A study of Pathways and Obstacles to Sustainable Supply Chain in the oil and gas industry

By

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Declaration

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Abstract

The ongoing sustainability campaigns are now well established. There is a general consensus that the earth is heating up due to man-made activities with potential perils facing the future of humanity. In order to curtail the hazards posed to the environment as a result of mass production of goods and services, there is a renewed interest in sustainable supply chains. In this regard, a significant body of research has been carried out, focusing, amongst other things, on exploring what constitutes sustainable supply chain management and related practices, which are mostly conducted in developed nations. In addition, the links between these practices and organisational performance are unclear and therefore remain a major interest to academics and practitioners alike to address the gap. More so, there has not been corresponding interest and focus on potential pathways and obstacles to achieving sustainability in Nigerian oil and gas industry, constituting an additional knowledge gap. Therefore, this study aims to identify the pathways and obstacles to sustainability implementation and their impact on sustainable supply chain practices and performance. Furthermore, to examine the impact of sustainable supply chain practices on sustainability and operational performance and its role in mediating the relationship between pathways to sustainability and sustainability performance.

To address these research gaps, an extensive literature review was carried out. The research developed a comprehensive pathways/obstacle to sustainability – sustainability practices – organisational performance framework focusing on antecedent and outcome effects, explaining the theoretical connections between the constructs. Further, the thesis is grounded in stakeholders' theory and the delineation of its relevant insights was highlighted. Environmental and social Sustainable supply chain practices are the model's main constructs, with pathways and obstacles to sustainability as an antecedents and sustainability and operational performance as the consequences. Data was collected using a survey by questionnaire from 170 oil and gas companies in Nigeria to examine these relationships. The research model's reliability, validity, and goodness of fit were assessed using accepted statistical tools. In addition, the study uses structural equation modelling to examine the research objectives.

The results of this study are significant, providing evidence that pathways have a positive and significant impact on sustainable supply chain practices and sustainability performance. This suggests that these pathways are not just important, but critical requirements for sustainability implementation and improved sustainability performance. The study also reveals that obstacles can negatively influence sustainability practices and performance. It further shows that sustainable supply chain practices have a positive and significant impact on sustainability performance, although their impact on operational performance is insignificant. Moreover, these practices act as a mediator between pathways to sustainability and sustainability performance. Recognizing these findings and the potential risks associated with obstacles is crucial for developing comprehensive strategies that aim to integrate sustainability into operations and supply networks. Lastly, it is essential for organizations to embed sustainable supply chain practices in their activities to achieve greater sustainability performance.

Building upon extensive literature reviewed and empirical findings, this study contributes to the existing literature in the field of sustainable supply chain management by identifying both the pathways and obstacles to sustainability implementation in Nigeria, empirically confirming that these pathways improved sustainability practices and performance, and obstacles negatively impede sustainability practice and performance. Furthermore, the study clarifies the link between sustainable supply chain practices and organisational performance. Lastly, this research provides valuable insight for managers, policymakers, and environmentalists seeking to implement sustainability practices and promote sustainability agender. The study also provided businesses with a validated conceptual framework for evaluating the impact of implementing sustainability practices on their performance outcome.

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Dedication

This PhD thesis is dedicated to my beloved parents, my daughters Amina and Fatima and my dear wife.

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List of Abbreviations

AGFI	Adjusted Goodness of Fit Index
AMOS	Analysis of a Moment Structures
AU	African Union
AVE	Average Variance Extracted
CEO	Chief Executive Officers
CFA	Confirmatory factor analysis
CFI	Comparative fit indices
CIS	Commonwealth of Independent States
CMB	Common Method Bias
COVID	Coronavirus Disease
CR	Construct Reliability
DF	Degrees of Freedom
E&P	Exploration and Production sector
EFA	Exploratory factor analysis
EU	European Union
GES	Global Energy Statistics
GOF	Goodness of Fit Index
GSCM	Green Supply Chain management
GUI	Graphical User Interface
IBM	International Business Machines Corporation
ICT	Information Communication Technology
ISO	International Organisation for Standardisation
KMO	Kaiser-Meyer-Olkin
LNG	Liquefied Natural Gas
MDGs	Millennium Development Goals
MDs	Managing Directors
MMR	Mixed methods research
NDCs	Nationally Determined Contributions
NFI	Normed Fit Index
NGOs	Non-government Organizations
NGX	Nigerian Exchange Group
NNFI	Non-normed fit index
NNPC	Nigerian National Petroleum Company
NUPRC	Nigerian Upstream Petroleum Regulatory Commission
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of the Petroleum Exporting Countries
Pclose	Parsimony Close
RBV	Resource Based Theory
RMSEA	Root Mean Square Error of Approximation
SCM	Supply Chain Management
SEM	Structural Equation Modelling
SMEs	Small and Medium-Sized Enterprises
SPSS	Statistical tools for social science
SRMR	Standardized Root Mean Square Residual
SSCM	Sustainable Supply Chain Management
SSCP	Sustainable Supply Chain Practices
TBL	Triple Bottom Line
TDM	Total Design Method

TLI	Tucker-Lewis's index
UAE	United Arab Emirates
UCLAN	University of Central Lancashire
UK	United Kingdom
UN	United Nation
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIEF	United Nations International Environment Forum
USA	United State of America
WCED	World Council on Environment and Development
WSSD	World Summit on Sustainable Development

Chapter One: Introduction

1.1 Introduction

In this chapter, the foundation for this thesis is established. It provides a detailed explanation of the background context, including identifying the research gaps in the literature. It also presents the sector of the study, the aim of the research, the Research objectives, the significance of the study, the methodology employed for the study and the structure of the thesis. The chapter also presents a summary of the chapter.

1.2 Background to the study

In recent times, sustainability has become a growing international issue. The mass production and consumption of energy and other natural resources are the causes of these pressing social and climate change concerns (Geyi et al., 2020; Tseng et al., 2016). As such, organisations and industries are under pressure from different stakeholders to reduce their social and environmental impact and move towards sustainability (Sarkis et al., 2018; Orji et al., 2019, Govindan, et al., 2020; Gupta et al., 2020; Ali et al., 2021a). The major driving forces for this shift can be attached to increasing competitive pressure, arising from the recognition of cost reduction through minimizing the use of energy, material input, and waste management. Other forces emanate from raising awareness of social and environmental issues and pushing for sustainable products and legal obligations to increase sustainability regulation. More so, the rise of environmental concerns, coupled with the limited availability of resources and the deterioration of the overall living conditions, has also prompted stakeholders, customers, and government entities to call for an increased provision of products and services that prioritise environmental preservation. Consequently, the anticipated line of accountability encompassing environmental and social factors, coupled with growing demands from stakeholders, customers, competitors, and regulators on a broader scale, have compelled companies in Nigeria, especially those in the oil and gas industry, to prioritise the eco-friendliness of their supply chains. In order to meet this demand, Esfahbodi et al. (2017) argued that companies should integrate sustainable materials and transition towards

operating as sustainable supply chains, thereby offering more environmentally conscious products, services, and product-service combinations.

These pressures could translate into competitive benefits for the organization that elect to adapt to them – reduced cost, increased market access and market share, increase levels of investment, improved corporate reputation, minimized risk, enhanced customer satisfaction and employee engagement (Yahaya et al., 2013; Zhu et al., 2017). As organisations recognise these opportunities, sustainability requires firms to determine how to meet their various stakeholders' social, environmental, and economic objectives across the supply network (Ozkan, et al., 2020; Slack and Brandon-Jones, 2018). It emphasized that businesses should measure their financial outcomes and their social and environmental performance using a framework of 'triple-bottom-line (Matiyazhagan, et al., 2013). These called for cross-border collaboration and strong governance as sources for protecting natural resources and reducing climate change. Here collaborative governance means not only to the action of operations managers, but collaboration among the whole supply networks, including universities, suppliers, customers, NGOs (non-government organizations), government, employees, civil society, and other stakeholders may be a pathway to innovative and sustainable solutions to current challenges.

Therefore, the extent to which organizations and industries, particularly the oil and gas industry in Nigeria, should proactively address these sustainability issues remains a point of contention in the literature. In this regard, a significant body of research has been carried out, focusing, amongst other things, on exploring what constitutes sustainable supply chain management and related practices and providing persuasive, logical reasons and anecdotal evidence for how such activities can enable businesses to increase their sustainability performance even though disputed (Zhao et al., 2023; Larbi-Siaw et al., 2022; Pan et al., 2022), which are mostly conducted in developed nations (Arena et al., 2023; Appiah et al., 2022; Sun et al., 2022; Fu et al., 2022). Furthermore, there has been a notable absence of corresponding interest and focus on potential pathways and obstacles to achieving sustainability, particularly in Nigeria (Dhali et al., 2024; Yetano et al., 2020; Elum et al., 2017), creating a significant knowledge gap. Only a few prior academic research have shed light on the successful path that either enables or impedes the implementation of sustainability practices,

and these are notably lacking in empirical studies, further accentuating the knowledge gap.

In addition, Green et al. (2012), as cited in Esfahbodi et al. (2017), argued that the willingness of companies to adopt sustainable supply chain practices throughout their supply chains is primarily influenced by the efforts of government and regulatory bodies worldwide to mitigate their negative environmental impact. In a similar view, Bostrom et al. (2015) and Piya et al. (2022) state that while there is a certain level of influence from increased customer demand for eco-friendly products, the oil and gas industry in Nigeria mostly embraces sustainable supply chain practices in response to environmental regulations imposed by the government. While existing literature often highlights regulations as the primary driving force behind the adoption of sustainable supply chain practices (Huang et al. 2021; Omar et al. 2019; Koh et al. 2012; Zailani et al., 2012), several recent studies have indicated that regulations alone are necessary but insufficient for the implementation of such practices (Ohene et al. 2022; Yin et al. 2018; Gunningham et al. 2017; Levidow et al. 2014; Zhu et al., 2019; Hsu et al., 2016). Recent research has suggested that while regulations can promote adopting sustainable supply chain practices to a certain extent, achieving true sustainability also requires internal commitment and support at various company levels (Esfahbodi et al., 2017).

In addition, despite the presence of supportive legislation, regulations, and assistance, numerous obstacles continue to hinder the widespread adoption of sustainable supply chain practices in oil and gas industry in Nigeria. Researchers have examined these obstacles in different sectors and nations in recent years (Ohene et al., 2022). However, such studies have been conducted in developed nations. Until now, only a few efforts have been made to comprehensively identify these obstacles in oil and gas industry in Nigeria in order to develop effective strategies to address them, which necessitates this study. Additionally, there is a scarcity of surveys that examine both the state-of-the-art and local perspectives regarding the barriers to implementing sustainable supply chain practices in the oil and industry in Nigeria (Ohene et al., 2022).

Therefore, this study assumes a collection of antecedents together with regulations as pathways or obstacles to the sustainability implementation. More so, there is a

lack of studies in the literature that altogether study the antecedents and consequences of sustainable supply chains, particularly in developing economies' oil and gas industries (Karmaker et al., 2023; Piya et al., 2022; Zhang et al., 2021; Huang et al., 2021;).

Furthermore, research conducted by Baliga et al. (2020) and Wang et al., (2023) has demonstrated that the adoption of sustainable practices can lead to cost reductions, as effectively managing sustainably supply chains improves the financial performance of organizations. Similarly, other studies conducted by Wang et al. (2018), Shafique et al. (2017), Kuo et al. (2017), Hasan (2013), and Luthra et al. (2015) have shown a positive association between sustainability practices and overall organizational performance. Pullman et al. (2009) examined the impact of sustainable supply chain practices on performance in Egyptian companies and found evidence supporting the connection between sustainability practices and environmental performance, as well as the link between social practices and quality performance (Kuwornu et al., 2023).

Nevertheless, there are conflicting findings regarding the influence of sustainable practices on organisational performance (Zhao et al., 2023; Larbi-Siaw et al., 2022; Pan et al., 2022; Geyi et al., 2020; Magon et al., 2018; Alshehhi et al., 2018; Grewatsch et al., 2017; Luzzini et al., 2015). Studies such as Ahmed et al. (2020) report a negative impact of sustainability practices on firm performance. Other studies that reported a negative finding include Das (2018), Khan et al. (2017) and Garg (2015). These findings suggest a lack of clarity in understanding the relationship between sustainable supply chain practices and corresponding organisational performance outcomes.

This research aims to address the uncertainty present in the current literature by conducting a comprehensive investigation into the ongoing debate regarding the influence of sustainable supply chain practices on organisational performance. More so, these studies have significantly contributed to understanding the impact of sustainable supply chain practices on organisational performance. But there is a lack of empirical evidence on the role of sustainable supply chain practices in mediating

the relationship between pathways to sustainability and sustainability performance, which the study also seeks to fill the gap.

Furthermore, integrating Sustainable Development Goals (SDGs) into oil and gas operations represents a critical pathway towards achieving environmental sustainability, social responsibility, and economic viability within the industry. In 2015, all United Nations Member States adopted the Sustainable Development Goals (SDGs) as a global call to action to eradicate poverty, protect the environment, and ensure everyone can live in peace and prosperity by 2030. These 17 interconnected goals serve as a "blueprint for creating a better and more sustainable future for all." They tackle many global challenges, including poverty, inequality, climate change, environmental degradation, peace, and justice (Ashraf et al., 2019; Leal Filho et al., 2019; Saxena et al., 2021). Integrating the Sustainable Development Goals (SDGs) into Nigeria's oil and gas supply chain industry is a critical move for the industry's sustainability and a significant contribution to global sustainability targets. Traditionally, the oil and gas industry has been associated with a substantial environmental impact and a significant contribution to greenhouse gas emissions. However, it faces mounting pressure to show its commitment to sustainable supply chain practices.

Therefore, incorporating SDGs into the oil and gas supply chain is crucial for reducing environmental and social impacts while fostering innovation, competitiveness, and relevance amid evolving energy dynamics (Borges et al., 2022; Rashed & Shah, 2021). Nigerian oil and gas companies can significantly contribute to global efforts against climate change, energy security, and economic growth by integrating SDG principles into their strategies. However, despite the adoption of the 2030 Agenda, there is a consensus among experts about the lack of a transparent implementation approach for SDGs, risking attaining these goals without immediate action (Borges et al., 2022). With the ongoing global reliance on oil and gas (Mendes et al., 2017), successful implementation of SDGs in Nigeria's oil and gas sector is not just a necessity, but a responsibility that the industry must shoulder. Furthermore, the industry, as a key player, must address the challenge of understanding interconnections and trade-offs between SDGs, especially those impacting clean energy, economic growth,

infrastructure, and climate action (Wang et al., 2019; Stafford-Smith et al., 2017; Castro et al., 2021)

Therefore, the purpose of this study is to examine the direct impact of pathways and obstacles on sustainable supply chain, sustainability and operational performance. Further, to determine the direct impact of sustainable supply chain practices on sustainability and operational performance and its mediating role in the relationship between pathways and sustainability performance across the whole supply network.

The main variable of the study is sustainable supply chain practice, which has multiple roles: first, as the outcomes (dependent variable) of pathways and Obstacles; second, as enablers (independent variable) of sustainability and operational performance; and last, as a mediator between pathways and sustainability performance. In the context of this thesis, sustainable supply chain practices refer to integrating environmental and social considerations into the management of the supply chain, from sourcing crude oil to delivering finished refined products (oil and gas) to customers across the oil and gas supply network. This approach seeks to minimize the environmental impact of supply chain activities and promote social responsibility while maintaining efficiency and competitiveness in the oil and gas industry.

1.3 The sector of the study: Oil and Gas Industry

The oil and gas industry is currently undergoing a transformation towards cleaner energy sources to mitigate the impact of climate change. Russia's invasion of Ukraine and relaxation of COVID–19 restrictions made economic activity recovers, and energy consumption is expanding, which increases the demands for available energy supplies and leads to fragilities in the system that make the industry face challenges related to sustainability, geopolitical uncertainties, the escalating cost of exploration, price volatility, and the need to embrace technological advancements.

The oil and gas industry satisfies more than 57% of global energy demand. The global Energy Statistics (2023) indicate that in line with economic patterns, the growth rate of global energy consumption was halved in 2022. It went from a 4.9% increase in 2021 to 2.1% in 2022, surpassing the average rate observed between 2010 and 2019

of 1.4% per year. The two largest energy-consuming countries (China and US) experienced a slowdown in energy consumption growth. The report also indicates that in 2022, there was a 3.5% increase in global oil product consumption, which was higher than the average growth rate of 1% per year observed between 2010 and 2019. However, this growth rate was much slower than the previous year, 2021, when it increased by 6.1%. The slower growth in 2022 can be attributed to stagnation in the United States and the European Union and a mere increase in China due to an economic slowdown and the implementation of the Zero-COVID policy on transportation.

In addition, the report showed that following a rise in global gas consumption recorded in 2021, gas consumption experienced a decline in 2022, marking its first decrease since 2009. This drop can be attributed to reduced gas demand in several regions, including the European Union, Russia, Brazil, and China. Conversely, gas consumption saw significant increase in North America, the USA and Canada. This increase was driven by higher gas production, economic expansion, and increased gas demand from the industrial and power sectors. Gas consumption also rose in the Middle East due to increased gas-fired power generation, water desalination, and petrochemical production (GES, 2023).

Therefore, the oil and gas industry are viewed as a major cause of climate change and environmental problems. It is under significant pressure to transform into a more sustainable way of operating while enhancing shareholder return (Morgunova et al., 2022). The industry must act swiftly because success and sustainability necessitate a complete transformation of organisations, not incremental change (Geyi et al., 2020).

1.3.1 Oil and gas industry in Nigeria

Oil was found in Nigeria in 1956, and production began in the late 1950s (Kamara et al. 2023; Fagorite et al. 2023). In the following decade, foreign companies were allowed to explore oil in Nigeria, leading to continuous growth in the oil industry, with a few exceptions due to economic circumstances. In 1977, the Nigerian National Petroleum Company (NNPC) was established as a state-owned corporation to regulate and participate in the country's oil business (Promise et al. 2023). Nigeria is

the largest oil producer in Africa, operating 18 pipelines and producing an average of 1.8 million barrels per day in 2020, making it the eleventh largest oil producer globally (Abu et al. 2023).

The petroleum industry contributes about nine percent to Nigeria's GDP, accounting for nearly 90 percent of its total export value (Awe et al. 2023). Since the early 1970s, Nigeria has been a member of the Organization of the Petroleum Exporting Countries (OPEC). The organization's goal is to unify and coordinate the global oil market. Nigeria ranks as the ninth largest oil exporter in the world in terms of value. This means about 90 percent of the country's export value comes from mineral fuels, oils, and distillation products.

According to data released by the Nigerian Upstream Petroleum Regulatory Commission (NUPRC) (2023), Nigeria has managed to increase its crude oil production in relation to its budget benchmark, despite consistently falling short in the past two years. The data shows that between the second half of 2022 and the first quarter of 2023, Nigeria was able to raise its crude oil output from an average of approximately 60 percent to 75 percent.

