figure 7.4: Second and final CFA results**.**

Also, other GOF indices as specified above sufficiently support a good model fit. Besides, previous studies have also accepted models that recorded NFI of similar value (Zhu, Sarkis and Lai 2007).

Therefore, with the results of the GOF indices of this model, a claim of good fit indicating that the survey data fit the model well is actively supported. Detailed results of the model output are produced in table 7.10.

In addition, the table below shows that the minimum loading value of items on constructs is 0.516 (PPC1 on PolPrev), which is higher than the minimum value of 0.50 as recommended. Apart from the above, the AMOS output further produces a standardised residual matrix which represents the 'individual differences between the fitted covariance terms and the observed covariance terms' (Hair et al. 2006: 796). According to Kline (2011), a smaller residual value suggests a better model fit. Specifically, Hair et al. (2014) argue that residual values above 4.00 indicate a high degree of error. The residual covariance values of this research from the AMOS output ranges between -0.860 and 0.122, meaning that no residual is above the threshold value of 4.00 referenced above. The above further support the claim for a good fit of the structural model of this research.

Table 7.10. Factor loadings of measurement items and CFA model fit indices.

Research Constructs	Measurement items	Standardised coefficients
Government regulations	**Reg1:** My company considers national environmental regulations (such as waste emission, cleaner production, etc.) in its operations.	0.859
	Reg2: My company considers national resources saving and conservation regulations in its operations.	0.907
	Reg3: My company considers regional environmental regulations (such as waste emission, cleaner production, etc.) in its operations.	0.902
	Reg4: My company considers the possibility of sanctions against products' potential conflict with the law in its operations.	0.935
	Reg 5: My company considers the effects of regulatory supervision and monitoring in its operations.	0.830
Supply chain continuous innovations	**SCI1:** My company continuously collaborates with its supply chain partners to pursue continuous innovations in core processes.	0.851
	SCI2: My company continuously collaborates with its supply chain partners to pursue continuous innovations for cost reduction.	0.778
	SCI3: My company continuously collaborates with its supply chain partners to pursue continuous innovations for more effective processes	0.771
	SCI4: My company continuously collaborates with its supply chain partners to pursue continuous innovations in technological advancement	0.798
	SCI5: My company continuously collaborates with its supply chain partners to pursue continuous innovations for product management.	0.825
Pollution prevention capabilities	**PPC1:** My company focuses on enhancing its capacity for the safe disposal of solid wastes.	0.516
	PPC3: My company focuses on modifying its processes for reducing wastes at the source.	0.928
	PPC4: My company focuses on enhancing its capacity for water reuse and recycling process.	0.967
	PPC5: My company focuses on enhancing its capacity for energy consumption.	0.519
Product stewardship capabilities	**PSC1:** My company builds the capacity to evaluate, monitor, and issue information about the health and environmental risks of products	0.757
	PSC2: My company builds the capacity to effectively provide specific information about products' transportation and usage hazards.	0.878
	PSC3: My company builds the capacity to design product packaging to be safe and ecologically sound	0.934
	PSC4: My company builds the capacity to use environment-friendly alternatives.	0.940
	PSC5: My company builds the capacity to deploy a life-cycle approach to product safety management.	0.832

Clean technology capabilities	**CTC1:** My company builds the capacity to develop, adopt or commercialize photovoltaics/solar energy	0.659
	CTC2: My company builds the capacity to develop, adopt or commercialize wind power sources	0.793
	CTC3: My company builds the capacity to develop, adopt or commercialize new technology for cleaner energy.	0.660
Environmental competitiveness	**EVC1:** My company has built a better relationship with the regulators than our competitors.	0.686
	EVC2: My company has a higher reputation as an eco-friendly firm than our competitors among stakeholders.	0.671
	EVC3: My company has improved employees' environmental consciousness through training and evaluation more than competitors.	0.803
	EVC4: My company considers environmental issues in process, products and technology innovation more than the competitors.	0.828
	EVC5: My company has decreased the frequency of environmental accidents more than the competitors.	0.646
Economic competitiveness	**ECC1:** My company has lowered the cost of environmental compliance than competitors	0.905
	ECC2: My company generates more income from selling usable wastes (e.g. Cardboard, plastics, scraps) than competitors	0.873
	ECC3: My company cost of material purchasing has decreased more than the competitors'	0.804
	ECC4: My company has decreased fines for environmental accidents more than the competition.	0.865
	ECC5: My company has decreased the fee for waste discharge more than the competition	0.700
FIT INDICES: Relative Chi-square=1.336, RMSEA=0.40, TLI=0.966, CFI=0.970, IFI=0.971, NFI=0.893		

Nevertheless, regardless of the above results, it is highly recommended that a further test is carried out to ascertain the reliability and validity of the model before proceeding to test the structural model towards confirming the hypotheses of this research. Therefore, the following section presents the reliability and validity results of the measurement model based on the CFA output.

7.4.1 Validity and Reliability

The CFA output provides further information to ascertain the construct validity and scale reliability of the measurement model. As earlier mentioned, construct validity relates to the degree to which measurement items actually measure the constructs they purport to measure. As proposed by Campbell and Fiske (1959), construct validity is classified into two categories-convergent validity and discriminant validity, as indicated in table 7.4. Through the Exploratory Factor Analysis (EFA) in section 7.3.3, the convergent validity of the measurement items was originally established. Nonetheless, construct validity (including the convergent and discriminant validity) can also be reconfirmed through the CFA output in SEM (Joreskog 1969).

7.4.1.1 Convergent validity and reliability through CFA

According to Hair et al. (2014), the first test of convergent reliability of measurement scales in a CFA is through the regression weights of the observed variables on the construct. For this purpose, all measurement items should be statistically significant with a minimum factor loading of 0.50 (while 0.70

and above are considered good values) (Hair et al. 2014). As indicated in table 7.10, the factor loadings of all items range between 0.516 and 0.97, which are higher than the minimum 0.50 and, in many cases, above the good value threshold of 0.70. The above results lay the first credence to convergent validity in this study.

Beyond the factor loadings indication of convergent validity, a more conservative way of establishing convergent reliability in a CFA is by computing the Average Factor Extracted (AVE). The AVE presents the extraction of mean variances of item loadings on constructs, thereby summarising the convergence of all factors on their respective constructs. As a rule of thumb, 0.50 is considered the minimum acceptable value of AVE to show an excellent convergent validity of a measurement model (Hair et al. 2014). It must be noted that AMOS current version (like many other SEM software) does not produce AVE (and other important metrics such as Composite Reliability-CR) in its output. Nonetheless, the necessary information and variables needed to compute the AVE (and similar metrics) manually are produced in AMOS. Therefore, to calculate the AVE, the following formula recommended by Hair et al. (2014) was applied:

$$\mathrm{AVE} = \frac{\sum_{i=1}^{n} L_i^2}{n}$$

Where *AVE*= Average Variance extracted,
L =standardised factor loading
And *n*= number of observed variables.

The results of the AVE for the constructs of this research based on this formula is produced in table 7.11.

Another important metric that is also not produced in the AMOS output but used alongside AVE in confirming convergent validity and predominantly to establish construct reliability is composite reliability (CR). Although construct reliability has been established through Cronbach Alpha, as shown in table 7.5, CR is often used to measure reliability in CFA. Mathematically, CR is based on the sum of the squared values of factor loadings for individual constructs and the summation of the error variance terms of the constructs. According to Hair et al. (2014), the minimum threshold for ascertaining reliability and convergent validity based on the CR is 0.70. Also, since the CR is not produced as an output in AMOS, it is computed using the formula below:

$$\mathrm{CR} = \frac{\left(\sum_{i=1}^{i} \lambda_i\right)^2}{\left(\sum_{i=1}^{i} \lambda_i\right)^2 + \left(\sum_{i=1}^{i} 1 - \delta_i^2\right)}$$

Where CR=composite reliability

λ=factor loading,

And δ =error variance

Based on the application of these formulae, the AVE and the CR of the constructs in this research (together with the correlation matrix produced from AMOS) are shown in table 7.11.

Table 7.11. Reliability and Convergent validity using Average Variance Extracted (AVE).

	CR	Alpha	AVE	MSV	ASV	GovReg	SCInno	PolPre	ProStew	CleanTec	EnvCom	EcoCom
GovReg	0.949	0.943	0.787	0.084	0.148	**0.887**						
SCInno	0.902	0.910	0.648	0.171	0.443	-0.289	**0.805**					
PolPre	0.837	0.841	0.583	0.089	0.178	-0.184	0.298	**0.764**				
ProStew	0.940	0.945	0.758	0.241	0.585	-0.229	0.287	0.223	**0.871**			
CleanTec	0.748	0.739	0.500	0.087	0.175	-0.066	0.185	0.013	0.203	**0.707**		
EnvCom	0.850	0.845	0.534	0.392	0.781	-0.159	0.414	0.231	0.440	0.295	**0.731**	
EcoCom	0.918	0.911	0.693	0.392	0.520	-.0144	0.158	0.085	0.491	0.262	0.626	**0.833**
Note: diagonal values bolded in red is the square root of the AVE of the individual constructs.												

The results produced above show that the least AVE value in this research (CleanTec) meets the minimum cut-off value of 0.50, with other constructs AVEs ranging between 0.534 and 0.787. The above indicates that the research model can pass the convergent validity test based on the AVE metrics. Similarly, the CRs of all the constructs are above the recommended minimum value of 0.70 as they range between 0.748 and 0.949. This not only lays credence to the good convergent validity of the research model but also re-established the model's reliability as initially confirmed through Cronbach's alpha. Furthermore, the Cronbach's alpha of each construct is reported alongside other variables in table 7.11. This is for the purpose of comparison with the CR of the constructs. According to Hair et al. (2014), in testing for reliability using the composite reliability, the difference between construct reliability values produced by CR should not be significantly different from those produced in Cronbach's alpha. Looking at the CR column vis-à-vis the Cronbach's α column in table. 7.11, it will be deduced that the figures reported under the two different reliability metrics are very close. Again, this further confirms that the research model is both reliable and valid.

7.4.1.2 Discriminant validity through CFA

Another aspect of validity to be addressed through the CFA is the discriminant validity. As earlier highlighted, discriminant validity depicts the distinctiveness of the observed variables of a particular construct in distance from other constructs in the model. Thus, confirming that the measurement items of a variable measure that specific variable and no other constructs in the model. In this research, discriminant validity is assessed using the Fornell-Larcker criterion. Following this criterion, discriminant validity is tested by comparing the square root of the AVE of a construct with all other inter-construct correlations on the construct (Fornell and Larcker 1981). For this purpose, the square root of the AVE must be greater than any inter-construct correlation for discriminant validity to be established in a model (Fornell and Larcker 1981: Hair et al. 2014). In addition to the above, the AVE can also be compared with the Maximum shared variance (MSV) and the Average shared variance (ASV) to assess discriminant validity. While the MSV is the square of the highest inter-construct correlations in a construct, the ASV is the mean of all inter-construct correlations. To ascertain discriminant validity, the AVE must be greater than the construct's MSV and ASV.

From table 7.11, the diagonal values in bold represent the square root of the AVE of the individual constructs. Comparing these values with all the relative inter-constructs correlations, it will be deduced that all the diagonal values are higher than the inter-constructs correlations. Based on Fornell and Larcker's (1981) recommendation, the above results confirm that this research has no discriminant validity issue. Furthermore, a cursory look at the AVE compared with the MSV and ASV reveals that the AVE extracted is greater than the MSV and ASV of each construct. This further confirms that the research model does not suffer from any discriminant validity problem.

7.4.1.3 Multi-collinearity/Collinearity

Multi-collinearity refers to a situation whereby two or more variables yield a high correlation in a research model (Field, 2009). The presence of collinearity in a research model can lead to unpredictable changes in the coefficient estimates. Consequently, the presence of multi-collinearity tends to distort the effects of constructs by generating incorrect estimations of regression weights in SEM (Hair et al., 2014). Multi-collinearity is commonly assessed and measured in a path analysis through the variance inflation factor (VIF). With VIF, a researcher can evaluate the impacts of collinearity in regression analysis by determining the extent to which other predictor variables explain each predictor variable. Field (2009) recommends that a VIF value of 10.0 and above represents the presence of multi-collinearity in research.

In this research, a multi-collinearity test was carried out on SPSS software, using its collinearity diagnostic function. The VIF results were all less than 3.0, ranging between 1.318 and 2.796. These values are significantly less than the recommended threshold of 10.0. These results affirmatively confirm that multi-collinearity is not a threat in this research.

7.5 Structural Equation Modelling (SEM) results

Sequel to the successful validation of the measurement model and further establishing the convergent and discriminant validity as shown above (in addition to ascertaining the absence of multi-collinearity and common method bias), the next step in SEM is testing of the structural model to examine the theorised constructs in the research model. Unlike the measurement model that focuses on establishing how well the measurement items explain the latent construct, the structural model aims to determine causality among constructs based on the theory specified by the researcher (Byne 2013; Hair et al. 2014). Therefore, while constructs are co-varied to carry out measurement model tests, cause-and-effect relationships are specified among constructs during the structural model test. For this purpose, constructs are categorised into exogenous and endogenous variables based on their theoretical relationship (Byne 2013).

As noted by Hair et al. (2014), exogenous variables are likened to independent variables in a multiple regression analysis, while endogenous variables are likened to dependent variables. Hence, while endogenous variables have single arrows pointed on them, exogenous variables have no single arrow attached. Since SEM can simultaneously establish multiple relationships among variables, it is essential to note that a focal dependent variable in a relationship can function as an independent variable in another relationship. Such an example is seen in this research where, for instance, SCInno, a dependent variable in a causal relationship with GovReg transforms into an independent variable in a causal relationship with PollPre, ProStew and CleanTec.

To test the structural model in this research, the measurement model was converted to a structural model on AMOS by deleting the covariance relationship among constructs and substituting with the a priori causal relationships specified in theory. As earlier mentioned, this, in effects, indicates that constructs will be divided into independent and dependent variables. In this research, the only construct that functions purely as an independent construct is GovReg, as it is assumed to be influenced by factors outside the model (Kaplan 2000; Schumacker and Lomax 2010). All other constructs (apart from EcoCom, which is purely a dependent variable) have two arrows located to them, indicating that they function both as dependent and independent constructs. Following the conversion of the measurement model to the structural model, the relationships that exist among all the constructs in their interdependence linkages are presented in figure 7.5.

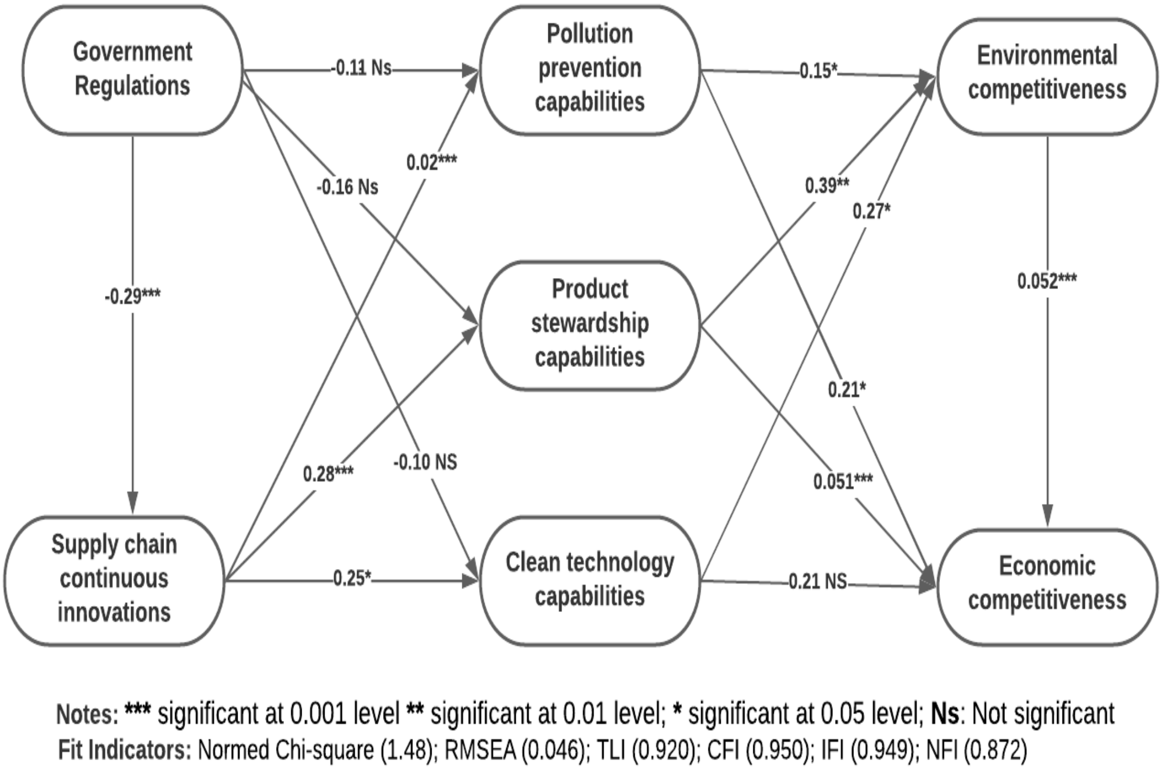

Figure 7.5: The results of the SEM model

The interpretation of the results above regarding the model fit and hypothetical relationships among constructs is hereafter presented.