Based on the analysis of production data, it was found that Nigeria fell significantly short of its projected crude oil production of 1.88 million barrels per day, as stated in the 2022 federal budget. Between January and December 2022, Nigeria produced over 277 million barrels less than the projected amount, resulting in an average production rate of 60 percent. However, due to increased efforts in combating oil theft and vandalism of assets in the Niger Delta, Nigeria has successfully extracted 115 million barrels of crude oil in the first quarter of 2023. This achievement has elevated the average production rate to 75 percent, representing a significant increase of approximately 15 percent.

Therefore, Oil and gas production in Nigeria has significantly contributed to climate change. Greenhouse gases emitted during the extraction, refining, and burning of fossil fuels, along with widespread gas flaring, have increased carbon dioxide and methane levels. Oil spills and improper waste disposal have also harmed ecosystems, releasing additional greenhouse gases. Oil and gas combustion for energy,

transportation, and industry further amplifies the problem. Nigeria should prioritize sustainable practices, such as reducing flaring, improving regulations, promoting renewables, and adopting cleaner technologies to mitigate emissions and lessen the impact of climate change.

The increase in the mass production and consumption of energy, as stated above in the world and Nigeria in particular, is the primary motivating force for chosen oil and gas industry, specifically Nigeria as the sector of the study.

1.4 Aim of the Research

This study significant to the Nigerian oil and gas industry, aims to identify and investigate the impact of pathways and obstacles to sustainable supply chain practices and organisational performance (sustainability and operational). While most studies concentrate on sustainable supply chain management in developed nations, this research is tailored to the unique pathways and obstacles to sustainability in the Nigerian context. It delves into the links between these practices and organisational performance, a topic of major interest to academics and practitioners. Despite the industry's significance, there has been a dearth of research on potential pathways and obstacles to achieving sustainability in Nigeria's oil and gas sector. Furthermore, the literature on these issues still lacks empirical evidence. In light of this, the current study takes a holistic approach, examining the pathways and obstacles to achieving sustainable supply chain practice and performance across the entire supply network of the Nigerian oil and gas industry.

1.5 Objectives of the study

To accomplish the overall aim of the research, the researcher has subdivided the aim into a series of precise target objectives. These research objectives are:

1. To identify the pathways and obstacles to sustainable supply chain practices in oil and gas supply chains in Nigeria.
2. To investigate the impact of pathways on sustainable supply chain practices and sustainability performance in oil and gas supply chains in Nigeria.
3. To investigate the impact of obstacles on sustainable supply chain practices and sustainability performance in oil and gas supply chains in Nigeria.

4. To examine the impact of sustainable supply chain practices on sustainability and operational performance across oil and gas supply chains in Nigeria.
5. To Examine the mediating roles of sustainable supply chain practices on the relationship between pathways and sustainability performance across oil and gas supply chains in Nigeria

1.6 Significance of the study

This study aims to provide significant contributions to the impact of sustainability implementation in the oil and gas sector by identifying the pathways and obstacles to sustainability implementation as the antecedent of sustainability practices which was neglected in related previous studies, and empirically confirming the relationship between pathways, obstacles, sustainable supply chain practices and organisational performance from the perspective of a developing country such as Nigerian. Furthermore, there are conflicting results within the existing literature on the impact of implementing sustainable supply chain practices on organisational performance; the findings of this study make a head forward in clearing these ambiguities and uncertainties in the literature.

In addition, the study provides an empirically validated conceptual framework for evaluating the interrelated impact of pathways and obstacles to sustainability implementation on sustainability and operational performance. The framework shows critical requirements and obstacles for sustainability implementation, which can help the government, regulators, practitioners, policymakers, employees, and customers to identify those areas where improvement is required which should be prioritised.

1.7 Research methodology

This research utilised a quantitative research method. Data was collected via a questionnaire from oil and gas companies listed in West Africa's Premier Oil & Gas Directory and Nigerian Exchange Group (NGX Group) in Nigeria. The questionnaire was pilot-tested, and the pilot study results were used to review the questionnaire. The reviewed questionnaire was then used to undertake a full survey of organisations drawn from the oil and gas supply chain. The questionnaire was administered through postage and mailed directly to sampled organisations. The questionnaires

were distributed to respondents via mail because they were easy, inexpensive, and efficient. Six hundred (600) questionnaires were sent directly to the sampled companies' supply chain managers and chief executive officers. A total of 187 responses were received. However, only 170 questionnaires received were used for data analysis due to missing data. The data collected was analysed using the industry-standard software Statistical Package for Social Science (IBM SPSS 28 & AMOS 29). The structural equation modelling was used to address the research objectives.

1.8 Structure of the thesis

This thesis consists of seven chapters structured as follows: Chapter 1 is the introduction. It states the background of the research, aim, objectives and questions. Chapter 2 reviews the literature on the background of sustainability, the definition of sustainability, pathways and obstacles, sustainable supply chain practices, sustainability, and operational performance. Chapter 3 discusses the theoretical and conceptual framework. Chapter 4 discusses the methodology adopted to empirically examine the proposed relationship in the model established in Chapter Three. The chapter providing an overview of research philosophy, approaches, and methods adopted. Chapter 5 reports the survey by questionnaire, in which the data collected was analysed using SPSS and SPSS AMOS. Both descriptive and inferential statistics were presented in this chapter.

Chapter 6 delves into the study's findings, which are presented in Chapter 5. It presents a comprehensive and thorough analysis of individual and combined results of the model, offering critical interpretations of the derived insights. Furthermore, it examines the findings' consistency with existing literature, provides explanations for any inconsistencies that may arise, and also states the theoretical implications. In chapter 7, the research objectives are revisited. The chapter delineates the theoretical and managerial implications that emerge from the research. It also emphasises the significant contributions and acknowledges its limitations. The chapter suggests potential directions for further study.

1.9 Summary

This chapter presents detailed background information, including the research gaps within the existing literature on pathways and obstacles to sustainability. It also presents the sector of the study, gives justification for the chosen sector by highlighting that oil and gas energy remains the primary source of energy and indicates an increase in the production of oil and gas despite the current invasion of Ukraine by Russia and restriction of economic activities in the last three years as the result of COVID – 19 pandemics. It also included sustainable development goal (SDGs) as the rational for the study. The chapter further presents the research aim and objectives to be addressed in the study. The significance of the study was also presented, followed by the thesis's structure, and the chapter ends with a summary. The next chapter presents a review of related literature.

Chapter Two: Literature Review

2.1 Introduction

This chapter reviews relevant literature to provide the theoretical foundation for different constructs that will be used to formulate the thesis model. The literature review covers the following topics: Sustainability, Pathways and Obstacles to Sustainability, Sustainable Supply Chain Practices, Sustainability and Operational performance. Following this is a summary of this chapter.

2.2 Background of sustainability

The term sustainability was derived from the Latin word sustainer, meaning to hold or sustain, which means to maintain and endure. Sustainability defines the ability of organisations or processes to endure over time. For instance, Nigerian Conservation Foundation (NCF) is a prime example of sustainability in action. How sustainable an organisation can be understood by its overall efficiency and effectiveness. According to Brundtland's report (1987), sustainability is the development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. Based on this widely accepted definition of sustainability, it is thought that sustainability rests on three pillars: social, environmental and economic development (Van Wynsberghe, 2021; Murray et al., 2017). Spijkers (2018) states that the Brundtland report provided a complete view of the concept of sustainability, predominantly based on its findings on claims made in prior documents and conventions. The Brundtland report was developed on the premise that economic and environmental factors should be interdependent and mutually reinforcing, thus defending the ability to provide a complete perspective on sustainability.

The modern concept of sustainability is a testament to its complexity and depth, rooted in the gradual inclusion of its three pillars. The environmental aspect took the spotlight in the early phases of the concept's development, with the economic and social aspects gradually being incorporated. This evolution, as studies have demonstrated, is a gradual and thoughtful process, leading to the conclusion that the economic, environmental, and social factors are all crucial when addressing the issue of sustainability (Mangukiya et al., 2023; Boussemart et al., 2020).

Environmental sustainability, the pillar that ensures the natural environment remains productive and resilient, is under threat due to unsustainable practices. It relates to ecosystem integrity and the carrying capacity of the natural environment. Social sustainability, another pillar, is a reminder that we, as individuals, matter. It encompasses equity, empowerment, accessibility, participation, cultural identity and institutional stability. It implies that people matter since development is about people. Economic sustainability, the third pillar, means a system of production that satisfies present consumption levels without compromising future needs. It's crucial to note that traditionally, economists, assuming that the supply of natural resources was unlimited, placed undue emphasis on the capacity of the market to allocate resources efficiently, a mindset that has led to the depletion of resources and environmental degradation (Justice, 2019).

2.3 Definitions of Sustainability

Since its inception, sustainability has been defined in various contexts and disciplines in dozens of ways (Scalabrino et al., 2022; Abubakar, 2014). However, the World Council on Environment and Development (WCED) provides the first internationally accepted definition of sustainability (Chowa et al., 2023; Wachira et al., 2023) that defines *sustainability* as 'the development that meets the needs of the present generation without compromising the ability of the future generations to meet their own needs. This means that today's actions affect future generations (Roggema et al., 2023; Gill et al., 2022). This definition, despite some criticisms, is a significant milestone in the field of sustainability, providing a foundation for understanding and action. Adopting sustainability is an innovative approach to the current environmental crisis that guarantees production does not deplete resources beyond the point of renewal (WCED, 1987, cited in Lei et al., 2023). Some people agree and accept it (Chan et al., 2022; Jeronen, 2022; Nechita, 2022), whereas others accept the concept of sustainability but reject the WCDE's definition (Pazienza et al., 2022; Daly, 1989; Goodland, 1995).

Regardless of the criticisms against this definition, it provides a foundation for sustainability. Ligorio et al. (2022) and Ruggerio (2021) argue that debates over the definition of sustainability have raised the concept. For instance, one definition might

focus on the environmental aspect, stating that sustainability is about preserving natural resources for future generations. Another definition might emphasize the social aspect, defining sustainability as ensuring a high quality of life for all people. There are numerous definitions of sustainability to date, and these definitions have revealed a variety of distinct yet interconnected approaches (Carmine et al., 2023; Best et al., 2022). There are up to 300 definitions of sustainable development in the literature (Manioudis et al., 2022). The International Environment Forum of the United Nations (UNIEF) discovered that at least one thousand globally diverse definitions of sustainability have been proposed (Ricketts, 2010).

The literature includes definitions of sustainability from the 1980s and 1990s, which marked the early stages of defining sustainability, and those from the Millenniums, which reflect the evolving understanding and perspectives on sustainability, as explained in the table below. This historical context helps us understand the evolution of sustainability definitions over time and the diverse approaches that have emerged.

Table 2.1: The definitions of sustainability in the 1980s and 1990s and Millenniums

	Definitions and References
Sustainability Definitions in 1980s:	include Redclift (1987), which defined sustainability as the capacity of a system to uphold its productivity when confronted with significant disruptions, such as those stemming from soil erosion, financial obligations, and unforeseen threats are Liverman et al., (1988) who described the idea as the enduring continuation of the human species (accompanied by a quality-of-life surpassing mere biological existence) by means of preserving the fundamental life-sustaining elements (such as air, water, land, and living organisms) and maintaining the necessary structures and systems that manage and safeguard these integral components Robert, (1988) cited in Pearce et al (1990) defines Sustainability is a development strategy that manages all assets, natural resources, human resources, financial and physical assets for increasing long-term wealth and well-being. Lynam and Herdt (1989) suggested that sustainability is the capacity of systems to maintain output at a level approximately equal to or greater than its historical average, with the approximation determined by the historical level of variability.
Sustainability Definitions in 1990s:	Sustainability is the development without material growth beyond environmental carrying capacity and which is socially sustainable (Dally, 1990 cited in Goodland 1995). Pearce and Turner (1990) sustainability are the development that involves maximizing the net benefits of economic development, subject to maintaining the services and quality of natural resources over time. Costanza (1991) elucidated that sustainability is the amount of consumption that can be sustained indefinitely without degrading capital stock including natural capital stock.

	Sustainability was also defined as improving the quality of human life while living within the carrying capacity of supporting ecosystem (World Conservation Union, 1991). Sustainability is adopting business strategies and activities that meet the needs of the enterprise and its stakeholders today while protecting, sustaining, and enhancing the human and natural resources that will be needed in the future (IISD, 1992). Sustainability was also defined as the improvement in the quality of human life within the carrying capacity of supporting ecosystem (World Wildlife funds for nature 1993, cited in Goodland, 1997). Sustainability means to balance the limits to growth and the need for development (Mitcham, 1995 cited in Du Pisani, 2006).
Definitions in the Millenniums:	Hyclick and Hockerts (2002) defined corporate sustainability as 'meeting the needs of a firm's direct and indirect stakeholders (shareholders, employees, clients, pressure group and communities), without compromising its ability to meet the needs of future stakeholders as well' (P. 131) 'Sustainability … cannot be simply a 'green' or 'environmental' concern, important though 'environmental' aspects of sustainability are. A truly sustainable society is one where wider question of social needs and welfare, and economic opportunity are integrally related to environmental limits imposed by supporting ecosystems' (Agyeman et al 2002 cited in Agyeman and Evans 2004, p. 157). According to Sigma (2006) organisations pursue sustainability by actively managing and enhancing five assets: natural capital (the environment), human capital (people), social capital (social relationships and structures), manufactured capital (fixed assets) and financial capital (profit, sales, shares, and cash). Hasna (2007) deduced that sustainability refers to development of all aspects of human life affecting sustenance. Aras and Crowther (2009) stressed that sustainability is 'development that attempts to bridge the gap between economic growth and environmental protection, while taking into account other issues traditionally associated with development'.

(**Source:** Abubakar, 2014)

Therefore, sustainability is a complex concept with numerous definitions, each shaped by its dependence on economic, environmental, and social factors. Furthermore, sustainability is a topic that spans multiple disciplines, each contributing its own unique definition, leading to a diverse range of interpretations. However, the essence of sustainability is not in its myriad definitions, but in the way it is understood. The power of words lies in the consensus of a language community, for it is this collective agreement that gives them their true meaning (Mahowald et al., 2022).

2.4 Pathways to Sustainability Implementation

The implementation of sustainability in the oil and gas industry has attained maturity level mostly in developed countries. The concept of sustainability within supply chains is the integration of explicit and comprehensive economic, environmental, and social objectives into organisations' strategic vision and long-term strategic goals. Over the past two decades, there has been a significant surge in recognition of environmental concerns, and businesses have been eager to promote environmental and economic awareness among industrialists who prioritise sustainability and eco-friendliness (Wang & Song, 2017). Organisations have focused on green and sustainable supply chains to solve environmental (Saroha et al., 2020) and social issues (Mani & Gunasekaran, 2018). Furthermore, the growing concern about climate change has forced organisations to consider inculcating sustainable supply chain practices into their operational activities due to pressures from various stakeholders.

However, how to achieve these objectives has been a growing concern for organisations and industries, particularly the oil and gas industry, because of the ongoing debate on whether it pays to implement sustainability practices. Therefore, the realisation of the above objectives is subject to internal and external influences referred to as pathways. Pathways are ways of achieving sustainable results. In this thesis, it refers to essential requirements for achieving sustainability. Further, Pathways to sustainability are those enablers that influence the adoption of sustainable supply chain practices and impact the overall performance of the oil and gas industry.

Lee and Klassen (2008) suggest that having these pathways in place influence the implementation of sustainable supply chain practices and enhances the positive outcomes of sustainable initiatives on overall performance. Conversely, their absence can impede progress in this regard. Various studies, including those by Rajesh and Ravi (2015), Yang et al. (2011), Shibin et al. (2016), and Ciccullo et al. (2018) argue that numerous well-established supply chain practices can assist businesses in implementing sustainable practices. However, despite its significance, there is a lack of studies on pathways to sustainability in emerging economies like

Nigeria, necessitating further research for practical implementation (De Abreu et al., 2021; Mani & Gunasekaran,2018; Mishra et al., 2017.

This emphasises the necessity to identify the factors that can drive achieving these objectives (Ahmad et al., 2016). Men et al. (2023) assert that including sustainability objectives within the Supply Chain Management (SCM) framework is highlighted as a distinct factor that could force sustainable development or be impacted by other variables within the business and organisational context. The objectives are frequently examined in connection with creating and implementing practices for Sustainable Supply Chain Management (SCM) that can simultaneously enhance economic, environmental, and social performance through collaborative optimisation. Therefore, it is essential to evaluate the pathways for enhancing the implementation of sustainability across the whole supply chain. The pathways to sustainable supply chain practices in the oil and gas industry in Nigeria include the following:

2.4.1 Top Management Commitment

The top management of any organisation is not only responsible for knowledge management among the employees, but also for the direct duty of formulating and implementing policies. This makes them the driving force behind the development of sustainability policies and the management of employees for the complete implementation of sustainable practices (Akanmu et al., 2023; Lu et al., 2022). Their leadership creates an environment that encourages knowledge sharing and management, ensuring employees' high commitment to sustainability practices. The effective administration of knowledge and the promotion of awareness about the benefits of sustainable development are not just important, but urgent for its implementation (Cormican et al., 2021; Costache et al., 2021). This can only be achieved if the leaders are highly committed and focused on meeting sustainable objectives. An organisation with such a highly committed management will have a transparent and integrated sustainability policy and actively participate in fully implementing the sustainable supply chain practices that contribute to sustainable development.

2.4.2 Government Regulations/Legislations

Environmental issues such as climatic change and global warming compelled governments around the world to enact laws requiring businesses to control their operations to minimise their environmental and social impacts (Tang & Demeritt, 2018; Puppim et al., 2017). Studies have indicated that legal enabling is one of the most influential pathways for implementing sustainability in all categories of business organisations. As one of the significant pathways, legislation leaves a company with no choice but to comply or exit the market. These laws may be prompted by a government's concern for environmental degradation, public opinion or pressure, interest groups, a lack of resources, or a nation's preferred mode of development, and they may also act as a direct path to sustainability (Costache et al., 2021; Chege & Wang, 2020).

Despite variations in national laws, proactive approaches to legal conformance with climate-related laws appear more economically beneficial for businesses and societies than reactive approaches. The coercive and deterministic requirements of the regulatory pressure could improve the oil and gas companies support for implementing sustainability. Increasing penalties, fines, and legal fees have highlighted the significance of abiding by the law (Heyden et al., 2020). In addition, these oil and gas companies can avoid costly capital upgrades by staying ahead of the regulation. This means many oil and gas companies in Nigerian that implement sustainable practices do so because of national legislation. It is also essential to note that not all nations enforce these laws effectively. Thus, multinational corporations are allowed to conduct their business differently in various countries based on the degree to which the law of that country is enforced.