7.5.1 Model fit of the SEM results

The first step in interpreting the outputs of an SEM analysis is to evaluate the model fit indices (Hair et al. 2014). Literarily, SEM model fit is assessed with the same criteria used for assessing the CFA model fit. As shown in the AMOS output for the structural model in figure 6.5, the normed chi-square of 1.48 (653.596/443) is less than the maximum value of 3.00 recommended by Kline (2011). Also, the RMSEA of 0.047 is less than the maximum recommended range of 0.08. Furthermore, other model fit indices such as TLI (0.920), CFI (0.950) and IFI (0.949) are all above the minimum recommended value of 0.90. Although the Normed Fit Index of 0.872 is slightly below the recommended value of 0.90, this value is considered sufficient for this study. Based on the foregoing, the structural model results adequately support the claim of a good and acceptable model fit. Besides, all the standardised residuals on all constructs, ranging between -1.30 and 2.51, are below the maximum recommended value of 4.00 by Hair et al. (2014). This indicates that the results raise no concern about a potential high degree of errors. Achieving such a great good model fit in SEM is believed to have also been enhanced by the EFA process leading to the adjustment of the measurement items earlier carried out in this study.

Upon executing SEM, the AMOS output usually generates modification indices that suggest additional relationships among constructs that can improve the model fit. Interestingly, the modification indices produced in the AMOS output in this research suggested no new potential paths among constructs. The above indicates that all possible relationships among constructs have already been specified in the theorised research model, as SEM further suggested no other significant relationships on the statistical ground. This unique feature of SEM is fast becoming popular among researchers. It provides a great opportunity to ensure no significant relationships among constructs are missed in the SEM analysis course (Kline 2011).

As the model fit indices discussed above have laid credence to a claim of a good model fit for the structural model, thereby confirming satisfactory validity of the structural model, the results of the hypothesis testing are therefore reported in the next section.

7.5.2 Hypotheses tests results

Having established the acceptability of the SEM model fit, the next step in the analysis is to report the causal relationships among all the constructs (hypotheses) of the research. To achieve this, the path coefficient estimates, the standard errors, and the model's t-values were examined. The path coefficient estimates indicate the strength of relationships among the research constructs. The t-value (also known as the p-value) is an indicator of the critical ratio (CR), usually obtained by dividing the path coefficient estimates by the standard errors. For interpretation, a significant relationship exists where the CR is greater than ±1.96 at p-value ≤ 0.05 or ±2.58 at p-value ≤ 0.01 or ±3.09 at p-value ≤ 0.001 (Gefen et al., 2000). To determine the direction of the relationship, the plus and minus signs indicated against the estimate coefficients are considered. Here, (+) indicates a positive relationship and (-) indicates a negative relationship between the exogenous and endogenous constructs. In respect of the current study, the hypotheses results are presented in Table 7.12.

Table 7.12. The statistical results of the research hypotheses.

Constructs relationships	**Standardised coefficient**	**P-Value**
GovReg → SCInno	-0.29	***
GovReg → PolPre	-0.11	0.81
GovReg → ProStew	-0.16	0.42
GovReg → CleanTec	-0.10	0.21

SCInno → PolPre	0.02	***
SCInno → ProStew	0.28	***
SCInno → CleanTec	0.25	*
PolPre → EnvCom	0.15	*
PolPre → EcoCom	0.21	*
ProStew → EnvCom	0.39	**
ProStew → EcoCom	0.05	***
CleanTec → EnvCom	0.27	*
CleanTec → EcoCom	0.21	0.33
EnvCom → EcoCom	0.05	***
***** significant at 0.001 level ** significant at 0.01 level; * significant at 0.05 level; ns: not significant**		

The results of the hypotheses tests from the SEM analysis presented above show that this research cannot provide evidence for the H1 of this study. Contrary to the stipulated hypothesis that Government Regulations have a causal impact on Supply chain continuous innovations, empirical findings reveal the opposite by showing that a negative relationship exists between the two constructs in the Nigerian O&G supply chain context. Also, in respect of H2a, H2b and H2c, hypothesizing the causal effects of Government Regulations on Pollution Prevention, Product Stewardship and Clean Technology; empirical findings of the analysis reveal statistically insignificant relationships between the independent variable (GovReg) and the respective dependent variables (PolPre, ProStew and CleanTec), thereby providing no empirical support for the hypotheses.

In contrast, Supply chain continuous innovations have positive causal effects on Pollution Prevention (β=0.02, significant at 0.001) as the research H3a, Product Stewardship (β=0.28, significant at 0.001), being the H3b and Clean Technology (β=0.25, significant at 0.001) as the H3c. Also, all the NRBV strategic capabilities have positive causal effects on competitiveness, except for clean technology with a statistically insignificant impact on economic competitiveness. Specifically, Pollution Prevention statistically leads to a causal effect (β=0.15 significant at 0.05) on environmental competitiveness (H4a) and positive causality (β=0.21 significant at 0.05) on economic competitiveness (H4b). Similarly, Product Stewardship leads to a positive causal impact (β=0.39 significant at 0.01) on environmental competitiveness (H5a) and the same effect (β=0.051 significant at 0.01) on economic competitiveness (H5b). Finally, CleanTec has a positive causal impact on (β=0.27 significant at 0.01) on environmental Competitiveness (H6a) but no statistically significant effect on economic Competitiveness (H6b). Regarding the relationship between environmental competitiveness and economic competitiveness (H7), the study found empirical evidence that environmental competitiveness (β=0.052 significant at 0.001) positively impacts economic competitiveness across the supply chain of the Nigerian O&G industry.

Based on the foregoing, the hypotheses for which empirical evidence was not found (H1, H2a, H2b and H2c) were rejected, while the hypotheses that were supported by the results of the analysis (H3a, H3b, H3c, H4a, H4b, H5a, H5b, H6a, H6b and H7) were all accepted. Table 7. 13 presents the details of the hypotheses that were either rejected or accepted based on the SEM analysis in this research.

Table 7.13. Research decisions on the hypotheses results.

Tested Hypotheses	Decision
H1: Government regulations have positive impact on supply chain innovations (SCI)	Not supported
H2a: Government regulations have positive impact on pollution prevention capabilities (PPC)	Not supported
H2b: Government regulations have positive impact on product stewardship capabilities (PSC)	Not supported
H2c: Government regulations have positive impact on clean technology capabilities (CTC)	Not supported
H3a: Supply chain innovations (SCI) have positive impact on pollution prevention capabilities (CTC)	Supported
H3b: Supply chain innovations (SCI) have positive impact on product stewardship capabilities (CTC)	Supported
H3c: Supply chain innovations (SCI) have positive impact on clean technology capabilities (CTC)	Supported
H4a: Pollution prevention capabilities (PPC) have positive impact on Environmental competitiveness (ENVCOM)	Supported
H4b: Pollution prevention capabilities (PPC) have positive impact on Economic competitiveness (ECOCOM)	Supported
H5a: Product stewardship capabilities (PPC) have positive impact on Environmental competitiveness (ENVCOM)	Supported
H5b: Product stewardship capabilities (PPC) have positive impact on Economic competitiveness (ECOCOM)	Supported
H6a: Clean Technology capabilities (CTC) have positive impact on Environmental competitiveness (ENVCOM)	Supported
H6b: Clean Technology capabilities (CTC) have positive impact on Economic competitiveness (ECOCOM)	Not supported
H7: Environmental competitiveness (ENVCOM) has positive impact on Economic competitiveness (ECOCOM)	Supported

By presenting the analysis and results of the empirical test of the research model in this chapter, this study has provided answers to the final research question (RQ4) of this study. Thus, the study has accomplished its overarching aim, which is ‘t*o determine the impact of conceptualised GSCM practices* *on the competitiveness of the firms operating across the supply chain of the Nigerian O&G industry'* by assessing the research model in this chapter.

7.6 Chapter conclusion

This chapter presented the results of the quantitative study of this research. In line with the details in chapter 3, the SEM technique was applied to analyse 214 questionnaire survey responses collected from the top management staff across the SC of the Nigerian O&G industry. Adequate data preparation and cleaning were carried out on SPSS to determine the normality of data distribution and construct validity. All parameters fell within an acceptable range. Also, an EFA was performed to analyse the freeloading of measurement items on constructs. The process of hypothesis testing commenced with CFA on AMOS software, of which the initial model was adjusted based on suggested modification indices to achieve better goodness of fit. Construct validity and reliability tested using AVE and CR produced acceptable results. Based on the above, the CFA model was converted into a structural model in the direction of the stated hypotheses. Finally, the structural model results, leading to the acceptance and rejection of the relevant hypotheses and were presented. The next chapter in this thesis provides a detailed discussion of these results.

Chapter 8: Discussion

8.1 Chapter introduction

Underpinned by two theories (NRBV and stakeholder theory), this research proposed a framework of stakeholder pressures (GSCM driver), strategic resources, strategic capabilities (GSCM practices) and competitiveness for the O&G industry. An exploratory study in chapter 5 validated the conceptualisation of GSCM practices in the Nigerian O&G industry as the NRBV capabilities of pollution prevention, product stewardship and clean technology. It also identified government regulatory institutions as the most critical stakeholder that drive GSCM implementation through coercive pressures. Furthermore, supply chain continuous innovations represent the most valuable strategic resources for the industry's proactive environmental management (GSCM). These findings refined the initial conceptual framework and adapted it to the reality of the Nigerian O&G industry. Relationships among the constructs of the refined model were developed in line with the focus of this study in chapter 6. Finally, the refined model was evaluated in chapter 7 by firstly assessing the measurement model through the reliability and validity tests. After achieving a satisfactory model, the measurement model was converted into a structural model that created room for testing the hypotheses. Having presented this study's final results and findings in the preceding chapter, the current chapter discusses these findings. Specifically, the hypothesised relationships between the stakeholder pressures driving GSCM and the required strategic resources enhancing strategic capabilities (GSCM implementation) for competitiveness have been statistically assessed and the empirical results are presented in chapter 7. Therefore, this chapter discusses the empirical results of this study within the context of the extant literature. This outline of this chapter is provided in figure 8.1.

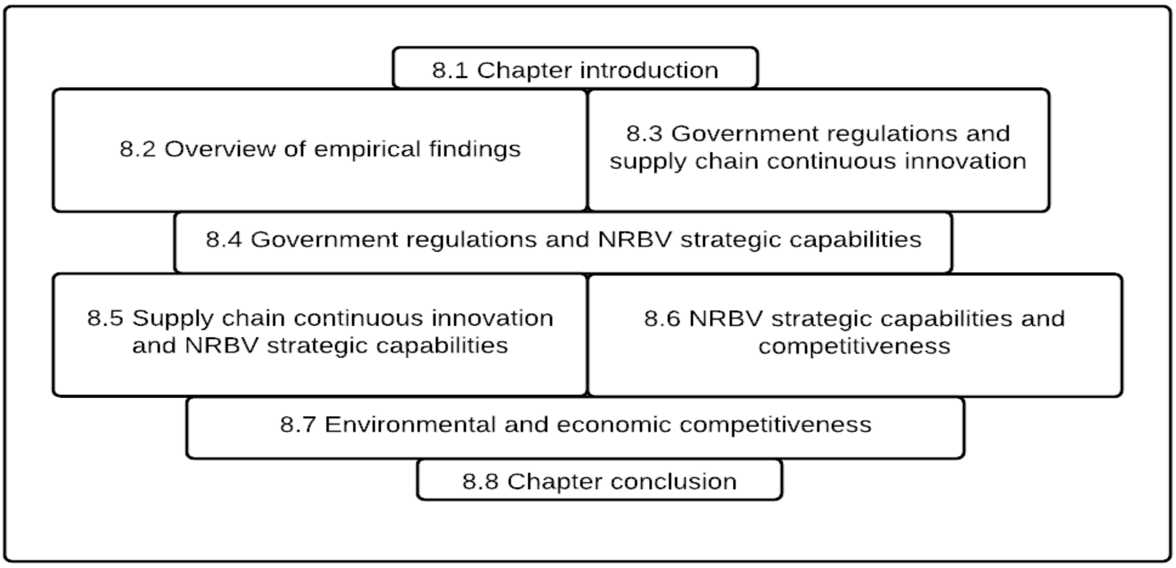

Figure 8.1: The structure of chapter 8.

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8.2 Overview of empirical findings

Reflecting on the results of the data analysis in chapter 6, it is clear that the theoretical model of this research is reasonably solid despite all hypotheses not being accepted. This is evident in the attainment of the good fit of the structural model (Chi-square ratio = 1.48, RMSEA =0.047, TLI =0.920, CFI = 0.950, IFI =0.949, NFI=0.872) and the relatively good support for most of the hypotheses. Based on the above, this research holds that the theoretical model of GSCM stakeholder pressures-strategic resources-strategic capabilities (GSCM)- competitiveness adopted in this research portrays a good representation of the relationships among the constructs investigated in this study. Therefore, this reflects the research's main clusters of stakeholder pressures for GSCM adoption, strategic resources, environmental management capabilities (GSCM), and competitive advantage. Incorporating the findings of the empirical analysis of data collected for this research, the final research model of this study is presented in figure 8.2.

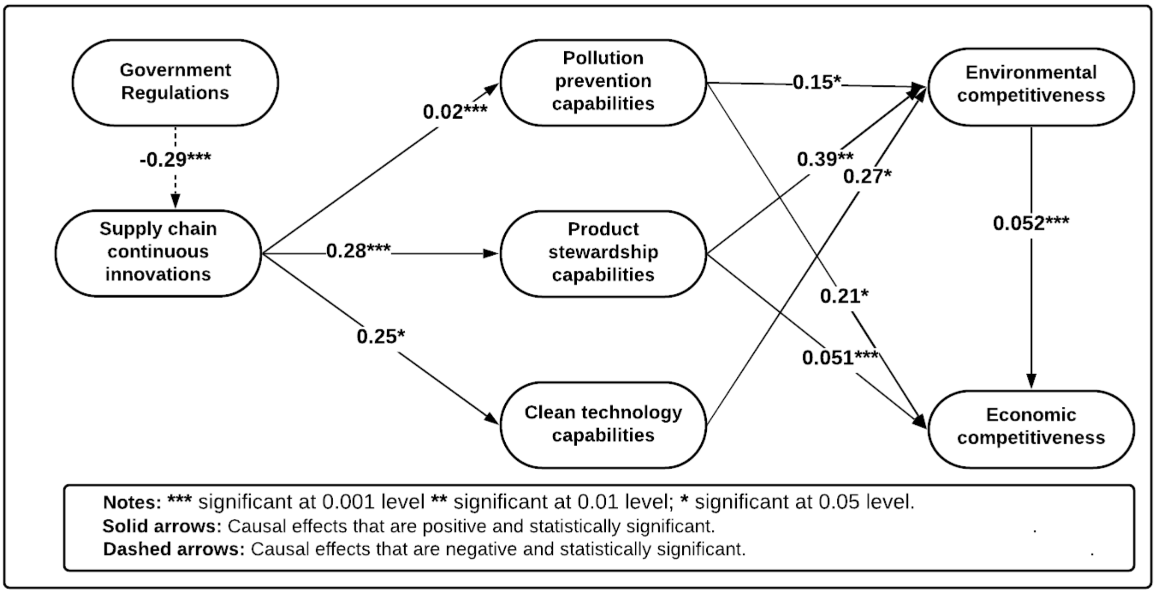

Figure 8.2: The final research model.