Government regulations may not ensure the success of sustainability implementation on their own despite their ability to compel businesses to adopt a sustainable approach (Huynh et al., 2024; Edirisinghe et al., 2024). Government regulations usually consist of take-back and closing-the-loop statutes for a company's primary products. In many instances, most government regulations, especially in Nigeria, only apply to a limited number of products that can claim to satisfy sustainability standards throughout their entire life cycle. Furthermore, government

regulations are significantly less pertinent in the upstream portion of the supply chain because they sometimes mandate clean or emission-free production.

Furthermore, the ISO 14001 standard, unveiled by the International Organization for Standardization (ISO) in 1996, has been a transformative force for oil and gas in Nigeria. It encourages the voluntary integration of environmental sustainability into operations, thereby reducing environmental risks and enhancing ecological performance across industries. These standard influences procurement, waste reduction, packaging materials, and logistics decisions. It has also revolutionized supplier selection, with many companies in the sector now choosing suppliers based on ecological criteria and requiring ISO 14001 certification to improve overall environmental and operational performance. Importantly, this standard has significantly raised awareness and pressure on companies to implement effective environmental management systems throughout their supply chains (Ofori et al., 2024), driving a sense of environmental responsibility.

2.4.3 Support from Government, Non-governmental organisations and International organisations

Implementing sustainable practices is a complex task that requires additional support from government, international organisations, and NGOs (Bello-Pintado et al., 2023; Siems et al., 2023, Yusuf et al., 2012). Their involvement is not just beneficial, but crucial for the success of these initiatives. Most sustainable supply chain practices are expensive and necessitate the adoption of new technologies (Romagnoli et al., 2023; Metcalf & Benn, 2013). Companies will need resources to implement green practices with minimal adverse environmental effects. In addition to physical resources, human resources are required to adapt to the new operating systems. Implementing green practices, such as renewable energy sources and sustainable transportation and procurement, incurs additional costs for the company to achieve sustainability. Most for-profit businesses maximise profits and increase shareholder value (Asgarian et al., 2024; Costache et al., 2021). If sustainable practices incur additional costs, the organisation must implement proper management to satisfy its obligations. In addition, the likelihood of most shareholders agreeing with sustainability decisions is minimal; therefore, the additional costs associated with

executing sustainable activities may discourage the company from engaging in them (Jayaraman et al., 2023; Wirtenberg et al., 2007). As much as greater support will facilitate the execution of sustainable practices. Therefore, support from these stakeholders will serve as a pathway to sustainable supply chain implementation.

2.4.4 Ingraining Culture in Organisation

In studies conducted over the past decade, culture has been identified as an essential pathway of sustainability practices. Culture is indispensable to sustainable development due to its role in economic development and poverty reduction. The social aspect of sustainability is primarily driven by culture (Wirtenberg et al., 2007). A culture-led approach and sustainable development ensure that individuals' social requirements are considered when carrying out any task (Kirwan, 2024; Cumpston et al., 2019). As a result, the organisation's impact is managed to prevent adverse social effects on individuals. Social development results from a community's cultural values and beliefs being respected. In addition, incorporating cultural norms into the management process provides valuable insight into selecting environmental management practices and identifying ecological challenges that must be addressed (Wirtenberg et al., 2007). Ingraining critical values into oil and gas companies are essential for achieving sustainability. It focuses on meeting human social requirements and provides valuable insights into approaches to environmental conservation, reducing biodiversity loss, and preventing climate change's adverse effects. Culture contributes to achieving sustainability through its connection to biodiversity, its association with consumption patterns, and its influence on sustainability management practices.

2.4.5 Customers Encouragement and Support

The primary objective of all processes and activities involved in supply chain management is to satisfy the final customers (Mentzer et al., 2001). This is because administering supply chain operations is only justifiable if customers accept the final products. Customers are significant in supply chain management because they can influence the adoption of new supply chain initiatives (Fang et al., 2023; Yusuf et al., 2012). Increasing environmental concerns today have led to increased environmental awareness and a gradual transition in consumer demand for more eco-friendly

products and services. This is supported by research findings that assert that consumers' environmental and social standards are increasing (Cao et al., 2023; Mitra & Datta, 2014; Yusuf et al., 2012). Considering the significance of consumers in the SCM context and their growing environmental awareness, studies identify customers as a further catalyst for sustainable supply chain adoption.

With the growing environmental awareness today and the heightened environmental expectations of consumers, businesses may fear that consumers will boycott their products if they are not environmentally sustainable. This could result in a significant loss of reputation and, ultimately, financial loss, which faced a consumer backlash and a drop in sales due to their unsustainable supply chain practices. Zhang et al. (2023) concur and suggest that consumers would hesitate to do business with companies with social or environmental issues in their supply chains. In the Nigerian oil and gas companies, it is essential to note that because of sustainability awareness, industrial customers also demand environmental protection initiatives to satisfy their end customers (Papadopoulou et al., 2023). Also contributing to the adoption of SSCM is customer pressure, which demands products that are produced using environmentally sustainable processes.

2.4.6 Information Technology Advancement

The emergence and growth of information technology have made significant contributions to the achievement of sustainable development. Jiskani et al. (2022) state that ICT is one of the most critical sustainability pathways for promoting green activities. ICT has made the development of intelligent systems possible to manage carbon emissions from extraction activities and the environment. The development of information technology has facilitated the improvement of product designs and the adoption of automation. The widespread use of these technologies in developed nations has reduced carbon emissions by over 15 per cent (Bull, 2015). However, the utility of information technologies in Nigeria has yet to be fully realised (Khan et al., 2022). This is due to challenges such as infrastructure limitations, cost constraints, and skills and training. Most sophisticated technologies originated in developed economies, so their implementation in developing and underdeveloped nations has been minimal.

Nevertheless, with increased research and adoption of new technologies in emerging and developing economies, the development of information technology will significantly facilitate the implementation of sustainable supply chain practices in the oil and gas industry in Nigeria. Information communication technology has also played a pivotal role in raising awareness about sustainability, enlightening corporations, and individuals about its benefits (Lacarcel & Huete, 2023; George et al., 2016). The Internet and social media platforms have become powerful tools for ambassadors to spread the message of sustainability, persuading most organisations to adopt sustainability practices (Anderson, 2023; Heyden et al., 2020). Through the communication platforms enabled by the emergence and advancement of information technology, it is also possible to provide feedback on the level of sustainability that has already been attained. Therefore, ICT not only facilitates sustainable development but also enlightens and informs the masses about its importance.

2.4.7 Training and Development

Developing an employee's green skills is not just about incorporating positive environmental thinking into the oil and gas companies. It's about empowering HR professionals to drive sustainable change through activities such as recruitment, selection, training, and leadership development. Once recruited and trained, employees are motivated by performance measurement and reward systems that emphasize opportunities to enhance environmental practice. This approach has been proven to positively impact environmental performance through waste reduction and organizational efficiency (Jabbour, 2015). The voluntary improvement of a company's performance can be facilitated by developing employees' sustainable practices capabilities. A study by Pellegrini et al. (2018) highlighted the significance of designing HR practices to improve employee commitment and behaviour, thereby supporting organizational transformation for long-term sustainable development. Hooi et al. (2022) discovered that training and incentivizing employees to engage in pro-environmental activities contributed to developing and promoting a green culture, a culture that HR professionals have the power to shape.

2.4.8 Collaboration with suppliers

When businesses strive to implement environmentally and socially responsible supply chain practices, they frequently have varying understandings of the relevant environmental and social challenges. The darkness surrounding sustainability concerns can be reduced by establishing an open and visible system. This can be done through collaboratively sharing information, discussing challenges, and managing with a growth attitude. This transparency makes it easier for all the frontline staff to have a common understanding of the supplier improvement goals that have been set and to share relevant information (Busse et al., 2016). There is a correlation between transparency and improved communication between parties. The development and construction of teams, with an emphasis on personal connections and a move towards establishing a human connection at work, can foster a culture of sustainability. This, coupled with education of individuals regarding the goals and techniques of sustainability, is likely to help implement sustainable supply chain practices.

2.4.9 Support from Shareholder

Shareholders are another driving force that supports companies in adopting environmental initiatives and initiating sustainable supply chain management practices. Shareholders are an internal group with a vested interest in the company (Soufi et al., 2023; Zhang et al., 2023). Implementing environmental initiatives and sustainable practices throughout the supply chain is typically dependent on internal and external support at various levels within the supply chain (Alzubi et al., 2022). The shareholders can direct the company's senior management on matters such as environmental sustainability. Once such an environmental sustainability vision receives internal support and commitment from the firm's top-level management, the company can proceed with new environmental initiatives, such as Sustainable Supply Chain Management practices. In other words, shareholders can facilitate the adoption of a sustainability agenda as an integral element of the organisation's mission statement, resulting in the firm's internal commitment and support (Ren et al., 2022; Mustafa et al., 2023). Collectively, stockholders play a crucial role in the implementation of Sustainable Supply Chain Management practices and the

dissemination of such environmental initiatives. Therefore, support from stockholders is regarded as one of the primary pathways for adopting SSCM (Soufi et al., 2023).

Furthermore, shareholders are interested in their company's economic, social and environmental performance (Ali et al., 2023). Shareholder support is broadly concerned with the firm environmental image and social acceptance, attempting to improve the firm's social and environmental concern performance. Sachin et al. (2022) state that social and environmental problems in a company's supply chain can tarnish the company's environmental image and social acceptability, resulting in a significant loss of reputation and profits. This further emphasises the role of shareholder support in motivating firms to undertake proactive environmental initiatives to demonstrate an environmentally responsible corporate vision. Therefore, shareholder support that generates internal commitment within the firm is regarded as a significant force that facilitates the implementation of SSCM practices.

2.5 Obstacles to sustainability implementation

The main challenges behind sustainability implementation, particularly in the oil and gas industry, are the dynamic changes in the business environment (Sarrakh et al., 2022). Many companies in this sector have shown a willingness to adapt to emerging market situations. However, due to various impediments, sustainability implementation has not been fully embraced, especially in Nigeria (Orji et al., 2019). This study, which aims to conceptualise obstacles as barriers and use them interchangeably, has identified these factors as potential inhibitors to embracing sustainability practices in the supply chain. The urgency and relevance of this topic cannot be overstated.

These obstacles, whether internal or beyond the control of the individual organisation, are critical to note. Understanding these changes and the associated risks is a cornerstone of a comprehensive program that seeks to implement sustainability across operations and supply networks. Despite the topic's importance, this research is one of the few that has focused on Nigeria's barriers to sustainability implementation in the oil and gas industry. Its findings are crucial for understanding

the obstacles to achieving sustainability implementation throughout the supply network, which requires more attention in the literature. Therefore, the need for further research in this area is paramount. In the following section, we will discuss these obstacles in detail.

2.5.1 Lack of awareness and Understanding

The lack of consumer awareness about the benefits of green products is a pervasive obstacle to SSCM. Customer demands serve as a critical form of external pressure. When customers demand green products, companies are compelled to adapt their technology and structure to produce innovative solutions. In the oil and gas market, companies persist in producing non-green products due to widespread consumer ignorance about the benefits of green alternatives. The prevalence of this ignorance is alarming. An estimated 75% - 80% of U.S. consumers admit that a company's reputation influences their purchasing decisions, and 62% are willing to pay more for environmentally friendly products (Szenderák et al., 2022). This starkly highlights the urgent need for awareness campaigns and education to overcome this significant barrier to SSCM implementation.

2.5.2 Resistance to change.

Implementing sustainability requires an organisation-wide process of transformation. Implementing changes may always face internal and external obstacles from stakeholders who perceive it as a threat. Sustainability has no exceptions and may be contested within the organisation as a threat. It may take a lot of work if organisations are challenged to implement it (Boztepe et al., 2023). Due to the complex environment in which businesses operate and the need for more experience, implementing any change in the face of certain inertia requires considerable time and effort. Although inertia may be lower in smaller departments, businesses focus on what they know well. They may have a greater understanding of the technical implementation of sustainability in their core business fields.

2.5.3 Costs of Adopting Sustainability

Over time, cost has been the primary indicator of performance. In many businesses, sustainability implementation has been regarded as an expensive endeavour. Initial investment requirements for sustainability practices, such as sustainable design,

sustainable production, and sustainable labelling of packaging, etc., are among the factors cited by Ajibola (2020), Oyedepo (2012) and Raut et al. (2018) as preventing oil and gas companies in Nigeria from implementing sustainability practices. Two types of costs are associated with environmental management: transaction costs and direct costs (Adhikari & Lovett, 2006). Gahlot et al. (2023) found that both categories of costs are likely to pose a significant barrier to the implementation of sustainability. To address this, it is crucial to understand that IT enablement, the adoption of technological advancements, the employment of high-quality employees, and the motivation and training of employees towards sustainability practices will require a substantial initial investment. This underscores the importance and urgency of the issue. Consequently, implementing efficient, sustainable supply chain practices in the oil and gas industry is hindered by several obstacles, with cost being the most significant.

Also, Lack of financial resources can hinder the capacity of organisations to engage in environmental activities, and financial constraints can prevent the implementation of various environmental activities (Amoah & Eweje, 2022). Furthermore, Bansal & Bogner (2002) reported that ISO 14001 certification was more expensive than ISO 9000 certification because ISO 14001 environmental certification is more rigorous and requires additional documentation. Therefore, to implement environmental activities, substantial financial resources are required. More financial resources could discourage management from implementing sustainability practices.

2.5.4 Lack of Sustainability Standards and Appropriate Regulations

As diverse as the continents are, so are the acceptable sustainability standards for each. As a result of varying environmental conditions in various regions, constructing and sustaining a global supply chain in each region presents its unique challenges. Different laws and regulations present obstacles for organisations operating in multiple countries. Since enforcing environmental legislation and standards varies from country to country, oil and gas companies may need help adopting sustainability in various world regions (Gustafsson, et at., 2023, Chen, et al., 2023). This serves as a significant obstacle to sustainability in the oil-gas industry.

2.5.5 Lack of trust-based relationship with buyers and suppliers

Relationships based on trust are crucial for sustainable supply chain implementation strategies. The belief that information sharing increases not only the size of the pie but also everyone's share can contribute to greater knowledge exchange and interfirm learning among network members (Aliyadeh, 2022). There is also confidence that the shared information is accurate and reliable. Before investing in sustainable practices, Friman (2023) argues that trust-based relationship-building activities should take place. Therefore, the need for an established relationship based on trust can impede the implementation of sustainable supplier processes (Singh et al., 2023).

2.5.6 Lack of Appropriate Information/Awareness

The lack of necessary information hinders organisations that wish to implement sustainability. To translate environmental attitudes into action, pertinent environmental information is required. Organisations often lack sustainability knowledge and cannot implement suitable performance-enhancing options. A lack of environmental information may manifest in the form and flow of information within an organisation. From the government, NGOs, and the media, an abundance of environmental information is readily accessible via the Internet. However, even for large corporations, managing large volumes of information is challenging, and many small and medium-sized enterprises suffer from information overflow. This overloading typically occurs as a result of the fact that SMEs seek environmental information only when it is required (Kineber et al., 2023; Luthra et al., 2011).

2.5.7 Lack of Communication and Coordination

Sustainability and enhanced organisational performance rely heavily on effective communications and coordination between members of the supply chain (Kineber et al., 2023). Recent research indicates that overlapping communication is influential in supporting sustainable supply chain management. Some instruments of exchange, such as a shared information technology infrastructure and quality control staff, are highly effective at assisting manufacturing organisations in implementing sustainability (Singh et al., 2016). Therefore, the absence of these affects' implementation of sustainable supply chain practices.

2.5.8 Inappropriate Infrastructure and Lack of IT implementation

Infrastructures, such as new technology (Like carbon capture and storage (CCS) technology) that involve capturing carbon dioxide (CO2) emissions from industrial processes or power generation sources, transporting it to a storage site, and securely storing it underground or in other geological formations are either scarce or prohibitively expensive. This poses significant challenges for many businesses, making it problematic for them to incorporate this technology into their drilling and transportation processes. It's crucial for businesses and policymakers to be aware of these challenges, as this awareness can drive responsible and engaged actions. The literature also highlights other impediments to sustainability, including the need to be more abstract and broader, a lack of personnel to oversee sustainability implementation, and the required resources not justifying it.

Furthermore, Mishra et al., (2022) state that IT systems facilitate collaborative supply chain processes and improve supply chain performance. A highly effective information and technology system is required to support the SSCM throughout the various phases of the product life cycle. It can benefit product development programmes incorporating environmental design, recovery, and reuse. Effective information systems are required for monitoring and tracing product returns in relation to previous sales. Informational support is required to develop linkages in the oil and gas industry to accomplish efficient SSCM. To efficiently manage a sustainable supply chain, it is necessary to manage the information flows associated with the forward and reverse flow of materials and other resources (Diaz et al., 2022). Additionally, IT enablement significantly reduces paper usage, which supports the SSCM philosophy. Therefore, the absence of IT implementation is a significant barrier to SSCM efficiency.

2.5.9 Lack of top management commitment

Yong et al. (2022) and Agrawal et al. (2022), top management's support and commitment are critical success factors for sustainable green supply chain management. Support from top management is particularly helpful for environmentally responsible practices such as using renewable energy, using health and safety systems, and providing environmental requirements for purchased items.

The top management has a significant influence that can support the formulation and execution of green initiatives throughout the organisation (Awan et al., 2023). Its top offers constant support for general supply chain management in developing strategic strategies and action plans for successfully implementing those goals. As a result, one of the obstacles to implementing sustainability in the oil and gas industry is a lack of commitment from top management.

2.5.10 Lack of Government support systems

As the government sets environmental regulations for the industry, government regulation can either encourage or discourage adopting sustainable supply chain practices (Grover et al., 2022). Regulatory requirements, fees, or time-consuming levies may discourage companies, and incentives that are distorted by tax structures can discourage oil and gas companies from implementing sustainable supply chain practices. Government institutions are viewed as impediments to environmental management development in the sense that institutional processes for implementing sustainability practices are ongoing. However, more institutional support should be given to novel sustainable supply chain implementation ideas. The government's propensity to encourage outdated practices is a significant barrier (Gunawan et al., 2022). Therefore, the absence of government support systems prevents the oil and gas industry from implementing sustainability practices effectively.

2.6 Sustainable supply chain practices

The issue of sustainable supply chains has gained increasing global attention. Christopher (2016) defines the supply chain as a network of interdependent and interconnected organisations collaborating to control, manage, and enhance the flow of materials and information from suppliers to end consumers. It is a strategic management tool intended to increase the profitability and competitiveness of businesses by enhancing customer satisfaction. Supply chain management encompasses integrating all essential business processes throughout the supply chain (Viriyasitavat et al., 2022). Due to the increasing magnitude of environmental and social issues, traditional supply chain models must be improved to identify

significant emerging sources of sustainable competitive goals (Soni et al., 2022; Mahroof et al., 2022; Mukhsin et al., 2022; Wong et al., 2018).

The sustainable supply chain considers production processes' social and environmental impacts as products travel along the supply chain (Marshall et al., 2015). The sustainable supply chain paradigm is a collection of supply chain initiatives that aim to reduce the environmental impact and improve the social condition of various supply chain members while also enhancing innovation, resource efficiency, reputation, and market share (Sancha et al., 2016; Stindt et al., 2016).

Currently, there exists a pressing requirement to safeguard the environment while simultaneously upholding economic growth and social responsibility, and the oil and gas industry is no exception. To mitigate the negative impact of its operations on the environment, the oil and gas industry must adopt sustainable production practices, such as green initiatives, reducing energy consumption, reusing and recycling materials. These measures can help to reduce carbon emissions to and promote a more sustainable future for the industry. Over time, the idea of sustainable supply chain management has grown to encompass activities such as ISO 14001, SA 8000, and codes of conduct (Orzes et al., 2017; Treacy et al., 2019), as well as due diligence in the supply of conflict minerals (Hofmann et al., 2018) and restriction of the use of hazardous materials (Blome et al., 2014a, b).

Given the multiple characteristics of sustainable supply chain practices, this research group these practices into two main sub-practices. These include environmentally sustainable supply chain practices and socially sustainable supply chain practices. The next section explained each of these practices.

2.6.1 Environmental sustainability practices

Environmental sustainability has historically dominated sustainability discourse, with a strong focus on issues like climate change, global warming, and resource depletion (Egeland, 2023; Rej et al., 2023; Elaouzy & Fadar, 2022). It encompasses the preservation of natural resources crucial for human survival, such as minerals and the atmosphere, as well as managing pollution levels within the environment's capacity (Zahoor et al., 2022; Saunila et al., 2023). Despite its critical importance,

environmental degradation persists due to population growth and industrial demands, leading to freshwater depletion, resource degradation, and climate-related impacts like droughts and food shortages (Herrero et al., 2022; Micklin et al., 2019; Moyo et al., 2023).

The escalating severity of environmental issues—such as pollution, deforestation, and biodiversity loss—underscores the urgent need for sustainable practices (Mishra, 2023; Adekomaya et al., 2022; Vasileva-Tcankova et al., 2022). Oil and gas companies in Nigeria increasingly recognise the necessity of integrating environmental considerations into their operations to ensure long-term viability and societal acceptance (Geyi et al., 2020; Xie et al., 2022; Emeka-Okoli et al., 2024). Supply chain management plays a pivotal role in this paradigm shift towards environmental sustainability. It involves strategies for reducing waste, emissions, and energy consumption throughout the supply chain (Garcia et al., 2022; Sharman et al., 2023). Proactive organisations are integrating sustainable practices across procurement, production, and distribution stages to align with environmental goals (Lim et al., 2022; Johnsen et al., 2022).

Key initiatives include sustainable transportation, investment recovery, sustainable procurement, sustainable product and process design, sustainable supplier selection, collaborative product design, lifecycle assessments, and implementing environmental management systems (Xie et al., 2022; Geyi et al., 2020). Logistics operations are also adapting to balance efficiency with environmental impact, promoting practices like just-in-time delivery and sustainable transportation (Sharma, 2022).

Therefore, environmental sustainability remains paramount on global agendas, requiring concerted efforts across industries to mitigate environmental impacts and ensure sustainable resource use. Integrating environmental considerations into supply chain management is not only a moral imperative but also a strategic advantage in reducing costs, enhancing efficiency, and securing long-term business success. The next section explains environmentally sustainable supply chain practices in detail.

2.6.1.1 Sustainable product and process design

Sustainable design integrates environmental considerations and stakeholder perspectives throughout product development to enhance sustainability across its lifecycle (Sarkis and Dou, 2018; Srivastava, 2007). In Nigeria's oil and gas sector, transparency about environmental aspects for customers is crucial. Collaboration across functions like design, extraction, and logistics avoids sequential methods, using principles like concurrent engineering (Green et al., 2012b; Zhu et al., 2008).

Design choices significantly impact supply chains, affecting resource usage and the environmental footprint. Efforts include reducing packaging, though standardised methods for sustainable resource enhancement are still developing. Sustainable design aims to minimise energy use and waste generation through recycled materials and reuse (Esfahbodi et al., 2016; Dües et al., 2013). Life Cycle Analysis (LCA) assesses environmental impacts from production to disposal, advocating for renewable or non-toxic materials (Mena et al., 2014). Proactive engagement with suppliers is crucial for mitigating environmental impacts (Sarkis, 2006). Stakeholder engagement drives successful implementation (Esfahbodi et al., 2016), cutting costs, and improving sustainability (Green et al., 2012b; Hart, 1995).

2.6.1.2 Sustainable procurement

Modern procurement practices emphasise sustainable sourcing to maximise economic, social, and environmental value (Slack and Brandon-Jones, 2018). It includes ethical sourcing and green procurement strategies that reduce material use and promote reuse (Carter et al., 2000). We should eliminate waste, effluents, and pollutants from production to disposal (Sarkis and Dou, 2018). According to Min and Galle (2001), sustainable procurement emphasizes recycling, reuse, and eco-friendly sourcing through waste elimination and source reduction. Supplier collaboration to improve environmental performance through cleaner production and sustainable products is essential (Tachizawa et al., 2015). Supplier compliance auditing and eco-labelling monitor sustainability requirements (Rajesh & Ravi, 2015). Sustainable procurement promotes innovation and efficiency by synchronising supply chain procedures from specification to supplier selection (Mena et al., 2014). Resource efficiency minimises costs and environmental impact with sustainable procurement (Porter and van der Linde, 1995; Hart and Dowell, 2011). It handles the

reputational hazards of ignoring environmental and social issues (Hill and Hill, 2012). Sustainable procurement improves the environment and economy, advancing global sustainability and market competitiveness (Esfahbodi et al., 2016).

2.6.1.3 Investment recovery

Investment recovery is crucial for sustainable supply chain practices, particularly through closed-loop supply chains that recycle waste into raw materials or reuse end-of-life products (De Angelis et al., 2018; Zhu et al., 2013). Reverse logistics plays a key role in efficiently managing the flow of materials and products from their point of use back to their origin for value recapture or proper disposal (Rogers and Tibben-Lembke, 2001).

Different recovery approaches include reuse, remanufacturing, recycling, and recovery, each aiming to minimise environmental impact by repurposing or reclaiming materials (Carter and Ellram, 1998). Reuse involves redeploying products without refurbishment, while remanufacturing restores products to their original performance standards (Wang et al., 2019). Recycling extracts raw materials from used products for new manufacturing, while recovery repurposes materials for lower value uses like road base or energy production (Sarkis and Dou, 2018).

Implementing these practices not only reduces environmental impact but also enhances competitive advantage and cost savings (Chen et al., 2019; Awasthi et al., 2019). A circular approach optimises resource use, creating more value from each unit of resource through regeneration and recovery (Choi and Hwang, 2015). However, achieving these goals requires robust supply chain capabilities, operational models, and technological advancements (Ciccullo et al., 2018).

2.6.1.4 Sustainable transportation

Sustainable transport aims to manage the environmental impact of transportation throughout the supply chain (Sarkis, 2006). Decisions such as transport mode and network design significantly influence carbon footprint and energy intensity (Christopher, 2016). Global sourcing trends have increased transportation distances, intensifying energy use in logistics (Fahimnia et al., 2015). The transport sector accounts for a substantial portion of global energy consumption, driven by road, rail, shipping, pipeline, and air transport (IEA, 2017). Addressing this requires

technological shifts like renewable energy adoption in transportation and packaging, electric vehicles, and energy-efficient delivery processes (Green et al., 2012b; Zhu et al., 2008).

Implementing sustainable transport solutions involves not only technological advancements but also fostering a collaborative mindset (Esfahbodi et al., 2016). Practices include selecting greener transport modes, optimising routes, using green packaging, and using energy-efficient facilities (Sarkis and Dou, 2018). Oil and gas companies can reduce transport intensity through product design review, strategic sourcing, efficient transport use, collaborative logistics, and postponement strategies (Christopher, 2016). These initiatives aim to enhance supply chain sustainability by minimising environmental impact and optimising resource use across transportation activities.

2.6.1.5 Environmental management systems

Sustainable operations in supply chains require comprehensive management of risks across manufacturing, operations, and decommissioning phases. Environmental Management Systems (EMSs) play a critical role in ensuring compliance with environmental regulations and corporate sustainability goals, facilitating systematic risk management (Sarkis, 2006). Integrated Management Systems (IMSs) combine various operational aspects, such as environmental, social, and health management plans, along with monitoring and audit procedures to gauge performance and compliance (Rogers and Tibben-Lembke, 2001).

ISO 14000 standards, particularly ISO 14001:2015, provide frameworks for environmental management, helping organisations minimise environmental impacts throughout their supply chains (ISO, 2017). These standards guide practices like resource use efficiency, waste management, and environmental labelling (ISO, 2017). EMS implementation not only enhances environmental performance but also supports market competitiveness and cost savings through improved efficiency (Krajewski et al., 2010).

Commitment to sustainability across supply chains requires alignment of economic and sustainability goals, integrating sustainability into daily operations, and fostering a culture where sustainability is everyone's responsibility (Pagell and Wu, 2009). Despite initial costs, EMS adoption can yield significant benefits, including increased

market access and profitability, as well as potential advantages in sales and consumer perception (British Standards Institute).

2.6.2 Social sustainability practices

Social sustainability encompasses practices that foster compatible growth within civil society, promoting harmonious coexistence among culturally and socially diverse groups while enhancing overall quality of life (Kjeldsen et al., 2022). JD (2023) further defines it as adhering to social justice, human dignity, and participatory governance norms, thereby ensuring the sustainable meeting of human needs without degrading natural resources. This perspective ties social sustainability to human rights, corporate responsibility, and global poverty alleviation (Reynolds et al., 2023).

Socially sustainable organisations contribute positively to communities by enhancing human and social capital, managing stakeholder relationships transparently, and aligning values effectively (Adamczyk et al., 2022; Mulang et al., 2023). They uphold ethical standards and labour rights, support community development, foster trust, and reduce operational costs (Saeidi et al., 2022). Such companies integrate social, ethical, and environmental considerations beyond legal requirements, aiming to improve stakeholders' quality of life (Marco-Lajara et al., 2022; Richmond et al., 2022).

Social sustainability is integral to achieving economic and environmental goals without compromising future generations' well-being (Yawar & Seuring, 2017). It involves managing practices, capabilities, stakeholders, and resources across supply chains to promote human potential and well-being (Nakamba et al., 2017; D'Eusanio et al., 2019). Evaluating social impacts—such as safety, health, wages, and working conditions—is essential for organisations to gauge and improve their social performance (Mani et al., 2016; IAIA, 2015; D'Eusanio et al., 2019).

As a result, social sustainability practices ensure that societal development respects diversity, upholds human rights, and supports sustainable human development. Integrating social considerations into business operations and supply chain management in Nigeria's oil and gas industry can improve both their sustainability and societal impact. Therefore, social sustainable supply chain includes the followings.

2.6.2.1 Labour Standards

The oil and gas industry implements fundamental practices throughout the supply chain to ensure fair treatment of workers through labour standards. This entails strict adherence to international labour standards, the provision of secure working conditions to protect the health of workers, the unequivocal prohibition of forced or child labour, and the provision of fair wages that meet or exceed local regulations (Eyo-Udo et al., 2024). These standards are critical for establishing a secure and conducive environment for all workers involved in the industry's operations and promoting ethical practices (Olawale et al., 2024). Therefore, adhering to these principles, companies establish their dedication to corporate social responsibility and contribute to sustainable development objectives, thereby fostering trust among stakeholders and harmonising with global standards for ethical business practices in the oil and gas sector.

2.6.2.2 Health and Safety

Strict health and safety regulations must protect oil and gas workers, contractors, and communities from operating hazards. This requires extensive risk assessments, safety regulations, and ongoing training to prevent accidents and prepare for emergencies. The measures include using personal protective equipment, following operational procedures to reduce risks, and monitoring workplace conditions. Chemical exposure, fires, heavy equipment accidents, and environmental damage. As a result, Oil and gas companies in Nigeria must prioritize health and safety to protect their employees and surrounding communities. Meeting or exceeding safety criteria requires compliance with rules and industry standards. Creating a safety culture motivates employees and contractors to report problems and enhance safety. Health and safety investments decrease hazards, improve reputations, and boost efficiency. Prioritising safety, firms show responsibility and promote sustainable workplace and environmental policies (Vincoli, 2024).

2.6.2.3 Community Engagement

In the oil and gas business, community engagement entails the establishment of meaningful relationships with local communities to fulfil the needs and concerns articulated by those people. This includes providing employment opportunities, consulting on the project's implications, and communicating in an open and honest

manner. It is possible for companies to aid local firms by means of procurement and to contribute to community development efforts such as the construction of infrastructure, educational programmes, or healthcare facilities. Effective community participation helps to cultivate trust, reduces the likelihood of social conflicts, and guarantees that all parties involved in resource extraction activities profit from the endeavour. Furthermore, it aligns with sustainable development objectives by promoting economic growth and social well-being in the affected areas (Abaku et al., 2024).

2.6.2.4 Human Rights

The oil and gas industry upholds human rights by ensuring the respect and upholding of the fundamental rights of all individuals affected by operations, including labourers and local communities Bhattacharya et al., 2024). This entails adherence to international human rights standards, including the Universal Declaration of Human Rights and pertinent conventions. Companies must prevent human rights violations such as coerced labour, discrimination, and violations of the rights of indigenous peoples. Furthermore, they should establish grievance mechanisms to address complaints and guarantee accountability for any violations that may occur. Due diligence is necessary to evaluate risks and collaborate with stakeholders to foster respect for human rights, as human rights considerations are present throughout the supply chain. Oil and gas companies contribute to sustainable development and social stability in their regions by incorporating human rights into their operations (Emeka-Okoli et al., 2024).

2.6.2.5 Ethical Sourcing

In the oil and gas sector, ethical sourcing involves the procurement of products and services in a manner that maintains integrity, transparency, and social responsibility throughout the supply chain. This entails the selection of suppliers and partners who comply with ethical standards, such as equitable trade practices, anti-corruption measures, and respect for human rights Kumar, 2024). In order to mitigate risks such as bribery, child labour, and environmental violations, companies conduct due diligence to ensure that suppliers satisfy these criteria. The objective of ethical procurement initiatives is to mitigate legal and operational risks, enhance corporate

reputation, and cultivate trust among stakeholders. Oil and gas companies contribute to sustainable development, support local economies, and align with global best practices by prioritising ethical considerations in sourcing decisions. Ethical sourcing also involves the promotion of diversity and inclusion among suppliers, the empowerment of disadvantaged groups, and the cultivation of equitable opportunities within the industry's supply chain (Silva et al., 2024).

2.6.2.6 Stakeholder Engagement

Stakeholder engagement in the oil and gas industry involves active involvement and communication with all parties affected by or interested in the company's operations. This encompasses shareholders, employees, governments, non-governmental organisations (NGOs), and local communities. Fostering trust and collaboration, effective stakeholder engagement aims to comprehend and resolve their concerns, aspirations, and expectations. Companies employ a variety of methods, including community meetings, consultations, and feedback mechanisms, to collect input and integrate stakeholder perspectives into their decision-making processes. Engagement endeavours also seek to transparently communicate about regulatory compliance, corporate governance, and environmental and social impacts (Emeka-Okoli et al., 2024). By proactively engaging stakeholders, oil and gas companies can establish stronger relationships, improve their social license to operate, and align their business strategies with the interests of the community and broader societal objectives. In addition to promoting sustainable practices and enhancing reputation, this approach not only mitigates conflicts but also contributes to long-term business success and positive socio-economic impacts.

2.6.2.7 Transparency and Accountability

Companies operate ethically and responsibly in the oil and gas industry by adhering to critical principles of transparency and accountability. Openly sharing information about operations, performance, and impacts with stakeholders, including local communities, regulators, and investors, is a critical component of transparency (Emeka-Okoli et al., 2024). To establish credibility and trust, this encompasses the disclosure of financial data, environmental practices, and social initiatives (Ukoh et al., 2024). Companies are obligated to address any adverse impacts promptly and

effectively, adhere to laws and regulations, and take responsibility for their actions, which are inextricably linked with transparency. Ethical governance structures, robust reporting mechanisms, and compliance with international standards such as the Sustainability Accounting Standards Board (SASB) or the Global Reporting Initiative (GRI) are prerequisites for accountability Gutterman, 2024). Therefore, implementing transparency and accountability, oil and gas companies can enhance their corporate reputation, improve decision-making processes, and foster stakeholder confidence, thereby contributing to long-term business viability and sustainable development objectives.

2.7 Sustainability performance

Companies in the supply chain rely on performance measures to assess performance against predetermined objectives and identify performance gaps (Pangarso et al., 2022; Yusuf et al., 2018). Any performance measurement system must have the capacity to establish a baseline (Beske-Janssen et al., 2015). Neely et al. (2005) defines a *performance measurement system* as a set of metrics used to quantify the efficacy and effectiveness of actions. There is a growing realisation that the traditional measures of performance used by companies are unsuitable for manufacturing supply chains (Yusuf et al., 2018; Neely et al., 2005). This is likely because they encourage short-termism, lack strategic focus, need to provide data on social and environmental issues, and provide information on what their consumers want and what their competitors are doing (Kavadis et al., 2023; Chong at el., 2022). Therefore, the current performance measurement system must approach the three dimensions of sustainability without giving economic outcomes precedence over social and environmental effects (Nunes et al., 2023; Pagell & Shevchenko, 2014).

2.7.1 Economic performance

The economic performance is centred on increasing sales and profitability. The crucial connection in this instance is the effect that social and environmental action can have on sales volume and consumer satisfaction. Liu et al. (2022) stated that there is a positive correlation between sustainability factors and sales growth. For instance, Paulraj et al. (2017) demonstrate that sustainable supply chain practices enhance economic performance, including profit as a percentage of sales, return on

assets, and market share growth. This can be accomplished by efficiently using resources, in which products use fewer materials and energy.

In addition to increasing the likelihood that consumers will remain devoted to the supplier, good social and environmental practises also increase the likelihood that consumers will continue to support the business. The retention of more customers increases sales and profits. This is expected because contented customers are more likely to place additional orders with supply chains. To maintain the supply chain, however, increasing market share and productivity is necessary. Market share quantifies the financial performance of a business (Yusuf et al., 2013; 2014). Similarly abundant and indispensable is financed flow. Strong positive cash flow has become objective and as essential to managers as profit (Flayyih et al., 2022). Most businesses are pressured to increase capital productivity to make their assets liquid. Return on investment, defined as the ratio of net profit to the quantity of capital used to generate that profit, is frequently used in this context.