As indicated above, government regulations (as stakeholder pressures behind strategic resources and capabilities for GSCM) have a negative and statistically significant relationship with supply chain continuous innovations (a strategic resource). However, it does not significantly impact the three NRBV strategic capabilities: pollution prevention, product stewardship, and clean technology. Therefore, the current regulatory framework in the Nigerian O&G industry is insufficient to drive the O&G firms in the country to develop strategic environmental capabilities for GSCM implementation. It also negatively affects the ability of the O&G firms to develop suppl y chain continuous innovations as strategic resources.

On the other hand, the empirical results indicate solid and significant positive linkages between the strategic resources (supply chain continuous innovation) and strategic environmental capabilities (pollution prevention, product stewardship, and clean technology). Similarly, the strategic environmental capabilities show strong and positive statistically significant causal effects on environmental and economic competitiveness (except for clean technology with no significant impact on economic competitiveness). Similarly, this study found a strong, positive, and statistically significant causal effect of environmental competitiveness on economic competitiveness. Thus, without the presence of supply chain continuous innovations, firms across the Nigerian O&G industry supply chain are not likely to develop strategic environmental capabilities of pollution prevention, product stewardship, and clean technology. The results confirming the hypotheses indicate that the current study can make reasonable contributions (Kaplan 2004) to the existing literature by showing conclusive results of the present findings.

More detailed discussions of the hypotheses tested in this research are provided below to put the above findings in the context of the literature and highlight the contributions of the current study,

8.3 Impact of Government regulations on supply chain continuous innovations.

The H_1 of this study postulated that government regulations have a positive causal impact on the development of supply chain continuous innovations. In section 6.3, government regulation is defined as *'regulatory pressures exerted on firms by governments and their agencies to ensure compliance with environmental standards*. Also, supply chain continuous innovation is defined as *'Any continuous incremental or radical change within the SC network, SC technology or SC processes (or combination of all) that can influence environmental practices of firms'*.

Porter's hypothesis presents the lens for examining the impact of government (environmental) regulations on innovations from a general perspective. Porter (1985) hypothesizes that government environmental regulations can spur firms to develop innovations. The findings of the current research do not support the above. The results in this study indicate a negative causal effect of government regulations on supply chain continuous innovations (GovReg SCInno; β=,-0.288. sig. at 0.0001level). Since the beta value indicates the weight of the paths between the two constructs, this result represents the volume of changes in the dependent variable (Supply chain continuous innovations) caused by one standard unit of the independent variable (Government regulations). Literarily, the results of this study indicate that a higher level of the current environmental regulations is likely to stiffen the development of supply chain continuous innovations in the industry, contrary to the stipulated hypothesis; hence the hypothesis is rejected. Thus, the current study challenged the blanket applicability of Porter's hypothesis in the Nigerian O&G industry' supply chain. Therefore, this research disagrees with a body of research that has found a positive association between government regulations and innovations (Ford, Steen and Verreynne 2014; Horbach, Rammer and Rennings 2012; Ramanathan et al. 2017).

However, given that the type of regulations applied in an industry can significantly determine the impacts of regulations on innovations (Ramanathan et al. 2017), the findings of this study raise issues concerning the appropriateness of the current type of regulations applied in the Nigerian O&G industry. Specifically, the literature suggests that properly designed environmental regulations, with flexibility, can enhance firms' innovations (Porter 1991; Porter and Van der Linde 1995a, 1995b). In contrast, a 'command and control' type of regulation would '*disincentivise'* innovations because of its primary focus on compliance with minimum standards (Managi et al. 2005; Purvis and Outlaw 1995). In his review of the regulatory framework of the Nigerian O&G industry, Ekhator (2016) asserts that the command and control type of regulations is the most predominant regulatory style in the industry. Arguably, this is one reason for the lack of positive association between government regulations and supply chain continuous innovation in this research.

Another reason that could be adduced for the lack of positive effect of government regulations on supply chain continuous innovation is the perceived insignificance of the sanction attached to the existing environmental laws in the industry. For example, the Associated Gas Re-injection (continued flaring of Gas) regulation of 1984 aimed at regulating gas flaring by O&G firms originally introduced a penalty of 2 (two) kobo (an equivalent of USD 0.000052) per 1000 standard cubic feet (SCF) of gas flared by O&G firms. The penalty was later increased to 50 (fifty) kobo (an equivalent of USD 0.0013) per 1000 standard cubic feet (SCF) in 1990 and further to 10 (ten) Naira (an equivalent of USD 0.025) per 1000 standard cubic feet (SCF) in 1998. The above indicates that the penalty for flaring 1,000 SCF in Nigeria was lower than USD1. Considering the required huge investment in technological innovations to ensure compliance with the provisions of this law, O&G firms find payment of penalty as a cheaper option and hence continue to flair gas. The above scenario provides a potential practical reason for the empirical results of this study. While this highlights the weaknesses of the regulatory framework of the Nigerian O&G industry, it calls for a total rejig of the regulatory architecture of the Nigerian O&G industry to foster efficiency.

8.4 Impact of Government regulations on NRBV strategic capabilities.

The second set of hypotheses tested in this study (H2a, H2b, and H23) envisaged a positive impact of government regulations on pollution prevention, product stewardship, and clean technology. As a form of coercive stakeholder pressure, the literature suggests that government regulations can drive firms to implement proactive environmental strategies like GSCM (Sarkis et al. 2010; Simpson 2012; Wu et al. 2012). Contrary to this expectation, the results of this research reveal that government regulations have no statistically significant impact on these strategic environmental capabilities (GovReg→ PolPre; β=- -0.11, ns, GovReg→ ProStew; β=- -0.16, ns, GovReg→ CleanTec; β=-0.10, ns). These results contradict a body of literature that suggests a positive association between government regulations and proactive environmental management practices (Esfahbodi et al. 2017a; Gardas et al. 2019; Shi et al. 2019; Tsai and Chou 2004; Zhu, Sarkis and Lai 2013). Therefore, the hypotheses on the relationship between government regulations and strategic environmental capabilities (H2a, H2b, and H2c) were rejected. However, the results are consistent with Kuppi (2013), who asserts that coercive regulatory pressures seldom lead to efficiency. Thus, the findings of this research align with the merit of the idea that government regulations alone are not sufficient to propel firms to develop sustainability capabilities. The above is based on the view that organizations that adopt sustainability practices solely because of regulations only tend towards achieving compliance with minimum standards, which arguably is not sufficient to develop the needed capabilities for proactive strategies

As empirically established in chapter 5, O&G firms across the SC of the Nigerian O&G industry consider government regulations as the critical stakeholder pressures driving force of sustainability practices adoption in the industry. However, the quantitative analysis shows that such regulations have no statistically significant impact on strategic capabilities for green practices. In essence, government regulations in the Nigeria O&G industry create the need for sustainability thinking among practitioners. Nevertheless, the regulations cannot motivate companies to develop the necessary capabilities to translate into competitiveness.

Perhaps, the most salient implication of these empirical findings is the exhumation of the weakness of the regulatory and enforcement frameworks of the Nigerian O&G regulatory policy. The above has been highlighted in section 8.3. However, it is important to note further that the current regulatory regime in the Nigerian O&G industry (Ekhator 2016) is not only detrimental to innovativeness it also fails to drive O&G firms to develop the capabilities for proactive environmental strategies (Georg 1994; Nash and Ehrenfeld 1997). In the past, practitioners have flouted legal sustainability requirements in the Nigerian O&G industry without any sanction. An example is the execution of a large LNG project in Bonny island without EIA documentation, of which there were no sanctions (Emeseh 2006).

Following this antecedent, O&G firms may not necessarily comply with sustainability laws that foster their development of environmental management capabilities, especially where the cost of compliance is considered high unless there is a possibility of accruing benefits. Thus, again, the findings of this study further reiterate the need to overhaul the present regulations and policy framework in the industry.

8.5 . Impact of Supply chain continuous innovations on NRBV strategic capabilities.

The empirical findings of this study reveal that supply chain continuous innovations generally relate to the development of the strategic environmental capabilities of pollution prevention, product stewardship, and clean technology by the Nigerian O&G firms as hypothesized (in H3a, H3b and, H3c). Thus, supply chain continuous innovations positively impact all NRBV strategic capabilities. In effect, this study shows that supply Chain continuous Innovation as a construct is a primary strategic resource that enhances the ability of the O&G firms in Nigeria to develop the needed capabilities for proactive environmental management strategies. The above highlights the critical role of supply chain collaboration for continuous innovation in driving sustainability practices. In a way, these empirical findings directly confirm the proposition of the NRBV theory that tacit and socially complex strategic resources (in this case, supply chain continuous innovations) enhance firms' capabilities to implement proactive environmental strategies for competitiveness (Hart 1995). Therefore, this study agrees with a body of literature in strategic management that found a positive relationship between innovations (supply chain continuous innovations) and environmental management capabilities (Hart, 1995; Hart & Dowell, 2011; Vachon & Klassen, 2008; Golicic & Smith, 2013). The statistical results indicate that supply chain continuous innovations are most largely and significantly associated with Product stewardship (β=0.28 sig. at the 0.001 level), slightly followed by Clean technology (β=0.25, sig. at the 0.001 level) and lastly by pollution prevention (β=0.02, sig. at the 0.05 level). Based on the NRBV literature, the above observation is not surprising because of the following reasons.

In the first instance, supply chain collaboration for innovation is not an original strategic resource for implementing pollution prevention strategy in NRBV (Hart 1995). Instead, the theory postulates that continuous improvement (innovations), focusing on internal structures, is the essential strategic resource that drives pollution prevention capabilities (Hart 1995). Thus firms focus more on their internal resources than on stakeholder engagement to enhance their pollution prevention capabilities (Hart and Dowell 2011). The above explains why pollution prevention reports the smallest regression coefficient concerning supply continuous chain innovations. More specifically, the results suggest that implementing pollution prevention strategies by the Nigerian O&G firm is less dependent on innovations from the supply chain than other NRBV capabilities examined in this study. This may be because firms generally consider pollution prevention as internal operations (Hart 1995), as indicated in Guang Shi et al. (2012), who depict pollution prevention as an intra-organizational capability activated by firms' internal structures. Following this notion, empirical studies on the relationship between strategic resources and pollution prevention capabilities, to date, have focused on intra-organizational resources.

Graham and McAdam (2016) applied regression analysis to examine the significant driver of pollution prevention strategy implementation in the UK food processing industry. The authors found that internal stakeholders' support is the most critical strategic resource that drives pollution prevention strategies in the industry. Similarly, Graham (2018) found that firms need to develop the internal resources of internal integration and environmental learning to improve their pollution prevention capabilities. Bhupendra and Sangle (2015) also found that internal strategic resources, in terms of management innovativeness, are the most critical driver of firms' capacity to implement pollution prevention strategies. All the above lay credence to the role of internal resources in implementing pollution prevention strategies in organizations. Even though the current study does not compare intra-organizational with inter-organizational resources concerning pollution prevention, the small size of the regression coefficient of supply chain continuous innovations in relation to pollution prevention suggests that firms in the Nigerian O&G industry exhibit less dependence on intra-organizational resources such as supply chain continuous innovations for pollution prevention capabilities. Nevertheless, it is argued that firms are unlikely to effectively develop pollution prevention capabilities with their internal resources alone without active collaboration with their external stakeholders, especially in a highly polluting industry like O&G. This argument is in alignment with Sharma and Vredenburg (1998), who found that firms that invest in stakeholder integration perform better than their competitors in waste reduction and energy conservation. The above explains why the current study still finds a positive covariance between supply chain continuous innovations and pollution prevention capabilities in the Nigerian O&G industry, despite being perceived as an intra-organizational practice (Shi et al. 201).

Concerning product stewardship, supply chain collaboration for innovation has always been depicted as the needed strategic resources for this capability within the NRBV framework (Hart 1990; Hart and Dowell 2011). Therefore, it does not come as a surprise that product stewardship capability sustains the most significant impact of supply chain continuous innovations (β=0.28 sig. at the 0.001 level). Furthermore, the above indicates that firms require more innovation through supply chain collaboration to manage the product's lifecycle impacts than they need for other NRBV capabilities examined in this study. This position is of considerable importance in the O&G industry because of the risk of severe environmental damages related to its products and operations (Yusuf et al. 2013). Therefore, operators in the industry continually adopt a supply chain approach to generate innovations to reduce the environmental impacts of products. This finding is consistent with previous studies that have found that collaborative innovation is positively associated with product stewardship in the industry. An example is Ahmad, de Brito and Tavasszy (2016), who analysed GSCM practices in thirty (30) global O&G firms and found that 60% of the companies collaborate with their supply chain members to develop innovations to address the negative impacts of production activities on the environment. Similarly, Ahmad et al. (2016a) found that open communication and maintaining close partnerships with suppliers enhance innovation for product stewardship capabilities of firms operating across the upstream and downstream sectors of the O&G industry.

Finally, clean technology capability sustained the second most significant impact of supply chain continuous innovation (β=0.25, sig. at the 0.001 level), slightly lower than product stewardship. The result is not unexpected as clean technology is driven by disruptive innovations (Hart and Dowell 2011). Arguably, it would not be out of place to expect supply chain continuous innovations to have the most significant impact on clean technology. This argument is consistent with the notion that clean technology capability is predominantly related to the technological innovations emanating from stakeholder's partnerships (Bell et al. 2012; Jensen et al. 2013). Considering that clean technology is an emerging issue, it is also understandable that it ranks behind product stewardship capabilities in this research. In response to the global drive to address climate change, IOCs collaborate with stakeholders to deploy technology that minimizes the environmental impacts of operations (Zhong and Bazilian 2018). Apart from investing heavily in renewables, as a form of product diversification, carbon and storage technologies are deployed to reduce carbon emissions in the upstream sector. This is in addition to innovative collaboration to reduce gas flaring and reduce their holdings of 'dirty' energy such as coal. Considering the rising trend of green consumerism and increasing divestment from fossil fuel companies, supply chain collaboration for innovations for the deployment of clean technology is fast becoming a matter of survival for O&G operators. Example of such rising divestment is seen in the case of Rockefeller Trust which divested its stocks in hydrocarbon company's assets in 2014 (Suzanne 2014). Also, in 2017, the World Bank announced its suspension of O&G funding after 2019 (Bank 2017).

This global trend has also impacted the Nigerian O&G industry, as revealed by the findings of this study. As empirically validated in chapter 4, firms operating across the supply chain of the Nigerian O&G industry specifically focus on hydropower energy and investment in renewables while emphasizing LNG as a form of cleaner energy. The views expressed by the participants concerning the above indicate that strategic collaboration with relevant stakeholders for innovations is an invaluable resource for the development of clean technology capabilities. The findings of this study are consistent with previous studies, which suggest that collaborative innovation is positively associated with clean technology (Bhupendra and Sangle 2015; McDougall, Wagner and MacBryde 2019).

8.6 Impacts of NRBV strategic capabilities on Competitiveness

The empirical results of the impacts of the three NRBV strategic capabilities investigated in this research show that all the capabilities have positive and statistically significant effects on environmental competitiveness and economic competitiveness (except for clean technology). This indicates that O&G firms that focus on developing their capabilities for pollution prevention, product stewardship, and clean technology can enhance their level of competitiveness in line with the postulations of the NRBV theory (Hart 1995; Hart and Dowell 2011). More specifically, it appears that the three NRBV capabilities relate more to environmental competitiveness than economic competitiveness. It, therefore, suggests that the Nigerian O&G firms that channelled efforts into developing these capabilities enjoy a higher level of eco-reputation than their competitors because of their more remarkable ability to reduce energy usage, environmental pollution, and consumption of hazardous materials (Green et al., 2012a; Zhu et al., 2008a).