Furthermore, numerous studies, have found that cost reduction is the most important aspect for businesses engaged in sustainability operations. Using recycled/reused materials may minimise the prices of raw materials and packaging if sustainability initiatives are adopted (Dragomir et al., 2022). Sustainability practises have evolved into crucial business strategies for achieving profit and market share objectives (Uniyal et at., 2019)

2.7.2 Environmental performance

Reducing the consumption of natural resources, such as materials, water, energy, and the atmosphere, is critical to environmental sustainability performance. While it is understandable that the supply chain's carbon footprint should be minimised, it must be recognised that suppliers' decisions have a broader impact on resources in general. In addition, it is crucial to consider the effect of human and economic activities on the source of the local material throughout the supply chain. According to Yusuf et al. (2013), this is preserving scarce resources necessary to satisfy the population's needs. Waste, including external waste, incurs internal costs (Flayyih et al., 2022). Even in the absence of laws, the wasteful use of materials, water, and energy, as well as the disregard for greenhouse gases, are not only detrimental to

the environment, but climate change is likely to increase the vulnerability of global supply chains, thereby putting pressure on manufacturers to reduce their greenhouse gas emissions. Additionally, climate change is unavoidable without reductions in greenhouse gas emissions such as Hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride, carbon dioxide, methane, and nitrous oxide. Multiple repercussions of a higher climate have increased the emphasis on environmental performance. Environmental performance indicators may also include, amongst other things, reduced air emissions, decreased material input, increased energy efficiency, decreased discharge of solid and toxic waste, and decreased use of natural resources (Paulraj et al., 2017; Zhu et al., 2008; 2013; Zhu & Sarkis, 2004).

Therefore, studies have established the impact of sustainability in business; effective, sustainable supply chain practices can reduce expenditure and encourage recycling, reuse, and remanufacturing, improving sustainability performance (Zhu & Sarkis,2007). A manufacturing strategy incorporating an environmental management system will help improve the organization's ecological performance (Zhu et al., 2017).

2.7.3 Social performance

Literature has emphasised the significance of social sustainability performance (Beske-Janssen et al., 2015; Walker et al., 2014). Environmental and economic sustainability can be accomplished through social performance (Yusuf et al., 2013). Chen et al. (2017) categorised social performance into two fundamental classes: human and social capital. Social capital entails, on the one hand, respecting the rights of the communities where the resources are located, improving the quality of life of people without injuring the environment, and avoiding overexploitation of the resources contained within it. This includes ethical treatment of customers (product and process safety) as well as social investment in the communities of suppliers (Krause et al., 2009; Sarkis et al., 2010). Human capital, on the other hand, includes among other things, improved health and safety of workers, fairness in the working environment, workers' diversity and inclusions, the welfare of workers, and employee commitment (Gayi et al. 2020).

In all, social performances indicate enhancing and sustaining the quality of life for the people, preferably without affecting the environment and over-exploiting natural resources, which warrants additional research. It has been recognised that sustainability strategies are crucial for environmental and social advantages (Govindan, 2015b). In addition, social performance results in a reduction in environmental risks, a contribution to environmental protection, and an improvement in the business image.

2.8 Operational performance

Operational performance is determined by how a business competes in the market and the markets it pursues (Schulze et al., 2022; Porter, 2004). Customers drive markets, and markets drive organisational practices in competitive markets. Customers make buying decisions based on various factors, such as the price of the goods or the service characteristics associated with the purchase. Businesses must position themselves in such a way that they meet the buyer's expectations. An organisation's sustainable supply chain practices can influence critical operational competitive characteristics. These include cost, quality, delivery dependability, speed, flexibility, and novelty (Yusuf et al., 2014). Oil and gas companies involved in the exploration, extraction, refining, transportation, and distribution of oil and gas products carry out operations characterised by efficiency, effectiveness, and overall productivity in the oil and gas industry. This sector is known for its complex and capital-intensive operations, which span various stages from exploration to distribution. Operational performance in the oil and gas industry is a multifaceted concept encompassing various metrics and indicators to achieve sustainable and profitable operations while adhering to safety, environmental, and regulatory standards. Critical aspects of operational performance include:

2.8.1 Cost management

Cost management is critical because exploration, drilling, and production require significant expenditures. Oil and gas companies maintain safety and environmental standards while optimising operational expenditures (OPEX) and capital expenditures (CAPEX). Furthermore, a low-cost position enables the business to employ aggressive pricing and a high sales volume (Parani et al., 2023). The

organisation maintains low product and service prices to provide consumers with a better value. For a business to compete with low-priced rivals, it will be crucial to emphasise this characteristic.

2.8.2 Product Quality

The precise chemical composition, physical properties, and integrity of extracted crude oil, natural gas, and refined products are all elements of product quality in the oil and gas industry. It guarantees adherence to stringent market specifications, regulatory standards, and customer requirements. In order to guarantee consistency and dependability, quality control measures encompass rigorous testing, compliance with international standards, and ongoing monitoring. High product quality is essential for sustaining long-term relationships and business growth in the dynamic and challenging oil and gas sector. It also supports market competitiveness and customer satisfaction, enhancing operational efficiency and safety (Rana et al., 2024; Abdullahi et al., 2024).

2.8.3 Operational Reliability

The reliability performance objective entails adhering to the terms and conditions previously agreed upon with the customer. On-time or ahead-of-schedule delivery may assist the business in establishing a competitive advantage, which may be crucial in securing a competitive position in the market (Yusuf et al., 2014). Failure to produce on schedule may result in the loss of trust. Because of market insecurity, the emphasis on dependability has grown (Gayi et al., 2020). Also, Reliability metrics evaluate the capacity of equipment and facilities to operate consistently and predictably. This encompasses performance monitoring systems, reliability-centred maintenance (RCM) strategies, and maintenance practices.

2.8.4 Production Efficiency

Production efficiency refers to the ability of oil and gas companies to extract and produce hydrocarbons (crude oil and natural gas) efficiently. Factors influencing production efficiency include reservoir management techniques, drilling technologies, and operational practices that minimise downtime and maximise output (Arinze et al., 2024). Moreover, the emphasis has shifted to speed because of increased rivalry and rapid technological progress. The speed with which a product

or service may be provided may determine a market's competitive edge. Speed means meeting scheduled orders on time and providing new solutions ahead of the competition. To increase operational speed, non-value-added tasks in supply chain business processes must be eliminated (Suwasono et al., 2022). Increasing speed supports waste reduction while decreasing inventory time reduces operational expenses.

2.8.5 Supply Chain Flexibility

In the oil and gas industry, supply chain flexibility refers to a company's ability to effectively manage and adapt its supply chain operations in response to various disruptions and changes. This includes quickly adjusting sourcing strategies, switching suppliers, optimising inventory levels, and ensuring timely delivery of critical materials and equipment (Scholten & Stevenson, 2024). Oil and gas supply chains are complex and global, involving multiple stakeholders and dependencies. Companies prioritising supply chain flexibility can mitigate risks such as shortages, transportation delays, geopolitical issues, and fluctuations in demand or commodity prices. By enhancing supply chain resilience and agility, firms can maintain operational continuity, reduce costs, and capitalise on opportunities in a competitive marketplace (Khan, 2024).

2.8.6 Technological Innovation and Adoption

Continuous improvement in operational performance often involves adopting new technologies and innovations (Popoola et al., 2024). Examples include advancements in drilling techniques (such as horizontal drilling and hydraulic fracturing), digitalisation of operations, and automation to enhance efficiency and reduce costs (Ochulor et al., 2024). Innovation is another indicator of organisational performance, and innovation is the deliberate use of information, imagination, and initiative to extract value from resources. Innovation occurs when a concept is used to meet customers' demands and expectations better. Adaptability may include innovation, innovative design, access to expertise in managing new technology, and process reconfiguration (Gayi et al., 2020; Guisado-González et al., 2016).

2.9 Global sustainability campaign

The 1970s witnessed a seismic shift in global economic thinking, as the prevailing notions of 'progress,' 'growth,' and 'development' were confronted with significant challenges. The belief that unbridled economic expansion could rectify developmental disparities in developing nations was no longer sustainable. Barbara Ward, the visionary who established the International Institute for Environment and Development, introduced the concept of sustainable development as a viable alternative in the early 1970s. This pivotal moment laid the groundwork for our current understanding of sustainability (Pazienza et al., 2022), underscoring the urgent need for a new approach.

The term' sustainability' emerged from concerns that the industrial growth model was unsustainable, causing environmental disruption and resource depletion (Radosavljević et al., 2022). Scholars like Du Pisani (2006) and Ricketts (2010) contributed to establishing sustainability as a critical societal goal, highlighting the limits of growth amidst finite resources. Adekomaya et al. (2022) warned that continued population growth, industrialization, and resource consumption trends could lead to irreversible environmental and social crises within a century. Since the 1972 UN Stockholm Conference, efforts have aimed to integrate environmental concerns into development policies globally (Greve et al., 2023). However, Arora and Mishra (2022) noted that environmental degradation persists, exacerbating poverty and hunger worldwide. Despite international efforts and policy frameworks established at conferences like the Rio Summit, achieving tangible progress towards sustainability has proven elusive (Yunita et al., 2022).

The concept of sustainable development advocates for a comprehensive approach that integrates environmental, economic, and social dimensions (Pettifor, 2020). Elkington's 'triple bottom line' approach emphasizes the necessity of balancing economic prosperity with environmental stewardship and social equity (Mastini et al., 2021). To succeed, this paradigm necessitates rigorous scientific, ethical, and political considerations in policy formulation and implementation (Fernando et al., 2022). Despite advancements in theory and policy frameworks, the transition to a sustainable development paradigm is fraught with challenges. Critics argue that true

sustainability can only be achieved through transformative changes in economic structures and societal values (Barkemeyer et al., 2014). Implementing effective strategies demands collaboration between governments, businesses, and civil society to address complex environmental issues before they escalate further (Linder et al., 2022). The evolution towards sustainable development signifies a necessary departure from conventional growth-driven models to holistic frameworks that prioritize long-term environmental integrity and social well-being. The journey towards sustainability is arduous, necessitating continued innovation, political will, and global cooperation to secure a viable future for all.

2.9.1 Stockholm Conference

The 1972 United Nations Conference on the Human Environment in Stockholm marked a pivotal moment in global environmental governance. It aimed to address pressing issues such as pollution and deforestation, resulting in adopting the Stockholm Declaration. This declaration, encompassing 26 principles, underscored the importance of safeguarding natural resources and ensuring environmental sustainability for current and future generations. Fundamental principles included recognising the right to a healthy environment (Principle 1), managing natural resources responsibly (Principle 2), and halting toxic releases (Principle 6).

The conference yielded significant outcomes, including the establishment of the United Nations Environment Programme (UNEP) and agreements on hazardous waste and wildlife conservation. It set a precedent for future environmental conferences, culminating in the Earth Summit in Rio de Janeiro in 1992, which produced Agenda 21, a comprehensive global action plan for sustainable development. The Stockholm Declaration, a testament to the conference's enduring influence, continues to shape international environmental law and foster cooperation among nations to address environmental challenges. Its principles, resonating through the years, are still relevant in the face of ongoing issues like climate change and biodiversity loss, underscoring the lasting impact of its foundational contributions to global environmental policy (Urpelainen, 2022; Chasek et al., 2021; Paglia, 2021).

2.9.2 The Brundtland Report

The Brundtland Report, commissioned by the United Nations in 1983, introduced the concept of sustainable development amidst growing global environmental concerns. It emphasised the need to meet present needs without compromising future generations' ability to meet their own needs. The report's comprehensive approach to sustainability was based on three pillars: economic growth, environmental protection, and social equity. It underscored the interdependence of these pillars and called for international cooperation to achieve sustainable development goals. Despite some criticism for its ambitious recommendations, the report significantly raised awareness and laid the groundwork for subsequent global discussions and initiatives on sustainability. (Hens et al., 2021; Millano, 2019; Ala-Uddin, 2019; WCED, 1987).

2.9.3 Rio earth summit

The Rio Declaration on Environment and Development, adopted in 1992 at the UN Conference in Rio de Janeiro, introduced 27 principles that have had a profound impact on the practice of sustainable development, human rights, and global environmental cooperation. These principles, such as the requirement to integrate environmental considerations into decision-making (Principle 3) and the application of the precautionary approach to environmental protection (Principle 15), have fundamentally changed the way we balance economic, social, and environmental needs. Despite the ongoing challenges, including differing interpretations among member states, the Rio Declaration has laid the foundation for international environmental law and has directly influenced subsequent agreements like the Kyoto Protocol. It remains a crucial tool in addressing contemporary environmental issues such as climate change and biodiversity loss (Hulme, 2016).

2.9.4 Kyoto conference

Following the 1997 Kyoto Conference on climate change, member nations took significant steps towards sustainable development. The conference set specific goals for environmental conservation, which guided the actions of these nations (Tóthová et al., 2022). The nations agreed to reduce their greenhouse gas emissions, leading to the creation of the Kyoto Protocol. This protocol outlined the specific actions to

be taken over the years. The United States proposed stabilising its emissions, while other industrialised nations committed to reducing their emissions of greenhouse gases. The aim was for each state to reduce its emissions by 5% from 2008-2012 (Marotta et al.,2022; Liao et al., 2022).

Nonetheless, the intended level of reduction was never achieved, even after some countries adopted the Kyoto Protocol. The complication of the stakeholder negotiations led to confusion regarding compliance, resulting in high compliance. In addition, the protocol only highlighted the fundamental rules for compliance and did not specify the detailed and essential laws the nations were required to uphold. Although approximately 84 countries signed the protocol intending to ratify it, other countries hesitated to take the initiative. Others, most likely the European Union, approved the protocol but failed to reduce their greenhouse gas emissions (Egelston, 2022). The United States' contribution to carbon dioxide emissions has steadily increased over the years, and future generations will likely experience a deterioration of the climate change situation. This underscores the crucial need for more specific actions and compliance measures to address the climate change situation.

2.9.5 The millennium development goals (MDG)

The Millennium Summit in 2000 established the Millennium Development Goals (MDGs), aiming to eradicate poverty, promote equality, reduce child mortality, improve health, eradicate diseases, and foster environmental sustainability by 2015. The subsequent World Summit on Sustainable Development in Johannesburg (2002), a significant event in global development, not only reinforced these goals but also added new objectives like improving sanitation access and minimising chemical impacts. This summit enhanced global partnerships among the UN, governments, businesses, and NGOs to address environmental and poverty issues. It underscored the growing importance of socioeconomic aspects in sustainable development and built on previous UN conferences' environmental agendas, setting the stage for future international cooperation (Singh, 2016).

2.9.6 The Paris agreement

The Paris Agreement, established in 2015 during COP21, binds 196 countries to limit global warming below 2 degrees Celsius, with an aspiration for 1.5 degrees Celsius. Effective November 2016, it mandates nations to formulate climate action plans. While ratified by 195 parties by early 2018, challenges persist. Global concern arose when the US initially announced its withdrawal in 2017 but later reversed it. France has demonstrated its commitment by aiming to ban gasoline vehicles by 2040 and eliminate coal usage by 2022. However, critics argue that many countries still heavily rely on fossil fuels and lack robust policies for greenhouse gas reductions. This disparity casts doubt on achieving substantial emissions cuts and realising the global sustainable development goals envisioned by the Paris Agreement.

2.9.7 The Glasgow Climate Conference

The Glasgow Climate Conference (COP26), held in October–November 2021 in Scotland, aimed to intensify global climate action and uphold the Paris Agreement's objectives amidst escalating climate urgency, extreme weather, and warming trends. Key goals included limiting global temperature rises to below 2 degrees Celsius, preferably 1.5 degrees Celsius, through enhanced Nationally Determined Contributions (NDCs) and emissions reductions. Mitigation efforts centred on phasing out coal, boosting renewables, and adopting sustainable practices. Adaptation strategies focused on bolstering resilience, particularly for vulnerable communities, while financial commitments aimed at mobilising $100 billion annually for developing countries' climate efforts. The conference also addressed loss and damage, emphasised nature-based solutions, and underscored technological innovation and international cooperation in tackling climate challenges. The Glasgow Climate Pact, a beacon of hope, reflected a global consensus on urgent climate action and set ambitious targets that inspire us all to work towards a sustainable and resilient future (Scott et al., 2023; Nukusheya et al., 2021; Valayanidis et al., 2021).

2.10 Models of sustainability

Sustainability is a broad concept that encompasses far more than environmental concerns. As Liu et al., (2022) argued, the subject is frequently divided into economic, social, and environmental domains to make it more manageable. It is challenging to imagine significant progress in any one of the three domains of sustainability in isolation from the other two (Mapook et al., 2022; Selmes, 2005). Requiring that all three dimensions be adequately considered is fundamental to the 'triple bottom line' (TBL) approach, the underlying theory of this concept.

2.10.1 Three-overlapping Circle Model of Sustainability

The Figure 2.1 from Mebratu (1998) depicts the sustainability concept as three intersecting circles representing social, economic, and environmental objectives. The intersecting circle model resembles a Venn diagram, a mathematical concept that shows the similarities between two sets within overlapping circles and implies that the achievement of social, economic, and environmental goals will result in 'true' sustainability at the point where these three characteristics (circles) overlap.

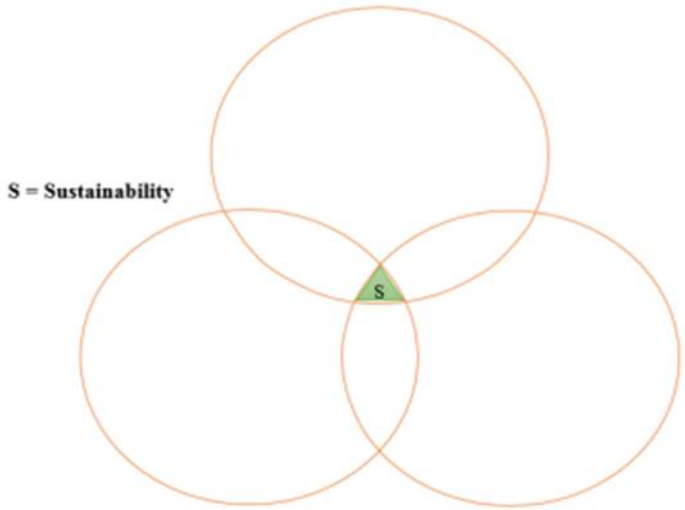

Figure 2.1: Three-overlapping Circle Model of Sustainability (Source: Mebratu, 1998)

The overlapping region correctly indicates that all three domains must be satisfied in the end, but this does not imply that all sustainability efforts must be balanced between these three domains. This model does not reproduce the fact that the economic circle solely depends on the other two and needs to be more specific. The

environmental issue is the most fundamental of sustainability. Hence, economic, social, and environmental aspects make sense to be reflected in such a diagram (Brockhaus et al., 2017). The natural environment supports Societies and economies (Mitchell, 2000). In other words, the environment can survive without human societies and economies. In contrast, human societies and economies cannot exist without the environment's resources, making the environment domain the most crucial in this theory (Wagner, 2015). Economic advantage must be based on sustainable activities that operate within the constraints of society and nature. In addition, economic mechanisms must encourage sustainable activities, producing a sustainable economy.