Based on the foregoing, it is argued that investment by Nigerian O&G firms in pollution prevention, product stewardship, and clean technology strategies is worthwhile. Such investments could reasonably reduce waste at source, material consumption, energy usage, and other items that create negative environmental and societal impacts. Effectively, the above results demonstrate that the strategic capabilities for GSCM can help O&G firms achieve the intended aim concerning firms' environmental competitiveness. However, the observations surrounding the impact of these strategic capabilities on economic competitiveness are not as clear-cut as found regarding environmental competitiveness. The empirical findings relating to each theoretical linkage between strategic environmental capabilities and competitiveness are discussed below.

8.6.1 Pollution prevention capabilities and competitiveness

The empirical results of this research reveal that pollution prevention capabilities have statistically significant and positive impacts on environmental and economic competitiveness, with standardized coefficients of $\beta=0.15$ (sig. at the 0.01 level) and $\beta=0.21$ (sig. at the 0.05 level) respectively. The above results indicate that the development of pollution prevention capabilities has a more significant influence on economic competitiveness than the environmental competitiveness of the Nigerian O&G firms. The above can be explained by the theoretical notion that the implementation of pollution prevention strategies is majorly targeted at reducing operational costs (Hart 1995). For instance, when firms develop strategic capabilities resulting in the removal of pollutants in their production process, they will most likely enhance their operational efficiency in the area of reduced input consumption, process simplification, and reduced compliance and liability costs (Hart and Dowell 2011). The combined effects of the above will likely reduce the overall operational costs more than competitors that pay less attention to pollution prevention strategies, thereby creating enhanced economic, competitive advantage. These findings are consistent with prior studies that empirically verified the impacts of pollution prevention on firms' economic performance (Chan 2005; Christmann 2000; Mishra and Yadav 2021). This study also contradicts other empirical studies that found negative impacts of pollution prevention strategies on financial competitiveness (Sarkis and Cordeiro 2001; Singh, Ma and Yang 2016).

Regarding the relationship between pollution prevention capabilities and environmental competitiveness, the results of this study reinforce an emerging argument that the contribution of pollution prevention strategy is not limited to economic performance, as presented in NRBV (Hart 1995), but includes environmental performance. This position aligns with few studies that have found that pollution prevention strategies positively impact firms' environmental performance. For example, Anthony Jr (2019) combined pollution prevention with other NRBV capabilities in an eccentric model and found a positive impact of all the NRBV capabilities (including pollution prevention) on firms' environmental performance. Similarly, Hastings (1999) asserts that O&G firms with evidence of pollution prevention capabilities enjoy an advantage of eco-reputation, leading to better access to oil fields in sensitive areas. This result is of great importance in the O&G industry in the face of growing divestment from the hydrocarbon industry. The future relevance of firms operating in the industry is likely to be determined by their ability to reduce their environmental footprints (Garcia, Lessard and Singh 2014). Considering that pollution prevention strategy is classified as an intra-organisational environmental practice in the context of GSCM (Shi et al. 2012), the empirical findings of this research is also consistent with previous studies that found positive links between internal environmental practices and environmental performance (Zhu and Sarkis 2004; Montabon et al. 2007; Pullman et al. 2009; Yang et al. 2010; Graham and Potter 2015).

8.6.2 Product stewardship capabilities and Competitiveness

The empirical findings on the impact of product stewardship capabilities on environmental competitiveness (β=0.39, sig. at the 0.01 level) and economic competitiveness (β=0.05, sig. at the 0.001 level) are positive and statistically significant. This implies that O&G firms that commit investment in developing product stewardship capabilities tend to enjoy above-the-market environmental and economic performances. Previous studies have equally validated the positive impact of product stewardship capabilities on firms' competitiveness in the NRBV literature (Wong 2012; Maas et al. 2014; Singh, Ma and Yang 2016; Al-Mutairi et al. 2019; Anthony Jr 2019). For example, in his study conducted in the Taiwanese electronic manufacturing industry, Wong (2012) found that firms committed to developing product stewardship capability experience improved financial performance. Similarly, Maas et al. (2014) established that product (service) stewardship capabilities enhance the differentiation advantage of German logistic service providers. According to Anthony Jr (2019), product stewardship and other NRBV capabilities positively influence the environmental and economic performance of the IT industry. Singh, Ma and Yang (2016) also validated the above findings by empirically confirming the positive impact of investment in product stewardship capabilities on firms' economic performance.

Also, a plethora of studies that examined the relationship between various elements of NRBV product stewardship capabilities within the GSCM literature have equally suggested that product stewardship capabilities can enhance a firm's competitiveness (Zhu and Sarkis 2007; Large and Thompsen 2011; De Giovannia and Vinzi 2012; Green et al. 2012; Diabat, Khodarverdi and Olfat 2013;). In all, the current study's findings validate the tenet of NRBV that the strategic capabilities of product stewardship positively impact the firm's competitiveness. However, the results conflict with Gabriel et al. (2018), who found that product stewardship capabilities may negatively impact environmental performance in the USA medical industry.

Comparing the results above with the previous results on pollution prevention, it is observed that the impact of product stewardship capabilities is higher on environmental competitiveness than economic competitiveness, contrary to the relationship between pollution prevention and competitiveness. This position is consistent with Al-Mutairi et al. (2019), who found that product stewardship has a more significant impact on environmental performance than pollution prevention and clean technology. One potential explanation for these results is that the original conceptualization of product stewardship capabilities within the NRBV framework is not directly linked to economic competitive advantage but differentiation advantage (Hart 1995). Environmental competitiveness is conceptualized as an element of differentiation advantage in the current study. Another reason for this may also be based on the fact that the pricing of O&G products in Nigeria is regulated by the government through the Petroleum products pricing regulatory agency (PPPRA), making it difficult for operators to pass costs associated with product stewardship to the final consumers. However, considering that the Nigerian government pays a huge subsidy for the landing costs of petroleum products (Nwachukwu and Chike 2011), costs incurred by firms (including those associated with product stewardship) may be subsidized as part of the landing costs of the petroleum products. This may justify the comparatively lower positive relationship between product stewardship capabilities and economic competitiveness in this study.

8.6.3 Clean technology capabilities and competitiveness

Clean technology is the third strategic capability examined in this study. Following the tenets of NRBV (Hart and Dowell 2011), clean technology was defined as a firm's ability to adapt to disruptive change in an industry by adopting or commercializing green technologies that can cause changes or diversification in their processes and products. Based on the literature, it was hypothesised that clean technology capabilities would positively impact firms' environmental and economic competitiveness. However, the empirical results of this research indicate a mixed impact of clean technology on competitiveness. While clean technology capabilities significantly and positively impact environmental competitiveness (CleanTec$\rightarrow$ EnvCom; β=0.27, sig. at the 0.001 level), it has no statistically significant impact on economic performance (CleanTec$\rightarrow$ EcoCom; β=0.21, NS). These findings imply that firms' adoption of clean technology strategies in the Nigerian O&G industry can enhance their environmental competitiveness, not necessarily their economic competitiveness. These findings are consistent with De Stefano, Montes-Sancho and Busch (2016), who found that clean technology innovation has a more significant impact on CO_2 emission (environmental performance) than product stewardship. It also agrees with Masoumik, Abdul-Rashid and Olugu (2015), who found that clean technology capabilities positively relate to green competitiveness in the Malaysian manufacturing sector. Furthermore, the results partially agree with Holban, Boteanu and Petrescu (2013), who found that investment in clean technology generates economic benefits while improving environmental compliance in the Romanian agricultural sector. Based on these results, the H6a of this study hypothesising a positive impact of clean technologies capabilities on environmental capabilities was accepted, while the H6b envisaging a positive impact of clean technology capabilities on environmental competitiveness was rejected.

The result showing a positive impact of clean technology capabilities on environmental competitiveness is not surprising as the NRBV clean technology capabilities are developed to take advantage of evolving and disruptive changes in industries to provide for human needs without straining the earth's resources (Meurig Thomas and Raja 2005). Therefore, clean technology adoption and commercialization should enhance firms' environmental competitiveness. This explains why global O&G firms publicise their investment in cleaner technology and renewable energy to gain eco-reputation as environmentally conscious companies. For example, Royal Dutch Shell has continuously expressed its increased annual investment budget in renewables from US$ 200 million in 2016 to US$ 1.2 billion in 2017 to acquire legitimacy as an eco-friendly organization (Pickl 2019). In this regard, Mr Van Beurden, the chief executive officer of Royal Dutch Shell, stated that Shell is no longer a petroleum company but an energy transition company (Sheppard 2018). Arguably, the development of such capabilities for investment in clean technology will enhance the reputation of O&G firms and lead to environmental competitiveness.

Regarding economic competitiveness, it may also be argued that investment in clean technology may not necessarily yield financial returns, at least in the short run. This is because the risk involved in investing in clean technology is considered higher than those involved in other environmental management capabilities because of its link with radical innovations that leapfrog standard routines and knowledge (Fussler 1996; Vergragt and Van Grootveld 1994; Von Weizsacker et al. 1997).

Besides, the success of radical innovations generally cannot be guaranteed as it usually takes a longer time to receive reasonable returns on such a risky and relatively higher investment (Bhupendra and Sangle 2015; De Stefano, Montes-Sancho and Busch 2016). An example of this is seen in practice, where BP closed down its clean energy (beyond petroleum) headquarters for five years in 2009 due to low returns on investment (Macalister 2015; Zhong and Bazilian 2018) but reconsidered the establishment of a wind firm in 2016, owing to pressures for decarbonisation (Crooks 2016; Zhong and Bazilian 2018). Validating the findings of this study, Gaddy et al. (2017) found that firms' investment in clean technology to date has generated a maximum of one-sixth returns on investment. Considering that firms exist primarily to maximize shareholders' value, such economic returns might not be deemed insufficient for the O&G industry (Zhong and Bazillian 2018). To this end, Chatteron (2017) asserts that O&G firms' investment in clean technology may not confer immediate economic benefits on firms. The above also explains why commercialization and adoption of clean energy are very slow among operators in the Nigerian O&G industry.

The findings of this research in this regard hold two significant thrusts for the O&G industry and NRBV literature. First, since clean technology (energy) appears economically unattractive to O&G firms, governments need to provide subsidies to firms willing to commercialize clean technology in the O&G industry, given the positive environmental implications of clean technology capabilities. Second, considering the supposed positive impact of clean technology on economic, competitive performance in Petrecsu (2013), which contradicts the results of this study, there is a need for further research on the impact of clean technology on firms' competitiveness. The above is in line with previous studies that indicate that clean technology capabilities have received less attention in the NRBV literature despite their competitive benefits (Masoumik, Abdul-Rashid and Olugu 2015; McDougall, Wagner and MacBryde 2019).

8.7 Environmental and economic competitiveness

Lastly, the research findings reveal that environmental competitiveness significantly and positively impacts economic competitiveness (EnvCom→EcoCom; β=-0.052, sig. at the 0.001 level). The positive relationship between the competitive constructs appears logical as the economic competitiveness construct arguably reflects cost savings emanating from improved environmental competitiveness (Zhu and Sarkis 2006). Such cost savings can be realised from reduced energy consumption, inventory management, reduced waste management costs and avoided penalties due to unsustainable practices (Green, Toms and Clark 2015; Sarkis 2012). The above implies that the strategic capabilities for GSCM implementation do not only directly impact economic competitiveness; they also exert indirect effects through environmental competitiveness. For instance, clean technology capabilities that exhibited a statistically insignificant direct impact on economic competitiveness can indirectly positively impact environmental competitiveness. This argument agrees with Chatteron (2017), who portends that clean technology capabilities may yield long-term economic benefits for O&G firms. As such, investment in the strategic capabilities for GSCM implementation can be viewed as a ‘win-win’ opportunity for both environmental and economic competitive performance in the Nigerian O&G industry

On the statistical ground, the positive association between environmental and economic competitiveness is sustained by realising the positive impact of strategic environmental capabilities for GSCM on environmental competitiveness in the industry. This finding is consistent with previous studies that empirically validated a positive effect of environmental competitive performance on economic performance. For instance, Wagner and Schaltegger (2004) examined the impact of economic and environmental competitive performances on corporate environmental strategy. They found that environmental competitiveness has a moderate positive impact on economic competitiveness. Similarly, Esfahbodi et al. (2017) investigated the impact of GSCM practices on the competitiveness of UK manufacturing firms. The authors found that environmental competitive performance is positively associated with economic, competitive performance in the UK manufacturing sector. Also, this result validates the view of Klassen and McLaughlin (1996) that firms with a higher level of eco-reputation can generate a competitive advantage in terms of cost reduction. It also reinforces the sustenance of environmental performance as a driver of economic performance in Guang Shi et al.’s. (2012) NRBV-GSCM model.

8.8 Chapter conclusion

The objective of this chapter was to discuss the empirical results of the data analysis concerning the stated hypotheses of this study. The chapter began by discussing the general overview of the findings, leading to the final research model of this study. Each hypothesis was later addressed in the context of the extant literature while providing possible reasons for the research outcome. Contrary to expectation, government regulations negatively impact supply chain continuous innovations, leading to the rejection of H1 of this study. Similarly, government regulations have no statistically significant impact on the three strategic capabilities examined in this study, leading to the rejection of H2a, H2b, and H2c. Thus, this study did not find government regulations as sufficient stakeholder pressure that firms’ acquisition of strategic resources and the implementation of proactive environmental strategies. A possible reason for these outcomes could be the style and the weakness of the Nigerian regulatory framework. In contrast, supply chain continuous innovations positively impact all the strategic capabilities, thereby validating this study's relevant hypotheses (H3a, H3b, and H3c). Also, all the NRBV capabilities positively impact the two competitiveness constructs (except for clean technology with no statistically significant impact on economic competitiveness). Overall, the findings of this study validate the existence of strategic environmental capabilities and their positive impacts on the competitiveness of the firms operating in the Nigerian O&G industry. Furthermore, the empirical results find consensus with many previous studies while locating the area of discrepancy with a few others. The next chapter concludes this thesis by presenting the academic and managerial implications of this study while highlighting the limitation of the research and identifying opportunities for future studies.

Chapter 9: Conclusion, Recommendations and Limitations

9.1 Chapter introduction

This chapter concludes this research investigation by revisiting the research objectives and research questions while highlighting the study's main contributions, including its academic and managerial implications. Furthermore, this chapter discusses the limitations of this research and makes recommendations for future research. The structure of this chapter is shown in figure 9.1.

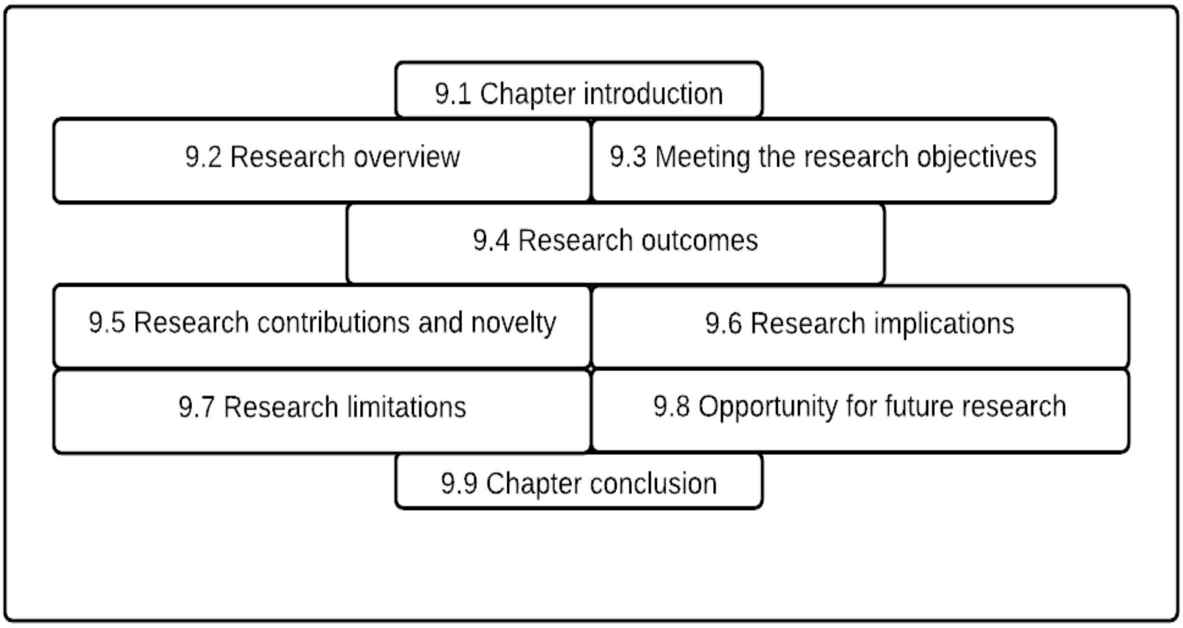

Figure 9.1: The structure of chapter 9.

As indicated above, an overview of the research recounting the research process from the first chapter to the current chapter is presented in section 9.2. This is followed by section 9.3, which restates the research aims and objectives and how they have been achieved. Section 9.4 presents the research outcome. After that, the study's primary original theoretical, methodological, and empirical contributions are outlined in section 9.5. Section 9.6 offers the academic and managerial implications of the study, while the limitations of the research and the direction of future research are presented in sections 9.7 and 9.8, respectively. The chapter is completed with section 9.9, which outlines the chapter summary as the conclusion.

9.2 Research overview

This research was motivated by the need to address a theory-practice gap in applying NRBV in the GSCM literature while providing an evidence-based solution to real environmental sustainability problems in the O&G industry. Owing to its history of environmental degradation and unsustainable practices, the O&G industry's supply chain presents a viable platform for examining the NRBV logic concerning the impact of strategic capabilities for GSCM implementation on firms' competitiveness. Therefore, this study combined stakeholder pressures theory with NRBV to explore how government regulations (as a coercive stakeholder pressures force) influence O&G firms to acquire strategic resources (supply chain continuous innovations) and strategic capabilities (pollution prevention, product stewardship, and clean technology). It further evaluated the impacts of these capabilities on the competitiveness of the Nigerian O&G firms. This study is structured into nine chapters, as discussed below.

Chapter 1 of this study began with the chapter introduction and background to the research. Here, the paucity of empirical validation of NRBV theory in GSCM literature was highlighted. It was argued that since the O&G industry is generally implicated in unsustainable practices, the industry provides a platform to validate NRBV in the context of GSCM. Specifically, the Nigerian O&G industry, owing to its history of environmental pollution, has been found culpable of sustainability deficiency across its supply chain. A strategic issue in this regard is an understanding of the critical role of stakeholder pressures (in this case, government environmental regulations) in driving the Nigerian O&G firms to acquire the required strategic resources and capabilities that can enhance their competitiveness.

Generally, GSCM in the O&G industry is under-researched (Ahmad et al. 2017), especially in the Nigerian O&G industry. The few available research generally lacks a holistic perspective of the O&G supply chain (Asaolu et al. 2012; Ukpabi et al. 2015; Ekiugbo and Papanagnou 2017). Also, the research in the industry lacks the theoretical perspectives evaluating the roles of stakeholder pressures driving GSCM implementation, the required strategic resources and the strategic capabilities for GSCM adoption, using established management theories, such as NRBV and stakeholder theory. Given the call for theory-based research in GSCM (Carter and Easton 2011; Sarkis, Zhu and Lai 2011), this lacuna is considered an academic gap worthy of exploration by this study.

Furthermore, considering that research models and conceptual frameworks allow research variables to be interlinked for scientific examination, the need to develop the relevant research framework to address the research objectives were highlighted. Although previous studies in GSCM have proposed various conceptual frameworks of GSCM across industries (Carters and Rodgers 2008), industry-specific GSCM models and frameworks in the O&G industry are scarce. For example, Ahmad et al.'s (2017) integrative model of GSCM in the O&G industry lacks empirical validation and is not developed on established theories. Besides, the framework is incompatible with the objectives of this study. Similarly, Guang Shi et al.'s (2012) NRBV-GSCM lacks empirical confirmation and does not fit perfectly with the current study's objectives. Therefore, this study proposed the development, refinement and assessment of an overarching framework that evaluates how stakeholder pressures drive GSCM implementation through strategic resources and capabilities that result in competitive advantage. On this note, the overarching aim of this study is stated in chapter 1 as follows:

> ***''To explore the specific critical stakeholder pressures and the strategic resources that drive GSCM implementation while assessing the impact of GSCM practices (pollution prevention, product stewardship, clean technology and base of the pyramid) on the competitiveness of the firms in the Nigerian O&G industry".***

Therefore, to address the aim and objectives of this study, chapter 2 of this thesis focused on the literature review. Hart's (1995) NRBV and Freeman's (1984) stakeholder pressures theory are compatible with the research's overarching aim. Therefore, this research made a considerable attempt to understand the current state of knowledge in GSCM from the perspective of these theories. The conceptual literature revealed that stakeholder theory provides a basis for understanding the drivers of green practices. On the other hand, NRBV creates the link between strategic resources, strategic environmental capabilities and competitiveness. The strategic capabilities contemplated in the NRBV align with GSCM. Furthermore, the literature on the state of GSCM research contextualized to the O&G industry was reviewed to identify the relevant gaps in the literature. This chapter revealed four critical areas of research interest, which are:

- The lack of empirical research on the alignment between GSCM and NRBV leads to the poor practical application of NRBV in GSCM research.
- Lack of an understanding of the specific strategic resources that drive the strategic capabilities for GSCM implementation in the Nigerian O&G industry.
- Mixed results on the critical drivers of GSCM in the O&G industry and a lack of research focusing on the stakeholder pressures that influence GSCM in the Nigerian O&G industry.
- Lack of empirically validated framework that combines stakeholder theory with NRBV to validate the impact of GSCM adoption on the competitiveness of O&G firms.

Using the constructs identified in the literature, chapter 3 proposed an initial conceptual framework of stakeholder pressures (GSCM driver)-strategic resources-strategic capabilities (GSCM)-Competitiveness to address the research gaps. Although the initial conceptual framework in chapter 3 was adjudged to be compatible with the focus of this study, it was too generic as the identified variables lacked empirical validation in the O&G industry. Consequently, the research adopted an exploratory approach to refine the proposed framework.

Chapter 4 describes the methodology and the methods for refining the proposed conceptual framework using an exploratory, inductive approach. It also presents the processes and procedures for assessing the refined conceptual framework from a deductive perspective. Thus chapter 4 describes a mixed-method research approach adopted in providing answers to the research questions of this study. In this chapter, emphasis was placed on discussing methodological options and justification for the choices made.

Specifically, data for the inductive research were gathered through semi-structured interviews conducted with twenty-nine (29) managers across the supply chain of the Nigerian O&G industry. The data were qualitatively analysed using the thematic analysis technique (Miles and Huberman 2014). The exploratory study results were used to answer the RQ1, RQ2 and RQ3 of this study (as stated in section 1.5). The results were also applied to refine the initial conceptual framework in chapter 3. Furthermore, chapter 4 highlights how questionnaire survey responses were gathered from 214 managers across the supply chain of the Nigerian O&G industry (after conducting a pilot study) to assess the refined conceptual model. The rationale for selecting CV-SEM for data analysis was also advanced in addition to addressing the fundamental issues of validity, reliability, generalisability, and ethical consideration in this research.

Chapter 5 presents the empirical results of the exploratory study. Using an a priori codebook developed on the framework adapted from the literature (Guang Shi et al. 2012; McDougall, Wagner and MacBryde 2021; Yunus and Michalisin 2016). The thematic analysis validated various GSCM practices interlinked with the strategic capabilities of pollution prevention, product stewardship and clean technology. However, there is no empirical evidence of GSCM practices linked with the base of the pyramid capability. Furthermore, data analysis revealed that operators in the Nigerian O&G industry consider specific tangible and intangible resources necessary to implement GSCM practices. Among these resources, continuous innovations and strategic supply chain collaboration were recognized as the most critical strategic resources enhancing the strategic capabilities for GSCM implementation. Therefore, following the logic in NRBV (Hart 1995), this study evolved the concept of supply chain continuous innovation (combining continuous innovation with strategic supply chain collaboration) to depict the most critical strategic resource for NRBV capabilities in the Nigerian O&G supply chain. Also, empirical findings indicate that through regulatory pressure, government institutions are the most compelling stakeholder driving GSCM in the Nigerian O&G industry. Following these results, the RO1, RO2, and RO3 of this research were achieved in chapter 4.

In chapter 6, the conceptual framework proposed in chapter 3 was refined, using the empirical findings in chapter 5. Specifically, the generic *'stakeholder pressures driving forces'* and *'strategic resources'* in the initial research framework were replaced with the empirically verified *'Government regulations'* and *'supply chain continuous innovations'.* Also, the NRBV's *base of the pyramid* capability was erased from the research model due to the lack of empirical verification in chapter 5. Furthermore, literature-based hypotheses were developed to establish linkages among the constructs of the refined conceptual framework. Finally, since the constructs are latent variables (Hair et al. 2014), measurement items were adapted from the extant literature to operationalise the refined conceptual framework.

Applying the structural equation modelling (SEM) to analyse quantitative data obtained from 241 managers across the supply chain of the Nigerian O&G industry, the refined conceptual model was empirically assessed in chapter 7. Thus, a confirmatory approach based on the SEM technique was used to test the proposed hypotheses. The results empirically validated most of the relationships among the constructs. More specifically, the study reveals that government regulation has a negative statistically significant impact on supply chain continuous innovations and no statistically significant impact on the strategic capabilities of GSCM, contrary to the stipulated hypotheses. Hence, the relevant hypotheses (H1, H2a, H2b, and H2c) were rejected. In contrast, supply chain continuous innovation was found to exert positive, statistically significant impacts on all the strategic capabilities as hypothesised, leading to the acceptance of the relevant hypotheses (H3a, H3b, and H3c). Also, the NRBV capabilities mostly have positive, statistically significant impacts on environmental and economic competitiveness, except for clean technology capabilities with no statistically significant effect on economic competitiveness.

Chapter 8 highlighted the lessons from the findings of this research by relating the results to the literature in terms of discussion. Areas of conflict and agreement with the extant literature were identified. Finally, the current chapter presents the study's conclusion, starting with the general overview, the implications and the limitations and direction for future research.

9.3 Meeting the research aim and objectives

The study's overarching aim, re-echoed in section 9.2, was broken down into five research objectives (ROs) in chapter 1. Table 9.1 presents these objectives and how they were attained in this thesis.

Table 9:1: Attainment of research objectives in the thesis's chapters.

Objectives	Chapter
R01 To explore and identify the specific GSCM practices that constitute the NRBV strategic capabilities of pollution prevention, product stewardship, clean technology and base of the pyramid in the Nigerian O&G industry.	Chapters 2, 4 and 5
R02: To explore and identify the critical strategic resources that enhance GSCM implementation in the Nigerian O&G industry.	Chapters 2, 4 and 5
R03: To explore and identify the critical stakeholder pressures that drive GSCM implementation in the Nigerian O&G industry.	Chapters 2, 4 and 5
R04: To develop and refine a conceptual framework linking stakeholder pressures with strategic resources, strategic capabilities for GSCM and competitiveness in the Nigerian O&G industry's supply chain	Chapters 2, 3, 5 and 6
R05: To determine the impact of conceptualised GSCM practices on the competitiveness of the firms operating across the supply chain of the Nigerian O&G industry by assessing the research model	Chapters 7 and 8

This study adopted a mixed-method approach to attain its objectives. The literature review in chapter 2 presented an excellent basis for providing answers to RQ1, RQ 2, RQ 3, and RQ 4 of this study. Specifically, the review of previous studies in chapter 2 identified the critical areas of alignment between GSCM and NRBV. This is related to the RO1 of this study, which is *'To explore and identify the specific GSCM practices that constitute the NRBV strategic capabilities of pollution prevention, product stewardship, clean technology and base of the pyramid in the Nigerian O&G industry.'* The extant literature in this perspective reveals that theorists assert that verifiable compatibility exists between NRBV and GSCM (Guang Shi et al. 2012; McDougall, Wagner and MacBryde 2021; Yunus and Michalisin 2016). However, empirical confirmation of the above is significantly unavailable. More importantly, evidence of the relationship between NRBV and GSCM in the O&G industry cannot be validated. The above necessitates an empirical study to examine the theoretical proposition. Thus, the second chapter of this study laid the foundation for attaining the RO1 of the study. The methodology in chapter four described the data collection and analysis process applied to verify the theoretical proposition in chapter 2. The RO1 was fully attained in Chapter 5 with empirical results that identified various GSCM practices that align the pollution prevention, product stewardship and clean technology strategic capabilities.

The procedure for attaining the RO2 and RO3 of this research is similar to the obtainable in RO1. Concerning RO2, section 2.6.2 reviewed the role of strategic resources in developing strategic capabilities. It was found that strategic resources vary across industries. Furthermore, section 2.5.4 reviewed the extant literature on the impact of stakeholder pressures in GSCM implementation, in line with the RO4 of this study. This section reveals that various stakeholders can drive firms' green practices. It was further realized that the stakeholder requirements could translate to cogent pressures. However, the impacts of these stakeholder pressures on firms' environmental practices could vary across industries, firms, and regions. Lack of previous works on the strategic resources for capability development in the O&G industry and lack of consensus on the most significant driver of GSCM adoption in the industry necessitated the empirical exploration of the specific strategic resources and the critical stakeholder pressures driving GSCM chapter 5. Using the methodology in chapter 4, RO2 and RO3 were also attained in chapter 5. Thus, achieving RO1, RO2, and RO3 commenced in Chapter 2 and was finally attained in chapter 5, using the methodology described in chapter 4.

The RO4 of this study is *'To develop and refine a conceptual framework linking stakeholder pressures with strategic resources, strategic capabilities for GSCM and competitiveness in the Nigerian O&G industry's supply chain'.* Using the conceptual review in chapter 2, the possible relationship among various theoretical concepts that articulate this study's objectives were highlighted. The above led to the development of a generic proposed research model in chapter 3. The paucity of contextual research in the O&G industry informed the need to refine the initial research model. Hence, the empirical findings of RO1, RO2, and RO3 in chapter 5 provided the needed information to refine the proposed model. Therefore, in chapter 6, some constructs in the proposed models were replaced with the results of the empirical findings in chapter 5, while the construct that lacked empirical evidence was deleted from the proposed research framework. In essence, the RO4 of this study was ultimately achieved in chapter 6.

Finally, the RO5, *'t**o determine the impact of conceptualised GSCM practices on the competitiveness of the firms operating across the supply chain of the Nigerian O&G industry by assessing the research model**,'* was achieved in chapter 7 and discussed in chapter 8. The process adopted in this regard is the quantitative research method. Specifically, a CV-SEM was employed to assess the refined conceptual framework depicted in chapter 5 with 214 questionnaire responses from managers across the SC (upstream and downstream) of the Nigerian O&G industry. The SEM results informed the acceptance or rejection of the relevant hypotheses. The confirmed model of the stakeholder pressures-strategic resources-strategic capabilities (GSCM practices)-competitiveness for the Nigerian O&G industry was depicted and discussed in chapter 8. Following the above, this research has effectively achieved its aim and objectives.

9.4 Research outcomes

The research findings align with the research objectives that were actively restated as research questions. As a sequential exploratory mixed-method research, the research outcomes provide answers to all the research questions (RQ) of this study. These RQs are logically interlinked with various aspects of the methodology, as indicated in table 9.1

Table 9.1: Methodological attainment of research outcomes.