Furthermore, it is believed that the incorporation of environmental sustainability into the strategic management functions of organisations contributes to their economic sustainability. Hassan et al. (2023) and Junaid et al. (2022) argued that "integration of environmental issues positively correlates with economic performance and thus supports the concept of organisational peculiarities in the context of integration. Consequently, firms with greater integration can realise competitive advantages and enhanced performance in various economic performance dimensions, such as risk, image, efficiency, and market performance.

Humans in the modern world tend to view themselves as emancipated from or in control of the natural environment. Humans mistakenly believe they can control nature when they are subject to Mother Nature's authority. This perception is unhelpful because it makes it more difficult to identify problems, yet the intersecting circles model may encourage this way of thinking. In addition, interpreting the three domains as requiring equal attention encourages consideration of the continued applicability of trade-offs that directly derive from the business dilemma. Unfortunately, this paradigm implies that the economy can exist independently of society and the environment; specifically, the portion of the economy circle that does not overlap with the society and environment circles has its existence. This significant discrepancy directs us to the next, more accurate model.

2.10.2 Three-Nested Dependencies Model of Sustainability

This model, also known as the concentric circle model of sustainability, is believed to be more accurate than the previous.

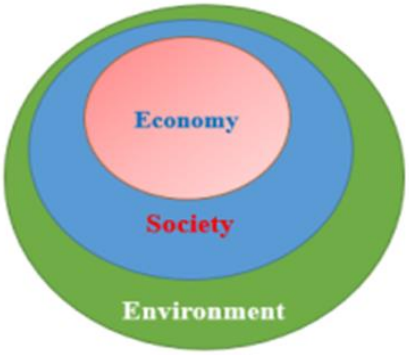

Figure 2.2: Three-Nested Dependencies Model of Sustainability (source: Mensah et al. 2012)

This model indicates that everything is interdependent, i.e. all three factors are interdependent. According to this paradigm, the economy depends on the society, meaning that money can be extracted from the society and cannot be obtained elsewhere. Considering that society is contingent on the environment, money also depends on the environment.

2.10.3 Three-Legged Sustainability Stool

The 3-legged stool model considers three dimensions essential for humans to experience a high quality of life. In addition, it asserts that a high quality of life cannot be attained if one of the three factors is lacking. Nevertheless, this metaphor isolates the economic, environmental, and social legs that are central to the concept of sustainability. Figure 2.3 demonstrates that the stool is a weak metaphor, which explains why the model is rarely used to define and explain sustainability.

Figure 2.3: Three-Legged Sustainability Tool (source: Willard, 2012)

2.10.4 Levett's Model of Sustainability

Figure 2.4 is consistent with the model presented by Reid (1995) in 'The Limits to Growth'. The environment is depicted in Reid's diagram as a thermodynamically closed system. Since the term 'economy' is a social construction, it is possible to go even further. Levett makes this point and redefines the three intersecting circles model as concentric circles or 'Russian dolls' (Levett, 1998) (see Figure 2.1). It is a construct of society. Human societies have created institutions and inculcated the underlying assumptions, expectations, and behaviours that allow them to operate as they do. Figure 2.4 demonstrates that the Levett model differs significantly from the intersecting circles model. Whether or not the intersecting circles model is intended to suggest a balance between social, economic, and environmental goals or something else entirely, the concentric circles model helps illustrate unambiguously that the economy is 'within' society and that society must live within the constraints of the environment.

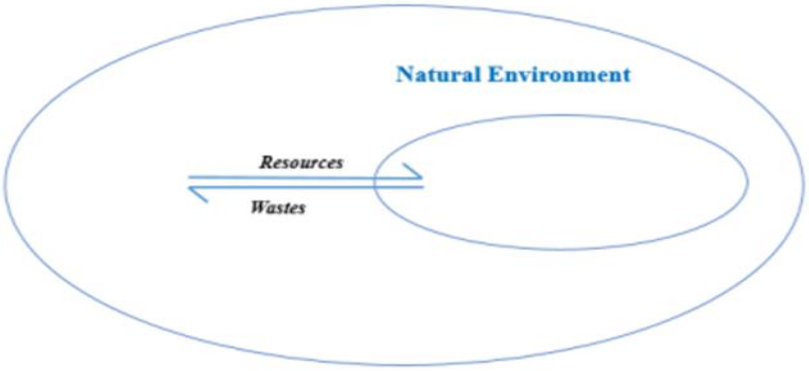

Figure 2.4: Levett's Model of Sustainability (Levett, 1998)

2.11 Categorization of sustainability model

Todorov and Marinova (2009) classify five types of sustainability models: Pictorial visualisation models, Quantitative models, Physical models, Conceptual models and Standardising models.

2.11.1 Pictorial Visualization models

As pictorial visualisation models, the three dimensions of the overlapping circles model (economic, social, and environmental) represented as pillars, a Venn diagram, or embedded circles are designated. They were criticised by Todorov and Marinova (2009) for their limited information but praised for their wide audience reach.

2.11.2 Quantitative Models

Boulanger and Bréchet (2005), quantitative models include macroeconomic, optimisation, dynamic system, and comprehensible universal equilibrium models. This aspect of models has been the subject of extensive research, resulting in the development of a vast array of models, the most prevalent of which are economic models. These models are criticised for lacking a comprehensive strategy and ignoring the importance of the involvement of stakeholders.

2.11.3 Physical Models

Physical models of sustainability are limited to their environmental component. Examples include urban design and energy efficiency (Levings, 2004), toxicity (e.g., Karlsson, 2008), and engineering ecology (Todorov & Marinova, 2009). These models are extremely specific and quantifiable, but their period is limited. They employ a

method that encompasses only a fragmented portion of the sustainability system and thus serves a limited purpose.

2.11.4 Conceptual Models

The conceptual Models are broader and more theoretical in scope. This category's models are extremely comprehensive and relate to societies. They inform the public about global environmental concerns such as climate change and global warming. Beginning with the work of the Club of Rome (Meadows et al., 1971) on the effects of nuclear power (Turco et al., 1983) and Ozone depletion (Litfin, 1994) on global warming and climate change, some of these models' date back to 1981. Like other categories, these models appear more politically centred and have pros and cons. The models have successfully alerted the public to environmental issues and sparked a variety of political and environmental policies. However, they lack concrete and clear ways to address the crisis of sustainability. The theoretical models make it complex to handle ambiguity; consequently, their efficacy is evaluated in a variety of ways. This is illustrated by the so-called repudiation of climate change (Nuccitelli, 2014).

2.11.5 Standardized Models

The final classification of sustainability models is "Standardised Models." One of these examples is sustainability indicators, and the United Nations provided 96 indicators of sustainability (United Nations, 2007). Standardised models typically cover particular activities, such as sustainable consumption or measurement instruments for sustainability (Mishra et al., 2023). Other models include the ecological footprint (Li et al., 2023) and the National happiness models (Aldhaheri et al., 2023).

These models and indicators permit the measurement of the system's performance (Alnsour et al., 2023), they can accommodate a particular local–global perspective, and their development can be collaborative. Iswan & Kihara (2022) argue that even though these models endeavour to measure sustainability or non-sustainability, there is a multitude of other indicators that perfectly match the current situation. Carlisle (2022) stated that we could learn at least as much about sustainability by averting our gaze from numbers and focusing instead on the soil washing down the

streams, the clear-cuts where forests once stood, the changing climate, the smell of city air, the places on earth too contaminated to live in or too desperate for safety in, and the hectic emptiness of our lives. In the meantime, we can recognise what we already know.

This acceptance of the problem necessitates a new way of thinking about sustainability, (Scrieciu et al., 2023) they argued that we must focus on the process itself instead of the external component and consequences. Regarding this, the authors agree with Todorov & Marinova (2009); however, this does not imply that the authors regard the models above as unimportant; they are valuable tools and provide guidelines for enhancing sustainability at different levels and under different circumstances. Nevertheless, we need a model that can be implemented in any environment or industry that evaluates procedures and operations to provide a better sustainability stewardship role.

2.12 Summary

This chapter reviewed the literature on sustainability. It discussed definitions of sustainability in the 1980s, 1990s and the Millenniums and further reviewed literature on pathways and obstacles to sustainability implementation and sustainable supply chain practices. It also discussed operations and the sustainability performance of the supply chain. The chapter also reviewed the literature on global campaigns for sustainability by looking at the Stockholm Conference, The Brundtland Report, the Rio Earth Summit, the Kyoto Conference, the Millennium Development Goals (MDG), The Paris Agreement and the Glasgow Climate Conference. Followed by the categorisation of the sustainability model.

Based on the literature, there is mounting pressure from stakeholders inside and outside organisations to adopt sustainability practices, driven by increasing social and environmental concerns and resource scarcity. The Glasgow Climate Conference (COP26) underscored the necessity of technology transfer and international collaboration to combat climate change (Mountford et al., 2022; Perrone et al., 2022; Wang et al., 2022).

Studies indicate that stakeholder pressures compel firms to integrate environmental considerations into supply chain management. However, achieving improved organisational performance through sustainable practices requires a coherent response from all stakeholders and a deep understanding of their impact. Studies have shown mixed results on the relationship between sustainability practices and organisational performance across different economies and sectors (Baliga et al., 2020; Golicic & Smith, 2013; Zhao et al., 2023; Larbi-Siaw et al., 2022).

Regulations significantly promote sustainable supply chain practices, but internal commitment and support are equally crucial for effective implementation (Esfahbodi et al., 2017; Bostrom et al., 2015; Piya et al., 2022). Despite government and stakeholder support, numerous obstacles hinder widespread adoption, particularly in emerging economies like Nigeria's oil and gas sector (Ohene et al., 2022; Karmaker et al., 2023). This study aims to fill these gaps by examining the pathways and obstacles to sustainability implementation in the Nigerian oil and gas industry and addressing the complexities of sustainable supply chain practices in an emerging economy context.

Chapter Three: Theoretical and Conceptual Framework Development

3.1 Introduction

This chapter reviews the development of the theoretical and conceptual framework. It starts by discussing the theory underpinning this study. This section explains the underlying theory related to the study (stakeholder theory). It then discusses the conceptual framework of the study. The framework and its justification are discussed in the section, and each research objective is explained. Finally, the thesis model and a table showing where the items in the model come from are presented.

3.2 Theoretical Underpinning

This chapter also presents the fundamental theories underlying this research, establishing the groundwork for the development of a research framework. The literature has identified stakeholder theory, which helps to explain how different forces influence the adoption of sustainable supply chain practices and their overall impact on sustainability and operational performance.

3.2.1 Stakeholder theory

Stakeholder theory is a management and ethics framework which asserts that organisations should consider the interests and concerns of all individuals or groups affected by their actions, not just shareholders (McGahan, 2023). It acknowledges that businesses are responsible to a broader set of stakeholders, including employees, customers, suppliers, communities, and the environment, beyond solely maximizing profits for shareholders. This theory has gained prominence as a more holistic and sustainable approach to business, recognizing that long-term success often depends on maintaining positive relationships with various stakeholders (Bhagwat, 2023). It also aligns with the growing societal emphasis on corporate social responsibility and sustainability. Stakeholder theory has been employed to examine sustainability initiatives, highlighting the core principle underlying sustainable behaviour (McGahan, 2023).

The term "stakeholder theory" emerged in 1963 through a groundbreaking Stanford Research Institute memorandum, arguing that managers "needed to understand the concerns of shareholders, employees, lenders, and suppliers, to develop objectives

that stakeholders could support"(Bhagwat, 2023). Stakeholders are defined as any group within or outside an organisation with a vested interest in the organisation and its performance or influence strategic decision-making (Alderson et al., 2022). The stakeholder theory posits a framework for understanding the dynamic between stakeholder influence and companies. It conceptualises the firm as a complex network of explicit and implicit linkages among persons and groups who can impact or be impacted by the organisation's pursuit of its objectives (Yuan et al., 2022).

The theory of stakeholders is descriptive, normative, and functional. It is descriptive because it describes the company as a constellation of cooperative and competitive interests with inherent value. It is normative because it implies that (i) stakeholders are persons or groups with legitimate interests in procedural and substantive aspects of corporate activity, and (ii) all stakeholders' interests have intrinsic value. Lastly, it is helpful because it establishes a framework for investigating the links between stakeholders' pressures and achieving corporate performance objectives (Marcon Nora et al., 2023).

These stakeholders are categorised into primary and secondary or internal and external. Primary stakeholders are actors who directly influence the company (e.g., suppliers, employees, community residents, and customers), While secondary stakeholders can affect the firms through their influence on primary stakeholders (e.g., Government, nongovernmental organisations) (Shahzad et al., 2023). Lambin et al. (2023) argue that the group of public stakeholders consists of governments and communities that provide infrastructure to markets whose regulations and laws must be followed. All these stakeholders play a crucial role in putting pressure on oil and gas companies to act sustainably (D'Souza et al., 2022).

This study examines the stakeholders commonly recognised in the relevant literature: employees, stockholders, customers, community, Government, international organisations, and NGOs. The primary source of pressure on oil and gas companies, often from legal entities, comes from coercive laws that they must adhere to avoid penalties or sanctions that could disrupt their regular operations. Legal actors also have the potential to motivate oil and gas companies to embrace environmentally friendly practices by offering incentives and rewards. Numerous studies have shown that government regulations are crucial in shaping a company's

environmental strategies. According to research by Roncari et al. (2023), a company that complies with environmental laws avoids tangible drawbacks like fines or temporary shutdowns and enjoys intangible benefits, such as an enhanced reputation among clients.

Customers, as representatives of the market's interests, have played a significant role in compelling companies to adopt Environmental Practices. This shift has been propelled by the increasing environmental awareness among consumers, who now demand more information and prefer products and services that demonstrate a company's commitment to the environment (Purcărea et al., 2022). Moreover, customers are the end-users of products and services, and their active participation is crucial for substantial reductions in a company's environmental footprint (Hazen et al., 2022). There is also a growing demand from customers for written certification of compliance with environmental regulations and assurance that the products they purchase meet environmental quality standards (Irfany et al., 2023). The proximity of a company to its customers is directly linked to the level of pressure it faces from them (Tsagarakis et al. (2011).

Furthermore, in recent times, the influence of communities has gained significant traction as a source of pressure on companies (Lee et al., 2023). This shift is driven by the growing awareness of environmental issues within communities (Megura et al., 2022). Communities play a pivotal role in providing social legitimacy by shaping public sentiment, redefining accepted norms, and altering people's perceptions (Megura et al., 2022). Alyahya et al., (2023) and Tandon et al., (2022) demonstrate that companies are motivated to act responsibly towards the environment to avoid hostility from their communities.

Pargal et al. (1997) have developed a market-oriented model for community-based environmental services. Companies rely on the community for the supply of essential services (such as employees and contractors) and the demand for their services or products. The exchange of these inputs and outputs is highly susceptible to community hostilities. A company known for harming the local environment may encounter difficulties in attracting and retaining workers or selling its products, resulting in informal "penalties" for poor environmental performance.

Furthermore, Young et al. (2022) and Chen et al. (2022) stated that in certain circumstances, especially in Nigeria, communities can effectively pressure companies to minimise their environmental impact, even without formal regulations. Therefore, communities are vested in understanding how oil and gas explorations impact the natural environment.

Stakeholder theory, when applied, can provide a practical understanding of how pathways to sustainability influence sustainability practices and performance within oil and gas companies. This theory underscores that pressures from these stakeholders can drive these companies to adopt sustainable supply chain practices, thereby achieving sustainability and operational performance.

Pathways to sustainability, such as increasing consumer demand for environmentally friendly products, stricter regulatory requirements, and growing community pressure, act as external factors that push oil and gas companies towards adopting sustainable supply chain practices. These pathways create opportunities for firms to develop new strategies that align with sustainability goals. For example, businesses have been found to employ carbon mitigation strategies to address climate change-related risks and opportunities in response to pressures from various stakeholders (Dhanda et al., 2022). Furthermore, it is widely acknowledged that stakeholder pressures create a sense of urgency for companies to employ more substantive carbon abatement measures and increase carbon transparency. Also, Cadez et al. (2019) state that stakeholder pressures, such as those from the market and regulatory agencies, influence the emissions reduction strategies of oil and gas companies, which in turn impacts their sustainability-related practice and performance.

3.3 Conceptual framework Development

A conceptual framework is a network of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena. The concepts that constitute a conceptual framework support one another, articulate their respective phenomena, and establish a framework-specific philosophy (Jabareen, 2009 cited in Salama, 2019). The conceptual framework illustrates the constructs (variables) studied and their proposed relationships (Abubakar, 2014). Therefore, this research

proposed investigating five constructs: pathways, obstacles, sustainable supply chain practices, sustainability, and operational performance. The framework proposes that sustainable supply chain practices are implemented as a result of pathways and obstacles. Then, if implemented, SSCP practices will impact both sustainability and operational performance. Also, SSCP was proposed to mediate the relationship between pathways and sustainability performance.

From the sustainable supply chain literature, sustainability has reached an advanced stage of implementation in the oil and gas industry in developed countries. Numerous studies have investigated the pathways for achieving sustainability within organisations. These pathways encompass the support of top management, the strategic importance of sustainability initiatives, alignment within the organisation's systems, the use of sustainability metrics, the integration of sustainability in a holistic manner, engagement with stakeholders, and the presence of deeply ingrained values consistent with sustainability as detailed in the literature chapter of the thesis.

While the implementation of sustainability faces significant challenges related to changes in the business environment, many oil and gas companies have shown a tendency to adapt and transform in response to evolving market conditions. However, numerous supply chain companies in Nigeria have yet to embrace sustainability implementation due to various obstacles. These obstacles hinder the integration of sustainability initiatives within the supply chain. Studies have identified multiple obstacles to implementing sustainability, as detailed in the literature chapter of the thesis.

Furthermore, oil and gas companies are increasingly addressing external issues critical to long-term success, reflecting the multi-layered nature of sustainability. As detailed in the literature review section, strategies for both environmentally and socially sustainable supply chain practices include eco-efficiency, renewable energy, local sourcing, emission reduction, and enhancing workplace sustainability. It's important to note that the successful implementation of these strategies relies heavily on our stakeholders' active participation and support. Emphasis is also placed on sustainable product design, stakeholder engagement, ethical governance, and incorporating sustainability into talent and performance management.

Performance measurements are not just a single metric but a comprehensive system that oil and gas supply chain companies rely on to monitor performance against established targets and to detect performance gaps (Yusuf et al., 2018). This system is designed to establish a benchmark, and it does so by possessing the capability to measure various aspects of performance (Beske-Janssen et al., 2015). It comprises metrics that quantitatively evaluate the effectiveness and efficiency of actions (Neely et al., 2005). The performance being measured can be sustainable or operational, with sustainability performance encompassing economic, social, and environmental dimensions. On the other hand, operational performance is influenced by a business's competitive positioning and the markets it targets (Porter, 2004). It includes critical factors such as cost, quality, delivery reliability, speed, flexibility, and innovation (Yusuf et al., 2014).

Therefore, the critical review of the literature indicates that implementing sustainable supply chain practices to achieve performance outcomes should commence by ascertaining their pathways and obstacles, such as perceived environmental pressures and benefit expectations from one side and perceived constraints from the other.