Research Question	Data Type	Data analysis	Chapter
RQ1	Interview	Qualitative	Chapter 5
RQ2	Interview	Qualitative	Chapter 5
RQ3	Interview	Qualitative	Chapter 5
RQ4	Questionnaire	Quantitative	Chapter 7

The first issue addressed is *'What specific GSCM practices can be represented by the strategic capabilities of pollution prevention, product stewardship, clean technology and the base of the pyramid'*. To answer RQ 1, this research adopted an exploratory approach based on qualitative techniques. A content analysis of the interview responses of the relevant managers in the O&G industry produced themes that formed the answer to this question. The analysis of the interview in chapter 5 produced the following findings as the answer to the RQ1 of this research:

- GSCM practices are linked with various elements of NRBV strategic capabilities. Specifically, pollution prevention strategies of the O&G firms are represented by the GSCM practices of Intra-organisational environmental practices, environmental management systems, and lean supply chain management. Also, product stewardship strategies are linked with the GSCM practices of green purchasing, green distribution, and sustainable supply chain collaboration. Finally, clean technology strategies are related to the GSCM practices of environmental technology, corporate environmental responsibility, and product/process diversification.
- Six specific GSCM practices are linked with various aspects of pollution prevention. These are ISO14001 certification, collaborative spills management, energy conservation policy, water conservation policy, waste removal at the source and automated leakages detectors.
- Four specific GSCM practices are related to various aspects of product stewardship. These are sustainable supplier selection, logistics partnership for sustainability, responsible product retailing and continuous stakeholders' engagement.
- Five specific GSCM practices are linked with various elements of clean technology. These include technology beyond legal requirements, carbon capture and storage technology, advocacy for liquefied natural gas (LNG), hydropower energy systems and investment in other renewables.
- There are no empirically verifiable GSCM practices related to the NRBV capabilities of the base of the pyramid in the Nigerian O&G industry.

The second question addressed in this research is *'what strategic resources enhance the implementation of GSCM practices in the Nigerian O&G industry?'* An exploratory research strategy using a qualitative technique was also adopted to answer RQ 2. The content analysis of the interview transcripts in chapter 5 provided empirical answers to this research question. The qualitative research findings in this regard reveal the following:

- Both tangible and intangible resources are recognised as critical enhancers of strategic environmental management capabilities by the firms in the Nigerian O&G.
- Participants identified four tangible resources as the critical catalysts of their strategic environmental capabilities. These are finance, technological assets, logistical infrastructures, and green distribution channels.
- The study also identified three intangible resources: knowledgeable employees, continuous innovations, and strategic supply chain collaboration as the key enhancers of strategic capabilities (GSCM).
- 100% of the participants cited finance, continuous innovations, and supply chain collaboration as the most invaluable strategic resources that enhance their strategic capabilities (GSCM).

Following the logic embedded in NRBV, supply chain continuous innovation was conceptualised as the most critical dynamic and combinative resources required by the Nigerian O&G firms for GSCM implementation.

The third research question in this study is *'What stakeholder pressures drive GSCM adoption in the Nigerian O&G industry?'.* This question was also addressed through a qualitative analysis of the participants' interview responses in this research. This exploratory technique reported various themes that emerged as the research outcomes regarding the RQ3 in the chapter 5 of this thesis. From the stakeholder theory perspective, this study found that various stakeholders can exert different types of pressures on O&G firms. Regulatory pressures from government institutions are the most significant driving force behind GSCM adoption in the industry. The following are the specific findings in this regard:

- Strategic capabilities for GSCM implementation are predominantly driven by pressures emanating from six categories of stakeholders: top management, customers, competition, government, host community, and media.
- Top management is the predominant stakeholder exerting internal pressure for green practices.
- Firms are exposed to market pressures from two categories of stakeholders: customers and competition
- Host communities and media are sources of normative stakeholder pressures in the industry.
- Government institutions are identified as stakeholders that exert coercive pressures on O&G firms through environmental regulations.

- 100% of the participants considered the pressures from government regulatory institutions and top management as the most significant drivers of GSCM in the industry.

Considering that top management support is an internal factor that drives firms' adoption of green practices, with a degree of consensus among scholars, the current study depicted government regulations as the most critical stakeholder pressure for GSCM adoption in the Nigerian O&G industry (Sarkis, Gonzalez-Torre and Adenso-Diaz 2010a; Simpson 2012; Wu 2013).

As earlier indicated, the research outcomes of the above questions provided the needed specific information for refining the proposed conceptual framework. Furthermore, it aided the transitioning of the research methodology to the quantitative method required to confirm the hypothesised theory of this research.

The fourth research question is '*What is the impact of GSCM practices on the competitiveness of the firms operating in the supply chain of the Nigerian O&G industry?'*. Using structural equation modelling (SEM), a quantitative approach was adopted to empirically validate the refined conceptual model of this research to answer this question in chapter 7. Thus, the quantitative study was carried out to assess the refined research model. The model first hypothesised a positive impact of government regulations (as a coercive stakeholder pressure) on supply chain continuous innovations (as a strategic resource) and NRBV strategic capabilities (pollution prevention, product stewardship and clean technology). Furthermore, the model hypothesized a positive impact of supply chain continuous innovations on NRBV strategic capabilities and a positive effect of NRBV strategic capabilities on competitiveness. Finally, the model envisaged a positive impact of environmental competitiveness on economic competitiveness. The outcome of the assessment of the research model reveals the following:

- Government regulations as coercive stakeholder pressures negatively impact the strategic resources of supply chain continuous innovations, contrary to H1 of this study. Hence, H1 was rejected.
- Government regulations have no statistically significant impact on the three NRBV strategic capabilities of pollution prevention, product stewardship, and clean technology, contrary to H2 a, H2b and H2c of this research. Hence, these hypotheses were rejected.
- Supply chain continuous innovations, as strategic resources, positively impact the three NRBV strategic capabilities, thereby validating the H3a, H3b, and H3c of this study. Therefore, these hypotheses were accepted.
- The three NRBV strategic capabilities positively impact environmental competitiveness in line with H4a, H5a and H6a of this study. These hypotheses were accepted.

- While pollution prevention and product stewardship capabilities positively impact environmental competitiveness in line with H4b and H5b, clean technology capabilities have no statistically significant effect on economic competitiveness, contrary to H6b.
- Finally, this research found that environmental competitiveness positively impacts the economic competitiveness of the firms operating across the supply chain of the Nigerian O&G industry, thereby validating the H7 of this study.

In summary, the evidence from this study provides a deep understanding of how O&G firms can utilise strategic capabilities (GSCM implementation) to enhance their competitiveness in terms of environmental and economic performance.

9.5 Research contributions and novelty

The contributions of this research are considered within the relevant literature on GSCM and strategic management as applied to the study's objectives. The study adopted a multi-disciplinary approach to evaluate how government regulations (stakeholder theory) can drive O&G firms to acquire the strategic resources of supply chain continuous innovations. It further examined how the above can help firms develop three GSCM related strategic capabilities (pollution prevention, product stewardship, and clean technology) with the overall effects on firms' competitiveness. Stemming from the findings of this research, as summarised in the preceding section, the current study makes several original contributions to the extant literature on GSCM and strategic management, as highlighted in table 9.2.

Table 9:2: Research contributions and novelty.

Specific contributions	Areas of contributions	Original Contribution	Research Novelty
Empirical validation of the specific GSCM practices linked with NRBV strategic capabilities in the O&G industry.	Bringing empiricism to the theoretical proposition on the linkage between GSCM and NRBV strategic capabilities.	✓	✓
	Creating an alternative approach for the examination of GSCM practices.		

Identification of the essential tangible and intangible strategic resources in the Nigerian O&G industry	The role of resources in strategic capabilities development within the NRBV framework.	✓	✓
The conceptualisation of supply chain continuous innovations as the specific strategic resources for NRBV strategic capabilities.	Extension of the Natural Resource-Based view theory with a new element.	✓	✓
Identification of the critical stakeholder pressures behind GSCM implementation in the Nigerian O&G industry	Application of stakeholder theory in GSCM literature	✓	
Proposition, assessment, and validation of a research model of stakeholder pressures-strategic resources-strategic capabilities (GSCM practices)-competitiveness in the context of the Nigerian O&G SC	Model development and validation in GSCM Deepening theory-based research GSCM.	✓	✓
An empirical examination of the impact of government regulatory pressures in the adoption of GSCM practices in the Nigerian O&G industry	Implications of regulatory pressure in driving adoption of GSCM practices in the Nigerian O&G industry. Evaluation of Porter's hypothesis in the Nigerian O&G industry.	✓	✓

The specific areas of contributions of the current research to knowledge in the GSCM, NRBV and O&G literature are further clarified below:

Contribution 1: In the first instance, this research makes an original and novel contribution to the GSCM and NRBV literature by addressing the theory-practice gap that existed in the application of NRBV in GSCM research. Previous studies have theoretically suggested that GSCM practices can be melted into the NRBV strategic capabilities (Guang Shi et al. 2012; McDougall, Wagner and MacBryde 2021; Yunus and Michalisin 2016). Therefore, the current study is arguably one of the earliest attempts to address this theory-practice gap by empirically identifying the specific GSCM practices linked with NRBV capabilities in the Nigerian O&G industry. The novelty in these findings is that this research presents an alternative perspective of GSCM.

Contribution 2: This research makes original contributions to the role of strategic resources in developing strategic capabilities for competitiveness. The NRBV exists on the RBV's notion that firms require tacit and socially complex resources to build their strategic capabilities (Barney 1991; Grant 1991; Hart 1995). Many scholars have criticised the practicability of RBV (the root of NRBV) on the ground of ambiguity in its conceptualisation of strategic resources (Lockett et al. 2009). It has also been argued that strategic resources can vary across firms and industries (Hart and Dowell 2011). To the best of the researcher's knowledge, studies exploring the specific strategic resources in the supply chain of the Nigerian O&G industry are inexistent. The current research has addressed the above gap by identifying the specific tangible and intangible strategic resources that enhance strategic capabilities in the Nigerian O&G industry.

Contribution 3: This research extends the gamut of NRBV to include supply chain continuous innovations as strategic resources that drive the acquisition of the NRBV strategic capabilities. Originally, Hart (1995) proposed that the strategic resources of continuous improvement, stakeholder integration, and shared vision respectively drive pollution prevention, product stewardship, and sustainable development capabilities. By evaluating and empirically validating the impact of supply chain continuous innovations in driving the attainment of NRBV strategic capabilities, this study has also made an original contribution to the strategic management literature concerning the resource-based theory and its extensions

Contribution 4: The current study makes another original contribution to the GSCM literature by deepening the application of stakeholder theory in GSCM, particularly in the O&G industry. Although previous studies have identified various drivers of GSCM in the O&G industry (Thurner and Proskuryakova 2014; Ahmed et al. 2017), these studies do not adopt the theoretical lens of stakeholder theory. Previous studies on the driving forces of GSCM have reported mixed results (Zhu 2013; Esfahbodi et al. 2017), necessitating further research focus on this area. In this regard, this study successfully identified several stakeholder pressures driving GSCM in the Nigerian O&G industry. Also, its identification of government regulations as the key driver of GSCM implementation in the Nigerian O&G industry is also unique as there is no evidence of previous research of this nature in the context of the Nigerian O&G industry.

Contribution 5: Furthermore, the study developed an integrative research model that combined the stakeholder pressures driver of GSCM with strategic resources, strategic capabilities (GSCM) and competitiveness in the Nigerian O&G industry. This framework was empirically tested, and a final model of stakeholder pressures-strategic resources-strategic capabilities (GSCM practices)-competitiveness was validated. The research model of this study is unique and different from previous frameworks developed in O&G industry GSCM research because it is built on existing theories (NRBV and stakeholder theory). Also, the research model was refined with the results of exploratory analysis. This approach is original and novel, as previous frameworks are lacking in this regard. For example, Ahmad et al.'s (2017) integrative framework of GSCM in the O&G industry is not mainly designed on the existing theoretical foundation. Also, Guang Shi et al.'s. (2012) GSCM-NRBV framework incorporates institutional theory with NRBV lacks empirical validation. Besides, NRBV clean technology capability is excluded from the framework. Therefore, this study is arguably one of the earliest attempts to develop and empirically assess an integrative model of stakeholder pressures theory and NRBV in the context of GSCM in the O&G industry.

Contribution 6: Finally, by evaluating the impacts of government regulations on strategic resources and capabilities, the current research has contributed to the growing literature on stakeholder theory application in GSCM research. As noted in chapter 2, the stakeholder theory is one of the most famous theoretical lenses adopted for examining research phenomena in GSCM literature, of which findings are disintegrated. Therefore, this study has brought a new perspective into the ongoing discussion on the role of stakeholder pressure in driving GSCM practices by introducing the concept of strategic resources and strategic environmental capabilities in GSCM research. Furthermore, this research also briefly examined Porter's hypothesis in the Nigerian O&G industry by empirically investigating the impact of government regulations on innovations. The finding in this direction is an original contribution to the strategic management literature concerning the relationship between regulations and innovations in a developing nation and the O&G industry.

In sum, the contributions of this research have deepened knowledge in the area of managerial practices and theoretical development. First, the current study expands the knowledge of the GSCM practices implemented in a critical O&G industry. It also validated that these practices could enhance firms' competitiveness. Since the extant literature has not addressed the impact of GSCM on the competitiveness of the O&G industry, this research has contributed to knowledge in this regard. Whereas the model of this research has been tested in the O&G industry, it is pertinent to state that it can also be adapted to other industries as it is developed on GSCM and NRBV logic which is relevant in many industries. Second, this study expands the current knowledge on the NRBV theory by validating supply chain continuous innovations as the strategic resources and stakeholder pressures as the exogenous driver.

9.6 Implications of the study

Having presented the overview of this study, its findings and the specific contributions to knowledge, it is also pertinent to highlight the theoretical, methodological, empirical and managerial implications of this research as discussed below:

9.6.1 Academic implications and theoretical contributions

As a study based on established academic theories, this study has made unique contributions to the GSCM literature by effectively integrating the relevant elements of the stakeholder theory and NRBV to examine GSCM issues in the O&G industry. Many authors in GSCM have clamoured for the increased application of theory in GSCM research due to the dearth of theory-based research in GSCM (Carter and Easton 2011; Sarkis et al. 2011). Indeed, a literature review by Touboulic and Walker (2015) reveals that up to 60% of articles published on GSCM in top journals between 1995 and 2013 lack a theoretical basis. Therefore, by developing an integrative framework on established theories, this research has not only responded to the call and quest for theory-based research in GSCM literature; it has also deepened the applicability of such theories in a real-life situations. Specifically, this research built a theoretical model integrating the relevant elements of the stakeholder theory and NRBV. The existing frameworks adopting a similar approach lack empirical validation (See Guang Shi et al. 2012). Thus, this study is one of the earliest attempts in the GSCM domain to validate an integrative framework developed on triangulated theories empirically.

Furthermore, this study has made a unique contribution to the NRBV theory by successfully conceptualizing supply chain continuous innovations as strategic resources that could enhance firms' strategic environmental capabilities for competitiveness in the O&G industry. Indeed, the paucity of empirical investigation of the NRBV has been linked to the impracticability in conceptualizing the required resources that meet its requirements (Powell 1992; Lockett, Thompson, and Morgenstern 2009). To this end, Hart and Dowell (2011) request researchers to further specific resources compatible with the NRBV strategic capabilities. By validating supply chain continuous innovations as strategic resources within the NRBV domain, this study has also created an opportunity for empiricism of the key GSCM linked strategic capabilities of pollution prevention, product stewardship, and clean technology in the NRBV framework. (Even though the Base of the Pyramid capabilities were not included in this study, the approach adopted in this study can be extended to this in future studies).

9.6.2 Methodological contributions

The positivist's epistemology underscores the predominant methodological approach in operations management. This informs the widespread adoption of quantitative methods in SCM research (Forza 2002; Soni and Kodali 2012). This research departs from this stereotype and makes a methodological contribution to the GSCM literature by adopting a mixed-method technique based on the pragmatist's philosophy and abductive approach to answer the research questions. Golicic and Davis (2012) noted that research in logistics and SCM is under intense criticism for lack of methodological diversity and resistance to adopting more appropriate methods for answering research questions. The current study has taken a more creative approach by seamlessly examining the phenomenon in the SCM domain with an effective combination of qualitative and quantitative techniques in an exploratory sequential mixed-method research approach. Thus, this research is one of the few attempts to combine the SCM traditional positivist's philosophy with the seldomly applied interpretivism philosophy to design a pragmatist's study in operations management. Therefore, this research has further confirmed that researchers can adopt a creative approach in GSCM research.

Another methodological contribution of the current study lies in its approach to refining the research model. Previous research in GSCM merely empirically assessed research models proposed solely from the literature review (Please see Esfahbodi et al. 2017). The current study adopted a more rigorous approach by exploring the existence of the constructs identified in the literature through a qualitative technique before quantitative assessment. Indeed, the qualitative exploration reveals that some of the constructs identified in the literature as part of the proposed conceptual framework do not exist in practice. This led to the expungement of the constructs in refining the proposed model before the final assessment. This rigorous methodological approach to research model development is arguably unique and guided the research to focus only on feasible constructs in the focal industry.

From the quantitative model assessment perspective, a significant methodological contribution of this research is the capability of the adopted data analysis technique, i.e., SEM analysis. The SEM technique rigorously assesses the impact of the GSCM practices on the competitiveness of O&G firms while accounting for the influential roles of the GSCM-related driving forces of government regulations and strategic resources, thereby reporting more credible findings. This distinguishing characteristic of the SEM technique offered a simultaneous assessment of various separate causal relationships, leading to a holistic evaluation of the research model, generating more accurate results (Inman et al., 2011; Kline, 2011). Thus, the SEM techniques enable a better understanding of the hypothesised relationships among the posited research constructs in the assessed model, in comparison with other multivariate methods such as multiple regressions and path analysis, which are constraint by the ability to examine a single relationship per time (Kaplan, 2004; Hair et al., 2010).

9.6.3 Empirical contributions

The topic of GSCM with a focus on firms' competitiveness from the perspective of NRBV is relatively an unexplored area of research in general and particularly in the O&G industry. Specifically, there is no empirical research exploring how Nigerian O&G firms can develop the capabilities for GSCM implementation and the resultant effects on competitive performance (Asaolu et al. 2012; Ngoasong 2014; Ekiugbo and Papanagnou 2017). Consequently, this study is empirically significant as it represents one of the earliest attempts to understand the effects of implementing GSCM initiatives on the competitiveness of the firms operating across the supply chain of the Nigerian O&G industry.

The general paucity of studies that empirically explore the role of coercive government regulations and strategic resources in influencing O&G firms to adopt GSCM practices underscores the empirical contributions of this study. In particular, a few empirical research that has examined the consequences of greening the supply chain of the O&G industry have overlooked the antecedent role of the drivers of GSCM driving forces when looking into this topic (Yusuf et al. 2013; Florecsu et al. 2019; Tanimu, Yusuf and Geyi 2021). Furthermore, while previous empirical research conducted outside the O&G industry provides some information on the impact of GSCM on firms' competitiveness, the findings of these studies are inconclusive since they contradict one another (Zhu and Sarkis, 2004; Rao and Holt, 2005; Green et al., 2012).

Therefore, this research makes a further empirical contribution to the extant literature by addressing the lack of consensus on this topic by undertaking a rigorous empirical examination and providing definitive results which agree with some of the recent findings. Finally, the high quality of the data analysed in this research is considered another significant empirical contribution of this study. This study is based on 29 interviews and over 200 questionnaire survey responses generated from a diverse group of highly experienced and relevant top managers across the entire supply chain of the Nigerian O&G industry. Considering that the existing research on GSCM in the O&G industry is generally mono-sectoral (Ahmed et al. 2017; Raut, Narkhede and Gardas 2017; Yusuf et al. 2013), the current research is one of the few studies to analyse a large-scale data covering the entire supply chain of the industry.

9.6.4 Managerial implications

This study holds many implications for the practice of GSCM in the O&G industry, especially in developing countries. Firstly, this study has highlighted the weakness of the incumbent regulatory regime in the Nigerian O&G industry in driving the adoption of green practices by the firms operating across the supply chain. Although this is in line with the view of Silvestre (2015) that developing countries are generally prone to weak regulations, it is argued that a country like Nigeria, which derives up to 90% of its foreign exchange earnings from the O&G industry, cannot afford to handle sustainability issues in the industry with levity. Furthermore, the lack of positive causality between government regulations and innovations (Supply chain continuous innovations) in this research contradicts Porter's hypothesis that flexible environmental regulations can enhance a firm's sustainability innovations (Porter 1991). It also validates Ekhator's (2016) findings that the regulatory approach to managing the Nigerian O&G industry is based on the 'command and control mechanism, which has been found to limit innovations (Managi et al. 2005; Purvis and Outlaw 1995). Therefore, this study reveals a need for a complete overhauling of the regulatory framework currently adopted in the Nigerian O&G industry and, by extension, the oil-producing developing nations. Also, the policymakers in the O&G industry are required to improve the enforcement framework and educate O&G firms on the need to understand that GSCM practices could yield long-term benefits beyond mere regulatory compliance.

Also, the findings that supply chain innovations can enhance strategic environmental capabilities imply that the relevant managers in the O&G industry should appreciate the need to improve collaboration with supply chain partners and other stakeholders. The above should be targeted toward generating continuous innovations that can help reduce operations' social and environmental impacts. Against this backdrop, the study also reveals that the acquisitions of strategic resources and environmental capabilities can boost environmental competitiveness and economic competitiveness. The above indicates that the accruing cost of GSCM practices by O&G firms should be viewed as an investment that may generate financial returns and enhanced eco-reputation.

Finally, the findings that supply chain continuous innovations can drive the development of clean technology capabilities, which in turn enhances the environmental competitiveness of the O&G firms, holds a positive implication for society at large. In essence, by working with supply chain members to activate radical innovation in clean technology, the O&G industry can considerably reduce its environmental impacts. Furthermore, firms in the industry can also develop a diversification strategy for the commercialization of renewables, thereby helping to reduce the threat of climate change and global warming linked to GHG emissions. Such innovative ideas have been found in the Norwegian Statoil/Equinor, which has invested over $12 billion in renewables worldwide (Equinor 2018).

9.7 Limitations of the study

Despite the notable positive contributions and implications of this research, the research is not devoid of certain limitations that open up several future research avenues, serving as an opportunity for further research opportunities. First, this study is limited by its inclusion of only an element of stakeholder pressures (government regulations) as the key driver of strategic resources and environmental capabilities within the stakeholder theory. Thus, the impacts of internal, market and normative pressures are not considered in the research model, despite validating their existence in the industry in chapter 5. This position is justified by the study's methodological approach that refined the theoretical model with the exploratory research findings. The qualitative research findings reveal that government regulations are the most critical driver of GSCM adoption in the Nigerian O&G industry. This is consistent with Zailani et al. (2012) that coercive stakeholder pressures have more significant impacts on firms' adoption of GSCM practices than other stakeholder pressures. The above justifies government regulations as the only key driver of this study's GSCM strategic resources and environmental capabilities. Nevertheless, including other stakeholder pressures validated in chapter 5 would add fresh perspectives to this study.

Second, this research expunged the fourth NRBV strategic capability of the base of the pyramid from its research model, leading to an incomplete examination of the NRBV strategic capabilities. The lack of empirical verification of GSCM practices linked with the base of the pyramid capability provides sufficient justification for the above. Nevertheless, non-consideration of the base of the pyramid capability in this research indicates that the study cannot fully empirically examine NRBV in the context of the O&G SC, thereby constituting another limitation of this study.

Third, this research conceptualized strategic resources for environmental capabilities as a 'single' resource (Supply chain continuous innovations) rather than a 'bundle of resources' as suggested in RBV (Grant 1991). The above is consistent with Judge and Douglas (1998), who adopted a single strategic resource as the driver of strategic capabilities. The adoption of supply chain continuous innovations as the strategic resources driving NRBV strategic capabilities in this study could be thought to be multi-dimensional. First, supply chain continuous innovations reinforce Hart's (1995) depiction of continuous innovations as the strategic resources that drive firms' pollution prevention capabilities. Second, since supply chain, continuous innovation is a fusion of strategic supply chain collaboration and continuous innovations, empirically verified in chapter 5, supply chain continuous innovation also includes stakeholder's integration depicted as the strategic resource for pollution prevention capability in NRBV (Hart 1995; Hart and Dowell 2011). Notwithstanding the above, it is believed that conceptualizing strategic resources as a 'bundle of resources' would deepen the findings of this research.

Fourth, the data analysed in this research is entirely from the upstream and downstream sectors of the Nigerian O&G industry. Consequently, the findings may not be extendable to the O&G sectors in other geographical locations, especially the developed countries. However, since sustainability in the context of supply chain and strategic management is not limited to a particular industry, the inclusion of other sectors, such as retailers, manufacturing, even service industries (such as banking, telecommunication, etc.), in different geographical locations would enhance the generalisability of this study. Nevertheless, since the theoretical model developed and empirically tested in this research is based on established management theories, it is strongly believed that same can be adapted for application in any industry of choice.

Finally, despite the fact that the sample size of 214 responses used in testing the theoretical model of this study is within the recommended range of 150-400 considered suitable for SEM (Hair et al. 2014), it has also been generally established that SEM works better with larger sample size (Kline). Therefore, using a larger sample size would be more beneficial to this study.

9.8 Opportunities for future research

Following the limitations of this study discussed earlier, this research reveals many questions that require further investigations, thereby providing future study opportunities. Firstly, since the current study found that government regulations as coercive pressures have a negative impact on strategic resources and statistically insignificant effects on NRBV strategic capabilities, future studies can examine the impact of other elements of the stakeholder pressures (internal, market and normative) on strategic resources and environmental capabilities. Such a study can also take a comparative approach to determine the impact of each stakeholder pressure on the dependent variables.

Secondly, considering that the NRBV base of the pyramid strategic capability is not examined in the current study, future research can inculcate this capability into their frameworks on NRBV. Such an approach would deepen the exploration of the social aspect of sustainability, which has received less attention in NRBV literature (McDougall, Wagner and MacBryde 2019). Research in this direction can also comparatively analyse the impacts of each NRBV strategic capability on the competitiveness of the firms operating in the selected industry.

Furthermore, other studies can modify the research model tested in this study and apply the same to other industries such as manufacturing, retailing, and many others. This will help evaluate the role of stakeholder pressures in driving firms to acquire strategic resources that can enhance environmental capabilities for competitiveness across industries. Similarly, since the current research is solely on Nigeria, other emerging economies such as China can be considered for a study of this nature. Likewise, further studies can focus on developed nations such as the USA and Canada. Indeed, other researchers can also take a multi-industrial or multi-geographic approach to enhance the generalisability of the findings across industries and geographical locations.

In specific terms, future research in this direction can address the stated limitations of the study highlighted in section 9.7 as presented in table 9.2.

Table 9.2: Addressing research limitations.

Limitation of the study	**Suggested solution in future studies**
Exclusion of other stakeholder factors in the research model	Future studies to include and compare empirically validated stakeholder drivers of GSCM in their frameworks.
The exclusion of the fourth element of the NRBV strategic environmental capability (Base of the pyramid) from the refined research model.	The future framework to take a more holistic view of the NRBV strategic environmental capabilities by including the Base of the pyramid construct.
Restriction of the research area to the Nigerian O&G industry.	Since the research model can be applied in other sectors and economies, future studies can adapt the model for inter-sectoral analysis.
The conceptualisation of a single resource as GSCM/strategic environmental capabilities enhancers.	In line with the logic of RBV, future studies should explore the 'bundle of resources' in research models.
Enhanced generalisability through a larger sample size	Although the sample size slightly exceeds the minimum SEM analysis standard, future studies should target a larger sample size to enhance generalisability.

9.9 Chapter conclusion

This chapter brings closure to this research. The overview of the study and the purpose of the thesis has been reiterated in this chapter. This chapter further presented the outcome of this study while articulating the value of the research to the academic experts and the O&G industry's managers and policymakers. Unequivocally, this chapter presented how the research objectives have been met and the research questions answered across the first eight chapters of this research. Finally, this chapter identified the various limitations of this research, which become an opportunity for further empirical investigation on related issues in GSCM and NRBV. It is believed that this study would spur other researchers to create alternative approaches to examining practical issues in GSCM, investigating the linkages between existing management theories and applicable managerial practices as carried out in this study.

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APPENDIX A: EMPIRICAL LITERATURE ON NRBV CAPABILITIES

Authors/ Year	Focus of the study	NRBV capabilities	Other variables	Techniques/ Methodology	Industry	Country/Region	Key findings
(Hastings 1999)	Strategic capabilities for new operation paradigm for oil operations in sensitive environment	Pollution prevention (as environmental management), product stewardship (as social responsibility) and sustainable development	Unspecified	Multiple case study	Oil and Gas	Latin America	Firms developing new capabilities in oil operations may achieve sustained competitive advantage
(Sarkis and Cordeiro 2001)	Environmental efficiency and firm performance	Pollution prevention	Financial performance	Multiple regression	Multi-industrial	USA	Pollution prevention has a negative impact on a firm's financial performance
(Menguc and Ozanne 2005)	Impact of higher-order construct of natural environmental orientation (NEO) on firm performance.	Pollution prevention (as CSR), product stewardship (as innovativeness) and sustainable development (as environmental commitment)	Sales growth, market share and profit after tax.	Structural equation modelling	Manufacturing	Australia	A higher-order construct of NEO is positively and significantly associated with profit after tax and market share but negatively associated with sales growth
Fowler and Hope (2007)	Examination of NRBV in the Patagonian apparel industry	Pollution prevention, product stewardship and sustainable development	Unspecified	Case study	Clothing	Patagonia	Resources and implementation of NRBV capabilities are independent and parallel
(Chen et al. 2009)	Impacts of institutional pressures on the adoption of green information technology (IT)	Pollution prevention, product stewardship and sustainable development	Mimetic and coercive pressures	Partial least square analysis of 75 questionnaire responses			Mimetic and coercive pressures influence green ICT adoption in the area of product stewardship
(Michalisin and Stinchfield 2010)	Effect of climate change strategies on firm performance	Pollution prevention, product stewardship and sustainable development	Accounting performance	Pairwise comparison	Multi-industrial	international	Firms with proactive environmental strategies achieve a higher level of accounting performance.
(Wong et al. 2012)	Investigation of the influence of environmental management capability (EMC) on firm performance and pollution reduction	Product stewardship (process stewardship), pollution reduction	Suppliers (EMC), financial performance	Surveys of 122 manufacturing firms	Electronic manufacturing	Taiwan	Product stewardship has a positive impact on financial performance