Figure 3.1 below shows the major relationships between pathways, obstacles, sustainable supply chain practices, and organisational performance in terms of sustainability performance and operational performance, resulting from the literature. As explained above, the model argued that both pathways and obstacles directly influence sustainable supply chain practices and sustainability performance. Also, sustainable supply chain practices directly influence sustainability and operational performance. Further, the model proposed that sustainable supply chain practices can mediate the link between pathways and sustainability performance; that is, the presence of pathways can lead to an increase in sustainable supply practice that will impact sustainability performance. In the model, both pathways and obstacles are portrayed as antecedents of both sustainability practices and performance.

Furthermore, the table 3.1 below present the study constructs and the key source of the items in the model. The model will be validated using questionnaire survey. The outcomes of the survey and the analysis process is detailed in **Chapter 5**. In view of

the underlying rationale, the following subsections presents the detailed explanation of research model.

3.3.1 The influence of pathways on sustainable supply chain practices and sustainability performance

Previous studies indicate that top management support, the strategic centrality of sustainability initiatives, sustainability metrics, holistic integration, stakeholder engagement, political and legislative actions and increased awareness of sustainability issues have encouraged companies to implement sustainability practices along their supply chains (Wirtenberg et al.'s 2007; Mitra & Datta,2014). Accenture and United Nations (UN), in their survey, found out that 80% of chief executive officers (CEO) considered it crucial to fully integrates sustainability issues into their operations compared to 50% in 2007 (Mertins & Orth, 2012). The pressure on the organization to embed sustainability practices into their business is increasing (Ren et al., 2020). Industries may have different internal policies, but the most ensure that their economic developments are in line with protecting the environment and beneficial to society; these include local sourcing of raw materials, local recruitment and collaborating with sustainable suppliers. Companies have corporate responsibility towards society; therefore, environmental concerns on a global scale have compelled regulatory and other government institutions to enact more stringent rules to align operational processes with the three pillars of sustainability (Misopoulos et at. 2018).

Furthermore, (Govindan, et al., 2020; Gupta et al., 2020; Ali et al., 2021a) emphasised the significance of pressure from the government, employees, and top management in implementing sustainable supply chain practices and stated that such pressures are becoming increasingly dominant. Cai et al. (2020) also noted that organisations across the globe are increasingly subjected to legislation that encourages them to limit the polluting consequences of their product and process activities. In identifying customers, investors, and non-governmental organisations as sustainability drivers, Adebanjo (2016) cited the growing knowledge of consumers and others as pathways to sustainability performance. Moreover, Pathways can drive the firm's creative, risk-taking, and proactive nature, implying that it can give the incentive to acquire the

requisite resources and competencies to meet the organisation's sustainability demand. Such pathways can also assist organisations in fostering innovative stewardship activities that will significantly set them apart from their competition, and via such initiatives and programmes that will simultaneously incorporate the environment, society, and economic requirements of the organisation, which could eventually enable businesses not only in generating more incredible wealth but also in achieving sustainable competitive advantage.

3.3.2 The influence of obstacles on sustainable supply chain practices and sustainability performance

In implementing sustainable supply chain practices, organisations must fully understand the benefit of adopting sustainability in their supply chain; some obstacles have prevented the implementation. For instance, implementing sustainable practices are IT enablement, technological adoption, employing quality people, and motivating and educating employees will demand a substantial initial investment, which is connected with an increase in direct and transaction expenses, resulting in a rise in the product's overall cost (Gopal & Thakkar, 2015). Even though an organisation can implement these sustainable supply chain practices, sustainability performance may only be achieved in the long term due to these obstacles. Unawareness on the part of customers is also a significant barrier; this means that customers need to be aware of green products and their benefits, resulting in a lack of considerable demand for sustainable products (Raut et al., 2019). The communication gap was another obstacle to sustainability (Orji et al., 2019). Other obstacles are resistance to change in technology adoption, support from the government, lack of qualified/trained employees, commitment from top management, compliance with regulations, and market ambiguity, all hamper sustainability practices and performance. Even though this relationship has not been empirically studied in prior studies in the oil and gas industry in Nigerian, it was evident that these obstacles impede organisations from improving their sustainability practice and performance.

3.3.3 The influence of sustainable supply chain practices on sustainability performance and operational performance

The concept of sustainability requires that companies integrate their economic prosperity, protection of the environment and social development in their operations (Lăzăroiu et al., 2020; Hysa et al., 2020). Economic performance was always the critical concern of the company among the three underlying sustainability concepts. Studies found that sustainability practices can lead to better performance, improving firms' market share and profit margin through enhanced environmental reputation and offering differentiated products (Hsu et al., 2021; Bhattacharya et al., 2019). In addition, companies are also well aware that environmental and social practices significantly impact their sustainability performance. Removing waste, energy, and emissions and re-using materials reduces costs, improves company image, and increases profit. Also, socially responsible practices, if implemented, will improve sustainability performance (Gayi et al., 2020).

Furthermore, existing literature has revealed the link between sustainability practices and cost, product differentiation and innovation strategies. Barauskaite et al. (2021) argued that successfully implementing environmentally friendly and socially responsible products is associated with unique approaches. In the same vein, Alzoubi et al. (2020) revealed that sustainable supply chain practices could result to cost reduction. Abbas et al. (2019) pointed out that sustainability practices are paths for improving innovation. Similarly, Gayi et al. (2020) argued that the greater an organization's innovations in pollution mitigation techniques, the greater its cost-benefit from sustainable supply chain practices. Therefore, sustainable approaches can result in improved innovation, cost, quality, and reliability of operational performance aspect It is clear that if sustainable supply chain practices are implemented, they will positively affect sustainability and operational performance.

3.3.4 The mediating role of sustainable supply chain practices on relationship between pathways and sustainability performance

Besides its direct effects on sustainability and operational performance, sustainability practice is considered a mediator between pathways and sustainability performance. Sustainability practices hopeful of preventing pollution and, more

critically, ensuring product stewardship demand relational competencies that transcend organisational boundaries and specific resource combinations. (Gopal & Thakkar, 2015); accordingly, relational competencies and capabilities developed through training, provision of technology enablement will facilitate information and knowledge, compliance to regulations and creation of awareness which can drive firms to implement sustainability practices that can help advanced performance. Moreover, through sustainable supply chain practices, organisations strive to enhance their sustainability practices across their supply network to ameliorate pressure from a regulatory body, customers, and employees. In addition, environmental legislation can drive sustainable supply chain practices, which in turn influence sustainable supply chain economic, environmental, and social performance (Adebanjo et al., 2016).

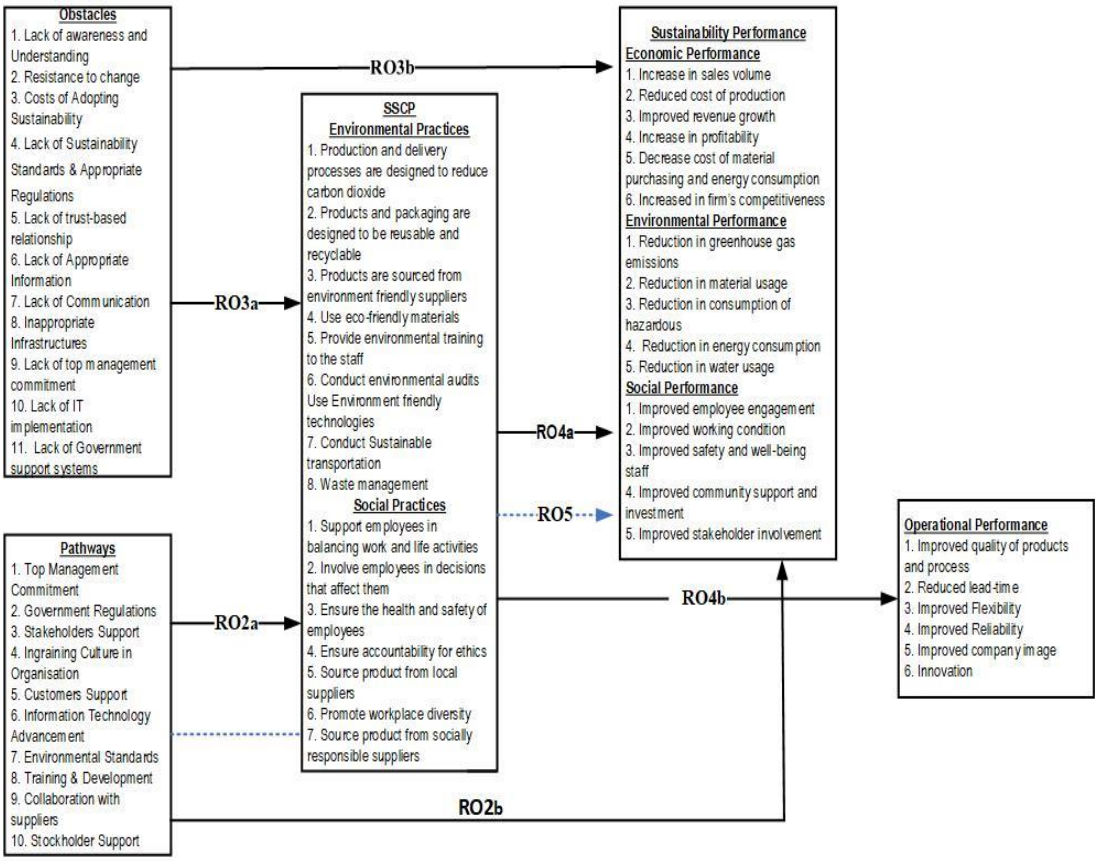

Figure 3.1 Final conceptual model

Table 3.1: The study constructs and source of the items in the model

First-order constructs	Second-order constructs	Source of the items in the model
Pathways to sustainability		Costache et al., (2021); Chege and Wang (2020); Wijethilake (2017); George et al. (2016); Rauter et al. (2015); Wirtenberg et al. (2007); Fairfield et al., (2011); Bansal (2003); Yusuf et al. (2012)
Obstacles to sustainability		Cantele & Cassia (2020); Klassen & Vereecke (2012); Kaur et al. (2018); Narimissa et al. (2020); Walker and Brammer (2009); Zhu & Sarkis (2004) and Correia et al., (2013)
Sustainable supply chain practices	**Environmentally sustainable practices** **Social sustainable practices**	Gimenez et al. (2012), Belhadi et al. (2020), Pullman et al. (2009), Zhu et al. (2008, 2013), and Paulraj et al. (2017)
Sustainability Performance	**Environmental performance** **Economic performance** **Social performance**	Geyi et al. (2020); Esfahbodi et al. (2017); Singh et at. (2019); Hong et al. (2017); Wijethilake, (2017); Yu et al. (2017); Hojnik and Ruzzier (2017); Savero et al. (2017); Chan et al. (2016); Fairfield et al., (2011); Sarkis et al. (2010); Zhu et al. (2008 2013); Qu et al. (2015); Neely et al., (2005) and Abubakar (2014).
Operational Performance		Eckstein et al., 2015; Srinivasan & Swink, 2018; Kamble et al., 2020; Yusuf et al., 2007); (Parani et al., 2023); (Rana et al., 2024; Abdullahi et al., 2024).

3.4 Summary

This chapter outline the fundamental theory that underpin this research, setting the stage for the development of the conceptual framework. It delves into the stakeholder theory, a cornerstone that illustrates how pathways and obstacles influences sustainable supply chain practices and overall organizational performance. Furthermore, the chapter establishes the conceptual framework, revealing the intricate relationship between pathways/obstacles, sustainable supply chain practices, and organizational performance, encompassing sustainability and operational performance. The literature in chapter two fortifies this relationship, and the theory is comprehensively explained here. The basis of each construct in the framework is presented in a detailed manner. The model serves as the guiding principle of the research process, and the philosophical approaches and methodologies adopted will be thoroughly presented in **Chapter 4.**

Chapter Four: Research Methodology

4.1 Introduction

This chapter reviews methodologies and methods used in this research. It starts by discussing sustainability management as a field of study, followed by the use of research onion to discuss the research design in the social sciences field, which consists of ontology and epistemology. This section defines the philosophical ideas and some research methodologies related to the philosophical stance. It then discusses the types of research approaches. The following section explains the methodological choice. The following section explains the research types, also known as research strategies. This is followed by the time horizon, their justification, and the details of the research data collection.

4.2 Sustainability Management as the field of this study

When conducting a research project, it is essential to choose the proper methodology. It is essential to employ a set of methods to ensure that the research project's questions, aims, and objectives are met, resulting in valid and reliable conclusions (Irhoma, 2017). The acquired knowledge can be descriptive or exploratory. Irhoma, (2017) notes that sustainability management is a relatively new concept in the field of study in which this study is situated. Sustainability management research employs methodological pluralism based on a variety of methodological and philosophical paradigms (Fahy and Rau, 2013). Thus, it was observed that the social and natural sciences utilised in sustainable supply chain management research have led to the evolution of general strategies. In other words, both quantitative and qualitative methods of data collection are employed. Numerous reputable research methods that contribute to knowledge have been developed. Therefore, it is essential to comprehend the philosophies on which these methodologies are based. However, philosophical grounds alone cannot be used to evaluate the suitability and practicability of a particular research design; rather, practical research considerations are crucial for determining which methods are appropriate for studies (Irhoma, 2017).

4.3 Research Onion

The research onion framework, developed by Saunders et al. (2012) and depicted in Figure 4.1, serves as a guide for researchers in developing a robust research design. It encompasses the essential components of a rigorous social research project, particularly in the field of business and management. The framework consists of three levels of decision-making: the outer rings represent the research philosophy and research approach, the research design comprises methodological choices, research strategy, and time horizon, and the core represents the method of data collection and analysis. By following the research onion framework, researchers can systematically navigate through these layers, ensuring a comprehensive and well-designed research methodology. To establish a robust research methodology, scholarly research begins with formulating research question(s) and objectives. Subsequently, a series of decisions are made regarding research philosophy and approach, followed by selecting a research design encompassing methodological choices, research strategy, and time horizon.

Lastly, data collection and analysis occur at the core of the research process. It is crucial to recognise that these layers of the research process are interconnected and reliant upon each other. In simpler terms, the choice of research philosophy influences the approach taken, which impacts the selection of methodological approach, research strategy, and time horizon, as well as the data collection and analysis processes. Ali (2016) states that the research onion, frequently utilised in business management studies, particularly at the doctoral level, is a valuable framework for addressing research inquiries. It is attributed to Saunders et al. (2009) and offers a comprehensive approach to exploring various aspects of a research project. In the subsequent sections, we will examine each layer of the research onion and its significance in the context of this thesis.

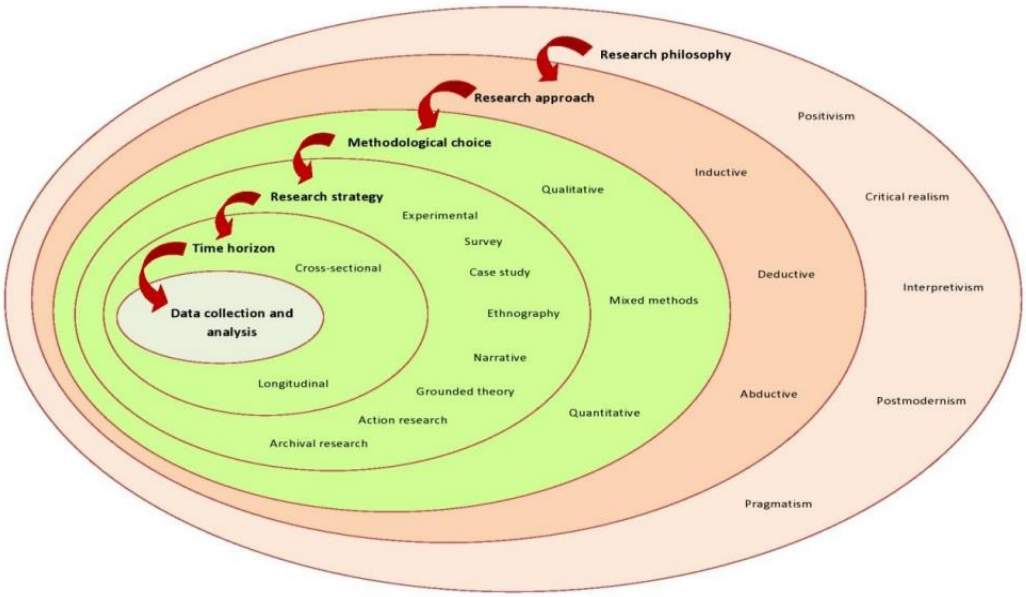

Figure 4.1: Research onion Developed
Source: Saunders et al. (2012)

4.4 Research philosophy

The concept of research philosophy, often seen as the first step in developing a research methodology, is a complex one. Research philosophy is a collection of beliefs and assumptions about various aspects of the universe and the nature of knowledge (Younus et al., 2022; Saunders et al., 2016). Creswell (2014) describes it as a 'worldview,' a fundamental set of beliefs that guide action. Other scholars, such as Denzin & Lincoln, 2005; Mertens, 2014; Burrell & Morgan, 2019), have used the term 'paradigms' to describe a cluster of beliefs and practices that influence what should be studied, how research should be conducted, and how results should be interpreted (Bryman & Bell, 2015; Morgan, 2013 cited by Geyi et al., 2020). In this context, 'paradigms' refer to a framework that shapes the entire research process.

In designing a successful research methodology, the research's philosophy is regarded as the most essential or predominant element (Cahnmann et al., 2017; Noddings, 2018; Moon et al., 2019). The main aspect of the research process is the belief that it is all about the processes or techniques by which data about a phenomenon should be collected, analysed, and presented for research purposes (Alvesson & Sköldberg, 2017; Creswell & Poth, 2017; Flick, 2018). The research

philosophy consists of ontology and epistemology, and they are discussed in the following section.

4.4.1 Ontology

Ontology, a branch of philosophy, is concerned with the assumptions we make regarding the logical coherence or reality of something and the nature or essence of the social phenomena we investigate (Zini et al., 2022; Packard et al., 2022). It delves into the philosophical exploration of the nature of existence or reality, the processes of being or becoming, and the fundamental categories and relationships of existing objects. Ontology can be objectivism or subjectivism.

4.4.1.1 Realism (Objectivism)

Realism has dominated science and social science research for over three decades (Mohajan, 2022). Realism refers to the forces and structures in the universe responsible for the phenomena we perceive. Society, institutions, emotions, intelligence, poverty, disability, individuals, groups, institutional and social levels, events, structures, and meanings are all as real as the sun. The position of realism is that reality exists independently of our perceptions and theories. The actual universe is complex and multi-layered (Butowski, 2023). Objects and reality can exist independently of our consciousness (Slater et al., 2022).

4.4.1.2 Subjectivism

Subjectivism is an ontological position that emphasises the subjective nature of knowledge and understanding. It posits that knowledge is constructed through the individual's subjective experiences, beliefs, and perspectives rather than solely based on objective facts or external reality (Menhat et al., 2019; Bryman, 2016; Gray, 2014). Subjectivism acknowledges the subject's active role in shaping their world understanding. Therefore, the ontological position of this study is objectivism.