(Holban, Boteanu and Petrescu 2013)	Examination of issues relating to the development of green energy concerning pollution prevention and product stewardship	Pollution prevention, product stewardship and clean technology	Not specified	Surveys of 430 Romanian companies	Agriculture	Romania	Investment in biomass can reduce energy bills (economic benefit) and improve environmental compliance.
(Maas et al. 2014)	Effects of pollution prevention and service stewardship capabilities on firm differentiation advantage and the moderating role of environmental communication	Pollution prevention, product (service) stewardship	Differentiation advantage	Regression and moderation analysis	Third-party logistics	Germany	Pollution prevention and service (product) stewardship enhance firms' differentiation advantage
(Masoumik, Abdul-Rashid and Olugu 2015)	Analysis of the total effects of green strategy adoption on the competitiveness of manufacturing firms	Pollution prevention, product stewardship and clean technology	Strategic environmental performance, competitive benefits	Structural equation modelling	ISO 14001 manufacturers	Malaysia	Green strategies have an impact on environmental performance and competitive benefits. Clean technology specifically generates competitive benefits and has attracted the least attention.
(Bhupendra and Sangle 2015)	Innovative capabilities required for the implementation of pollution prevention and clean technology strategies	Pollution prevention and clean technology	Innovative capabilities	Logistic regression	Multi-industrial	India	Process and behavioural innovativeness drive the adoption of pollution prevention. Top management risk-taking ability, market, product and strategic innovativeness drive adoption of clean technology.
(De Stefano, Montes-Sancho and Busch 2016)	Understanding of the technological innovations adopted by automobile firms for reducing CO2 emissions during the period of regulatory uncertainty	Product stewardship, clean technology	Co2 emission reduction	Quantitative content analysis	automobile	Europe	The impact of clean technology have a more prolonged effect on CO2 emission reduction than pollution prevention
(Singh, Ma and Yang 2016)	Explanation of mixed relationship between environmental	Pollution prevention and product stewardship	Environmental expenditure and economic performance	Survey of 120 firms across firms through pat-based analysis	Multi-industrial	Global	Environmental expenditure on pollution prevention has a negative impact on economic performance while

	expenditure and economic performance						environmental expenditure on product stewardship has a positive effect on economic performance
(Bhupendra and Sangle 2017)	Drivers of product stewardship strategies	Product stewardship	Absorptive capabilities	Logistic regression	Multi-industrial	India	Firms with traits of absorptive capabilities are better positioned to implement product stewardship strategies
(Gabriel et al. 2018)	The business case for adopting eco-friendly supply chain management in a medical product	Pollution prevention and product stewardship	Environmental impacts	Single case study	Medical supply	USA	Pollution prevention strategy has the lowest environmental impact, while product stewardship has a more significant environmental impact.
(Graham 2018)	Explanation of how internal capabilities develop during pollution prevention implementation and the effect on the process (product) stewardship	Pollution prevention and process (product) stewardship	Internal capabilities	Multiple regression analysis of 149 responses	Food manufacturing	UK	Internal capabilities are antecedents of pollution prevention which in turn affect process stewardship
(Ashby 2018)	Developing closed-loop supply chain (CLSC) to address environmental challenges	Pollution prevention	Shared vision	Case study	Clothing	UK	Through a shared vision, firms can progress from pollution prevention to more proactive CLSC.
(Dembek, York and Singh 2018)	Developing a data-based business model for addressing poverty at the base of the pyramid	The base of the pyramid				Indonesia and Philippines	
(McDougall et al. 2019)	Exploring the existence of NRBV capabilities in the UK agro-food industry	Pollution prevention, product stewardship, clean technology and base of the pyramid	Dynamic capabilities and innovations	Qualitative content analysis	Agro-food	UK	Affirmation of the practices of NRBV capabilities except for the base of the pyramid and the existence of local philanthropy as a new capability.
(Ashraf et al. 2019)	Examination of the antecedents of clean technology adoption in developing countries	Clean technology	Network embeddedness, market incentives and slack resources	Regression	Multi-industrial	International (Mainly India and China)	Firms' relational structures influence their adoption of clean technology
(Anthony Jr 2019)	Development and assessment of eccentric	Pollution prevention, product stewardship,	Believe-Action-Outcome, IT	Structural equation modelling	Multi-industrial	Malaysia	Pollution prevention, product stewardship and clean

	model relating green information system (GIS) with environmental performance	clean development (technology)	personnel and environmental performance				development positively influence environmental performance.
(Al-Mutairi et al. 2019)	Developing strategic decision making framework for prioritisation of green initiatives by firms.	Pollution prevention, product stewardship and clean technology	Competitive advantage	Analytical Hierarchy Process (AHP), Analytical Network Process (ANP) and Structural equation modelling (SEM)	Manufacturing	Kuwait	Product stewardship has the most significant impact on cost and green competitive advantage.
(Mishra, Chiwenga and Ali 2019)	Advancement of circular economy in developing countries.	Clean technology	Strategic collaboration, organisational learning	Case study	Manufacturing	North Africa	Strategic collaboration and organisational learning are required for clean technology
(Xie et al. 2020)	How board gender diversity affects corporate environmental strategies and financial performance.	Pollution prevention, sustainable development	Board diversity and financial performance	Latent class regression model	Multi-industrial	Global	Women on the corporate board positively influence environmental strategy, and pollution prevention strategy positively impact financial performance
(Andersén 2021)	Consideration of relational NRBV in green product innovation (GPI)	Product stewardship (GPI)	Differentiation advantage and firm performance	Structural equation modelling	Manufacturing	Sweden	Relational resources positively influence GPI, which in turn influences differentiation advantage

APPENDIX B: INVITATION LETTER TO O&G FIRMS

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APPENDIX C: INTRODUCTION LETTER FROM PTDF TO THE NIGERIAN O&G REGULATOR

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APPENDIX D: INTERVIEW PROTOCOL

Question Tags/Interview objective	Main Questions	Sub Question	Source
Part A: Demographic background	A1: In what sector of the O&G industry does your company operate? A3: What is your role in your company?	A2: How would you describe your company's operations in the sector? A4: How many years' experience do you have on the job?	Yusuf et al. (2012), Urciuoli et al. (2013).
Part B: General question			
Awareness of SSCM	B1: How would you describe sustainability in your organisation?	B2: Can you describe the specific sustainability strategies your company implement with the contractors, suppliers and other stakeholders?	Yusuf et al. (2012).
Part C: SSCM and NRBV strategic capabilities			
SSCM and pollution prevention	C1: Can you describe your company's approach to waste management and emission control? C3: What specific practices do you implement with business partners to manage wastes and reduce emissions?	C2: Can you tell me how your company collaborates with stakeholders to address waste management and emission? C4: Can you describe the area you think your company requires capacity for waste management and emission control?	Hart (1995), Russo & Fouts (1997), Aragon-Correa & Sharma (2003), McDougal et al. (2019)
SSCM and product stewardship	C5: How does your company consider sustainability across the entire distribution channels? C7: How does your company manage product hazards up till consumption?	C6: How do you involve stakeholders in managing product health, safety and environmental risks throughout the distribution chain? C8: Can you describe the specific strategies adopted by your company and its stakeholders to eliminate products hazards?	Hart (1995), Hart & Dowell (2011), IPIECA, (2015), McDougal et al (2019). .
SSCM and clean technology	C9: Can you please explain the roles of technology in your company's approach to sustainability?.	C10: What are the roles of your supply chain partners in your company's adoption of technology?.	Hart & Christensen, (2002), Hart & Dowell (2011), IPIECA, (2015), McDougal et al (2019).

	C11: what specific areas of your company's sustainability practices have you applied new technology?	C12: Please describe the specific technologies applied by your company to promote sustainability?	
SSCM and base of the pyramid	C13: Can you tell me about your company's approach to addressing global social sustainability? C15: How does your company address issues of global poverty and injustice beyond your geographical area of operations?	C14: What roles are played by your business partners (suppliers, contractors, customers) in your firms' social sustainability on a global scale?	Hart & Christensen, (2002), Hart & Dowell (2011) McDougal et al (2019)
Part D: Strategic Resources			
Tangible strategic resources	D1: Can you please explain the roles of physical resources and assets in your company's sustainability practices? Please give examples	D2: Can you please explain the roles of non-physical resources and assets in your company's sustainability practices? Please give examples.	Barney (1991), Grant (1991), Hart (1995) Hart and Dowell (2011).
Part E: Institutional driving forces of SSCM			
Stakeholders and institutions	E1: What factors do you think influence your firm's decision to implement sustainability practices?	E2: Can you tell me about the internal and external stakeholders that influence your company's sustainability decisions?	DiMaggio and Powell (1983), Meyer and Rowan (1997), Berrone et al. (2010).

APPENDIX E: QUESTIONNAIRE SURVEY

TOPIC: IMPACTS OF ENVIRONMENTAL SUSTAINABILITY PRACTICES ON THE SUPPLY CHAIN OF OIL AND GAS FIRMS.

INFORMED CONSENT

The aim of this study is to **conduct a survey into how government regulations affect supply chain innovation, strategic environmental capabilities and competitiveness in the UK and Nigerian oil and gas industries.** The study is being conducted by **OLATUNDE ADEWOLE OLAJIDE**, a **doctoral researcher/ PhD Student** at Coventry University. You have been selected to take part in this questionnaire survey because your company has been identified as a critical player in the Nigerian/ UK oil and gas industry, of which you have been identified as an officer with sufficient knowledge about the sustainability strategies and supply chain management in the company. Your participation in the survey is entirely voluntary, and you can opt-out at any stage by closing and exiting the browser. If you are happy to participate, please answer the following questions relating to sustainability strategies and their implications on the competitiveness of oil and gas firms in Nigeria/UK. *Your answers will help us understand the role of government regulations in enhancing supply chain innovations towards developing strategic environmental capabilities for competitive advantage in the oil and gas industry*. The survey should take approximately 15-20 minutes to complete. Your answers will be treated confidentially, and the information you provide will be kept anonymous in any research outputs/publications. Your data will be processed in accordance with the General Data Protection Regulation 2016 (GDPR) and the Data Protection Act 2018. Your data will be held securely in the password-protected server of Coventry University and will only be viewed by the researcher/research team. All data will be deleted **by 20th September 2021.** You are free to withdraw your questionnaire responses from the project data set at any time until the data are fully anonymised in our records **on 5th September 2019.** You should note that your data may be used in the production of formal research outputs (e.g. journal articles, conference papers, theses and reports) prior to this date, and so you are advised to contact the university at the earliest opportunity should you wish to withdraw from the study. To withdraw, please contact the lead researcher (email: olajide3@uni.coventry.ac.uk; Mobile: +447448683022). Please also contact the Faculty Research Support Office (email researchproservices.fbl@coventry.ac.uk; telephone +44(0)2477658461) so that your request can be dealt with promptly in the event of the lead researcher's absence. You do not need to give a reason. A decision to withdraw or not to take part will not affect you in any way. Coventry University is a Data Controller for the information you provide. You have the right to access information held about you. Your right of access can be exercised in accordance with the General Data Protection Regulation and the Data Protection Act 2018. You also have other rights, including rights of correction, erasure, objection, and data portability. For more details, including the right to lodge a complaint with the Information Commissioner's Office, please visit www.ico.org.uk. Questions, comments and requests about your data can also be sent to the University Data Protection Officer **-** enquiry.ipu@coventry.ac.uk. The project has been reviewed and approved through the formal Research Ethics procedure at Coventry University. For further information, or if you have any queries, please contact the lead researcher [**Olatunde Olajide, Coventry University, CBIS, olajide3@uni.coventry.ac.uk +447448683022**]. If you have any concerns that cannot be resolved through the lead researcher, please contact **Dr Dong-Wook Kwak (PhD supervisor)** email: **d.kwak@coventry.ac.uk,** Telephone: **+44(0)2477658435**. Thank you for taking the time to participate in this survey. Your help is very much appreciated. Therefore, by checking the box marked 'yes, I consent' below, you hereby agree to the following:

(a) I have read and understood the above information

(b) I confirmed that I am aged 18 or over

(c) I agree to take part in this questionnaire survey

Yes, I consent ☐

<u>JOB FUNCTIONS AND COMPANY INFORMATION</u>

Q1.What is your current job position?

☐Chief Executive Officer

☐ Director

☐ Operations manager/officer

☐ Supply chain manager/officer

☐ Procurement Manager/officer

☐ Logistics Manager/officer

☐ Compliance officer

☐ Others, please specify……………………………………………………………..

Q2. How many years of experience do you have on your job?

☐ 1-10

☐ 11-20

☐ 21-30

☐ 30 and above

Q3 In which country do you work?

☐ Nigeria

☐ UK

Q4. How would you describe your company's sector in the O&G industry? Please choose from the following options.

☐ Oil and gas company supplier

☐ Oil and gas service provider

☐ Oil and gas logistics and transport

☐ Exploration and production

☐ Refinery

☐ Oil and gas depot

☐ Oil and gas station operator

☐ Marketing and distribution

☐ Consultancy

☐ Others, please specify ____

Q5. How many employees do you have in your company? Please choose from the following options.

☐ 1-10

☐ 11-50

☐ 51-250

☐ 251-500

☐ 500 and above

Q6. What is your major currency of operations?

☒ NGN

☐ GBP

☐ USD

Q7. What is your company's annual turnover?

Less than 5 million

5 million-20 million

21 million-50 million

51 million-100 million

100 million-500 million

500 million and more

GOVERNMENT REGULATIONS

The following questions focus on government regulations and your operations environmental practices. Please provide the appropriate answers.

Q8 To what extent do you agree to the following statements?

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
My company considers national environmental regulations (such as waste emission, cleaner production, etc.) in its operations.	☐	☐	☐	☐	☐
My company considers national resources saving and conservation regulations in its operations	☐	☐	☐	☐	☐
My company considers regional environmental regulations (such as waste emission, cleaner production, etc.) in its operations.	☐	☐	☐	☐	☐
My company considers the possibility of sanctions against products' potential conflict with the law in its operations.	☐	☐	☐	☐	☐
My company considers the effects of regulatory supervision and monitoring in its operations.	☐	☐	☐	☐	☐

<u>SUPPLY CHAIN CONTINUOUS INNOVATIONS</u>

The following questions are related to your supply chain innovations. Please choose the appropriate options.

Q9. To what extent do you agree to the following statements?

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
My company continuously collaborates with its supply chain partners to pursue continuous innovations in core processes.	☐	☐	☐	☐	☐
My company continuously collaborates with its supply chain partners to pursue continuous innovations for cost reduction.	☐	☐	☐	☐	☐
My company continuously collaborates with its supply chain partners to pursue continuous innovations for more effective processes	☐	☐	☐	☐	☐
My company continuously collaborates with its supply chain partners to pursue continuous innovations in technological advancement	☐	☐	☐	☐	☐
My company continuously collaborates with its supply chain partners to pursue continuous innovations for product management	☐	☐	☐	☐	☐

<u>STRATEGIC ENVIRONMENTAL CAPABILITIES</u>

The following questions are related to your company's strategic capabilities for environmental management practices (EMS). Please provide the appropriate answers.

Q10. To what extent do you agree to the following statements on your company's pollution prevention capabilities?

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
My company focuses on enhancing its capacity for the safe disposal of solid wastes.	☐	☐	☐	☐	☐
My company focuses on enhancing its capacity for the safe disposal of hazardous wastes.	☐	☐	☐	☐	☐
My company focuses on modifying its processes for reducing wastes at the source.	☐	☐	☐	☐	☐
My company focuses on enhancing its capacity for water reuse and recycling process.	☐	☐	☐	☐	☐
My company focuses on enhancing its capacity for reducing energy consumption.	☐	☐	☐	☐	☐

Q11. To what extent do you agree to the following statements on your company's product stewardship (product hazards management) capabilities?

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
My company builds and enhances its capacity to evaluate, monitor, and issue information about the health and environmental risks of products.	☐	☐	☐	☐	☐
My company builds and enhances its capacity to effectively provide specific information about products' transportation and usage hazards	☐	☐	☐	☐	☐
My company builds and enhances its capacity to design product packaging that is safe and ecological friendly.	☐	☐	☐	☐	☐
My company builds and enhances its capacity to use environment-friendly alternatives	☐	☐	☐	☐	☐
My company builds and enhances its capacity to deploy a lifecycle approach to product safety management.	☐	☐	☐	☐	☐

Q12. To what extent do you agree to the following statements on your company's capabilities to adopt or produce clean technology?

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
My company has the capacity to adopt or produce photovoltaics or solar energy.	☐	☐	☐	☐	☐
My company builds the capacity to develop, adopt or commercialise wind power sources.	☐	☐	☐	☐	☐
My company has the capacity to produce or adopt new technology for cleaner energy.	☐	☐	☐	☐	☐
My company builds the capacity to implement a cleaner production process.	☐	☐	☐	☐	☐
My company perceives clean technology as a continuous long-term policy.	☐	☐	☐	☐	☐

COMPETITIVE ADVANTAGE

The following questions are related to the environmental and economic competitiveness of your company. Please provide the appropriate answers.

Q13. To what extent do you agree to the following statements in respect of your company's environmental competitiveness?

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
My company has a better relationship with regulators than our competitor(s)	☐	☐	☐	☐	☐
My company has a better reputation as an eco-friendly company than our competitor(s) among stakeholders	☐	☐	☐	☐	☐
My company is able to improve employees' environmental consciousness through training and evaluation more than our competitor(s)	☐	☐	☐	☐	☐
My company places greater consideration on environmental issues in our processes, products and technology innovations more than our competitor(s)	☐	☐	☐	☐	☐
My company is able to decrease the frequency of environmental accidents more than our competitor(s)	☐	☐	☐	☐	☐

Q14. To what extent do you agree to the following statements on your company's economic competitiveness?

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
My company has lowered the costs of environmental compliance more than the competitor(s).	☐	☐	☐	☐	☐
My company generates income from selling usable wastes (cardboard, plastics, scraps etc.) more than the competitors.	☐	☐	☐	☐	☐
My company has decreased costs of materials purchasing more than the competitors	☐	☐	☐	☐	☐
My company has decreased fines for environmental accidents more than the competition	☐	☐	☐	☐	☐
My company has decreased fee for waste discharge more than the competition	☐	☐	☐	☐	☐