4.4.2 Epistemology

Epistemology, derived from the Greek word episteme meaning knowledge, is a fundamental concept in research. It not only describes how we acquire knowledge and know the truth or reality (Setiawan et al., 2023; Sol & Heng, 2022), but also defines what qualifies as knowledge in the world, as Cooksey and McDonald (2011) aptly put it. It forms the very foundations of knowledge – its nature and forms and

how it can be acquired and communicated to others. It is the study of the nature of knowledge and justification. According to Bell et al. (2018), there are two types of epistemological positions: positivism and interpretivism, each with its own implications for your research. Epistemology is either positivism or Interpretivism discussed below.

4.4.2.1 Positivism

Positivism is a philosophical school of thought that emerged in the 19th century and gained prominence in the early 20th century. It is often associated with the work of Auguste Comte, the father of positivism (Drakopoulos, 2023; Halfpenny, 2014; Bourdeau, 2008). According to Comte, positivism involves using observation and reason to understand human behaviour. Initially, Comte believed that genuine Knowledge could only be derived from sensory experience and obtained through observation and experience (Mulyani et al., 2022; Corry et al., 2019). Positivism is characterized by its emphasis on empirical evidence and scientific methods as the basis for Knowledge and understanding of the world (Masuku, 2023).

4.4.2.2 Interpretivism.

Interpretivism, in contrast to positivism, is an epistemological stance that emphasizes the interpretation of social phenomena rather than solely relying on physical observation. According to interpretivism, social phenomena can be understood through the subjective interpretations of human beings, including social researchers (Jayasuriya, 2023; Coleman, 2019; Bryman, 2016). This perspective recognizes the subjective nature of individuals' interpretation and understanding of social phenomena, aligning with the ontological position of subjectivism. Therefore, the epistemological position is positivism.

4.5 Research Approach

4.5.1 Deductive approach

Researchers employ a deductive approach, which follows a logical progression, to examine the existing theoretical implications or explanatory models related to the phenomenon being studied considering the collected data (Graneheim et al., 2017; Schreier, 2012; Blackstone, 2012). Gill et al. (2011), as cited in Shibani (2016), a deductive research method involves establishing a conceptual and theoretical

framework before conducting empirical observations. This logical progression signifies a movement from theory to data, from a more abstract and general level to a more concrete and specific one.

The deductive approach can be broken down into four stages: (1) The researcher identifies the relevant concept about the subject of investigation, considering the workforce's wealth of experience, attitudes, and perceptions regarding implementing sustainability practices (2) Once the relevant concept is identified, protocols are established to observe and measure it empirically. Questionnaires are typically chosen as the most suitable research instruments for this approach (3) The hypotheses and theories (models) developed in the second stage are tested against the empirical data using explicit and unambiguous protocols. (4) The empirical data is compared with the researcher's developed model (theories and hypotheses), considering previous studies related to the subject of the current study.

Furthermore, Blaikie and Priest (2019) outline a sequential process consisting of six steps that are followed in a deductive approach: (i) proposing a preliminary idea, hypothesis, or set of hypotheses to form a theory; (ii) deducing a testable proposition by drawing upon existing literature or specifying the conditions under which the theory is expected to hold; (iii) scrutinising the premises and logic of the argument that led to the proposition, comparing it with existing theories to assess its potential for advancing understanding; (iv) testing the premises by collecting relevant data to measure the concepts or variables and analysing them; (v) if the analysis results are inconsistent with the premises, the theory is considered false and must be either rejected or modified, leading to a restart of the process; (vi) if the analysis results align with the premises, the theory is confirmed. Bell et al. (2018) also depicts the sequence of deductive logic as a series of steps, as presented in Figure 4.3. However, it is essential to note that deductive reasoning is limited by its reliance on rigid logic for testing, confirming, or refuting hypotheses. Based on the objective of this study, this approach is deemed suitable.

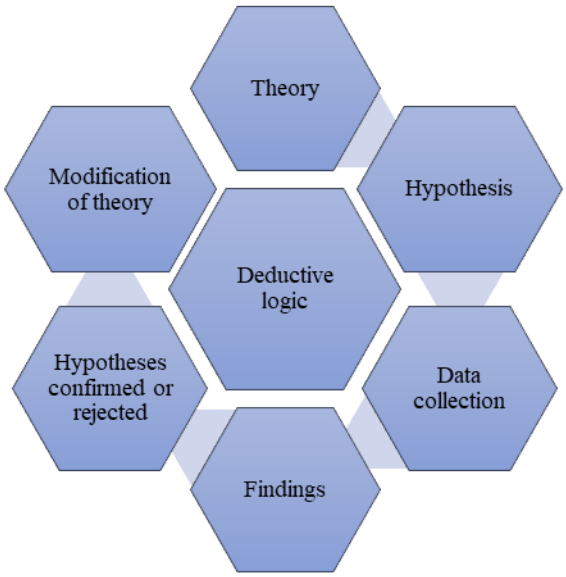

Figure 4.2 The process of deduction (source: Bryman and Bell, 2015, p 23)

4.5.2 Inductive approach

In contrast, induction entails deriving generalizable conclusions from observations (Bryman & Bell, 2015). It begins with empirical observations and progresses towards theory development or abstract generalization (Creswell, 2014). This process aligns with the interpretivism paradigm and qualitative research strategy (Saunders et al., 2019). Also, Gioia et al. (2013) defines the qualitative, interpretive research process and its associated analysis and presentation as an inductive approach. However, Aristotle argues that the inductive approach is a valid method for generating knowledge and applies to most research types (Pries-Heje et al., 2011, cited in Sarhan, 2018). Inductive reasoning involves moving from specific instances to generalizations (Sekaran & Bougie, 2016). Alase (2017) supports this notion, describing the inductive approach as a tradition that analyses raw data according to the researchers' objectives. However, the challenge with inductive reasoning lies in the critique that no empirical data alone can facilitate the construction of theories (Bell et al., 2018). Therefore, this approach is not suitable for this study.

4.5.3 Abduction Approach

The abductive approach, a concept with fascinating linguistic origins, is based on the understanding that significant scientific advancements do not strictly follow pure deduction or induction (Syll, 2023). Although Charles Sanders (Santiago) Peirce is

often credited with coining the term "abduction," he attributes its origin to Aristotle. There are three fundamentally different types of reasoning in science: deduction, induction and abductive, which are commonly misunderstood and translated as abduction (Syll, 2023). Additionally, Peirce mentions an analogy combining induction and retroduction (Peirce, 1931, as cited in Haig, 2022). From a linguistic perspective, abduction, initially referred to as apagoge, denotes "to lead away" in Greek and shares the same meaning as the Latin abdūcere ("to lead away; to carry off"). Peirce (1931) suggests that "abduction" is a mistranslation and should instead be called retroduction, although social scientists distinguish between abduction and retroduction (Danermark, 2001). Also, this approach is not suitable for this study.

4.6 Methodological Choice

Methodological Choice refers to the decision-making process of selecting and utilizing a research design that can be either quantitative, qualitative or a combination of both (Irhoma, 2017; Robson, 2011). In a mono-method design, a single data collection technique is chosen, followed by the corresponding analysis procedure, which can be either qualitative or quantitative. On the other hand, a multiple-method design involves the use of more than one data collection technique and analysis procedure (Collis and Hussey 2013). Another approach is the mixed-method design, which incorporates both qualitative and quantitative data collection techniques and analysis procedures (Saunders et al. 2019; Irhoma, 2017; Creswell 2013).

4.6.1 Qualitative Methods

Qualitative research embraces diverse philosophical assumptions, inquiry strategies, data collection techniques, analysis, and interpretation approaches. While there may be some similarities in the overall process, this method relies on textual and visual data, employs distinct steps for data analysis, and encompasses a broad range of inquiry strategies (Cresswell, 2003). In the late 1960s, universities in English-speaking countries made advancements in qualitative research methods, particularly within sociology and anthropology (Schwandt, 2007; Newman & Benz, 1998). Qualitative research focuses on understanding the essence or significance of a phenomenon or

culture being studied through in-depth descriptions (Newman & Benz, 1998). It acknowledged that the research process could evolve and change even after data collection had begun (Creswell, 2003, 2009). Qualitative inquiry encompassed various practices, where the meanings of methodological and philosophical terms varied depending on their usage or specific discussions about their significance. Rather than being an integrated system, these diverse modes of communication resembled a collection of contested practices. The controversies surrounding qualitative inquiry arose from different schools of thought and their distinct perspectives on the purpose of qualitative research (Dyar, 2022).

Qualitative research encompasses a wide range of methodologies that involve humanistic and interactive approaches. The methods used include empirical studies, materials-case studies, personal experiences, introspective analysis, life histories, interviews, observations, historical investigations, interactive text analysis, and visual text analysis (Bernad, 2022). These methodologies continue to evolve, with an increasing emphasis on participant involvement in data collection. Ethnography, case studies, field research, grounded theory, document studies, naturalistic inquiry, observation studies, interview studies, and descriptive research are commonly employed qualitative research methodologies. Additionally, other methodologies such as action research, phenomenology, feminist research, narrative research, focus group research, critical research, and discourse analysis contribute to the diverse landscape of qualitative research (Creswell, 2012).

4.6.2 Quantitative Method

Quantitative research entails gathering numerical data and follows a deductive approach to theories, assuming an objectivist view of reality (Bryman, 2016). This methodology focuses on formulating and validating hypotheses and constructing models to explain theories. The social sciences, contributing to the development of positivism and post-positivism (Robson, 2011). These methods are also known as statistical research, empirical research, or hypothesis testing research (Taherdoost, 2022). Quantitative research aims to draw generalisations from a sample to a larger population regarding their attitudes or behaviours (Taherdoost, 2022; Muzari et al., 2022). Quantitative research borrows methodologies from the natural sciences, such

as physics, chemistry, and biology (Robson, 2011). It is characterised by collecting numerical data, the relationship between theory and research, and an objective perspective on social reality (Bryman & Bell, 2007). In quantitative research, valid knowledge is derived logically from theory, measured operationally, and empirically replicated (Zwanenburg et al., 2022). It involves reducing variables to a minimal set, tightly controlling them through design or statistical analysis, and using them to test theories. The results of these tests confirm or disconfirm the theory or concepts being examined (Aguinis et al., 2023). The theory serves as the framework for the entire study, guiding data collection and analysis techniques (Damschroder et al., 2022).

Quantitative studies typically begin by stating a theory from which hypotheses, research questions or objectives are derived. Then, an experimental design is implemented to measure dependent variables while controlling for the effects of independent variables. Random selection of subjects is done to minimise errors and eliminate biases. After conducting pre-test measurements, the treatment is administered, and post-test measurements are taken. Statistical analysis is then used to determine the effects of the treatment. Usually, a single experiment is conducted, and statistical methods are employed to assess the likelihood of similar differences occurring again. These statistical significance tests provide results that either support or disprove the original hypothesis (Aguinis et al., 2023). The most effective way to address the issue is by understanding the factors or variables influencing the outcome. This understanding helps researchers comprehend and explain the problem (Creswell, 2009; 2011). Quantitative research methods include experimental studies, quasi-experimental studies, pre-test and post-test designs, self-administered questionnaires, structured interview schedules, and structured observation schedules (Chatpinyakoop et al., 2022; Majeed et al., 2022)

Quantitative research focuses on four key aspects: measurement, causality, generalizability, and replication. Measurement and quantification are at the core of quantitative research, emphasizing the need for accurate and precise measurements (Bryman and Bell, 2011). Additionally, quantitative researchers often address issues of meaning. Including attitude questions in surveys demonstrates their interest in

exploring significant matters (Majeed et al., 2022). When researchers routinely inquire about respondents' motivations for their behaviour in surveys, they are concerned with unravelling issues of meaning (Lin et al., 2022). To study meanings, quantitative researchers frequently employ methods such as attitude scales (e.g., the Likert scaling technique) and similar approaches (Anjaria, 2022).

4.6.2.1 Difference between quantitative and qualitative

Table 4.1 summarises the differences between qualitative and quantitative research. It highlights the distinct characteristics and methodological approaches of qualitative and quantitative research, reflecting their unique contributions to different research questions and objectives. Usually, qualitative, and quantitative research are pitted against each other in opposition' (Kuehn & Rohlfing, 2022).

Table 4.1: Difference between qualitative and quantitative

Aspect	Qualitative Research	Quantitative Research
Objective	Understand meanings, experiences, and concepts	Measure and quantify variables and phenomena
Data Collection Methods	Interviews, focus groups, observations	Surveys, experiments, secondary data
Data Type	Non-numeric, textual, visual	Numeric, statistical
Data Analysis	Thematic, narrative, content analysis	Statistical, mathematical, computational analysis
Research Design	Flexible, emergent, iterative	Structured, predefined, fixed
Approach	Inductive, developing theories from data	Deductive, testing hypotheses against data
Research Question	Exploratory, open-ended	Specific, hypothesis-driven
Sampling	Purposive, theoretical	Random, systematic
Validity and Reliability	Ensured through credibility, transferability	Ensured through reliability, validity, replicability
Results Presentation	Detailed narratives, case studies, descriptions	Statistical reports, graphs, tables
Researcher's Role	Active participant, subjective interpretation	Detached observer, objective measurement
Generalizability	Limited to specific contexts, not easily generalizable	Broad, aims for generalizability across populations
Time Frame	Often longer, in-depth study of few cases	Often shorter, broad study of many cases
Ethical Considerations	Emphasis on participant's context and perspective	Emphasis on anonymity and consent in large samples

4.6.2.2 Similarity between Quantitative and Qualitative Methods

Bryman and Bell (2011) suggest that qualitative and quantitative studies share common characteristics. Table 4.2 highlights that despite differences in methods and

analysis, both qualitative and quantitative research share fundamental goals and processes in the research framework.

Table 4.2: Similarities between qualitative and quantitative

Aspect	Qualitative Research	Quantitative Research	Similarities
Data Collection Methods	Interviews, focus groups, observations	Surveys, experiments, secondary data	Both involve systematic data collection
Data Analysis	Thematic, content analysis	Statistical, computational analysis	Both require rigorous analysis of data
Research Design	Flexible, emergent	Structured, predefined	Both need a clear research design
Validity	Ensured through credibility, transferability	Ensured through reliability, validity	Both seek to produce valid and reliable results
Research Question	Exploratory, open-ended	Specific, hypothesis-driven	Both start with a research question
Ethical Considerations	High importance, participant protection	High importance, participant protection	Both prioritize ethical considerations
Application	Social sciences, humanities	Natural sciences, social sciences	Both applied across various disciplines
Sampling	Purposive, theoretical	Random, systematic	Both use sampling to represent a population
Publication	Detailed narratives, case studies	Statistical reports, graphs	Both aim to disseminate findings through publications

4.6.2.3 Limitations of Quantitative and Qualitative Research

Both quantitative and qualitative research exhibit weaknesses. As shown in Table 4.2, qualitative research lacks systematicity, while quantitative research often replicates existing knowledge. Quantitative research has limitations regarding the scope of knowledge it can provide, whereas qualitative research faces challenges in generalizing findings to a larger population. Quantitative research tends to make more inferences beyond the collected data, whereas qualitative research relies on fewer such inferences. Further, quantitative research is considered scientific due to its objective evaluation of variables as presented to the researcher. On the other hand, qualitative research primarily examines phenomena based on human interpretation and emotions.

Table 4.3: Limitations of Quantitative and Qualitative Research

Quantitative	Qualitative
Proves what one already believes	Less systematic
Limited range or scope of knowledge	Limited generalizations to broader groups of people.
Restricted demonstration of the meaning of findings to people's lives.	Barely replicable findings.
----------	Minimized possibility of inferences beyond the data.

Source: Francisco et al. (2001)

4.6.3 Research Methodological Position of this Research

The researcher's perspectives typically influence their choice of adopting quantitative, qualitative, or mixed methods approaches in their research (Hendren et al., 2023; Bell, & Warren, 2023; Taherdoost, 2022). This study adopted quantitative research methods because they align with objectivist and positivist philosophies. Objectivism and quantitative research methods are compatible (Green, 2023). Further, the quantitative research paradigm follows a positivist or post-positivist research design (Perera et al., 2022). It involves formulating and testing hypotheses or addressing research questions (Wisenthige, 2023). Hence, this study aimed to identify pathways and obstacles that influence sustainable supply chain practices that impact sustainability and operational performance; as such, quantitative research is the best approach. This study is quantitative, employing a survey questionnaire for data collection. It is an empirical study that strictly adheres to a scientific approach. The findings were generalized to the oil and gas industry. The positivist paradigm and quantitative methods could offer broad coverage across various situations, they can be fast and cost-effective, and when statistics are aggregated from large samples, they can be highly relevant for policy decisions (Easterby-Smith et al., 2002).

4.7 Research Strategy

Research varies from one another by their nature (Walliman, 2011). "Different types of research, research strategies, or methodologies, as they are often referred to, are typically categorised as follows: exploratory, descriptive, hypothesis testing, or case study, depending on the level of knowledge about the research topic" (Sekaran and Bougie, 2009).

4.7.1 Action Research

In the 1940s, Kurt Lewin (1890-1947) coined the term action research to describe research that combines an experimental approach to social science with programmes of social action to address social problems (Schwandt, 2007). This research is used to initiate changes in an organization's work processes (Robson, 2011). The researcher begins with the problem at hand and collects data in order to provide a solution (Bell & Warren, 2023; Sekaran and Bougie, 2009) or to test a hypothesis that could improve the practical situation (Walliman, 2011). It requires collaboration between researchers and research subjects, as well as their participation in the process (Robson, 2011). It combines qualitative and quantitative methods of research (Geyi, 2020).

4.7.2 Descriptive Research

In order to describe the characteristics of variables of interest in a situation, a descriptive study is conducted. Additionally, an effort is made to comprehend the characteristics of organisations that adhere to standard procedures (Stantcheva, 2022; Sekaran and Bougie, 2009). The objectives are to learn more about an event and to record its specifics (Sun et al., 2022). Observation (interview, questionnaire, visual records, sound, and olfactory recordings) is used to collect data, which is then written down or recorded and analysed (Stantcheva, 2022). It attempts to examine situations in order to determine what is typical, i.e., what can be anticipated to occur in the future under identical conditions (Walliman, 2011). The purpose is to provide the researcher with a profile or description of pertinent aspects of the phenomenon of interest from an individual, organisational, industry-focused, or other perspective. In many instances, such information may be essential prior to even considering certain corrective measures; for instance, should the organisation consider changing

its practises? (Stantcheva, 2022) For descriptive studies, quantitative data in the form of frequencies or means and standard deviations are required (Sun et al., 2022).

4.7.3 Exploratory Research

Exploratory research is conducted when little is known about the situation at hand or when there is no information about how similar problems or research problems have been resolved in the past. Before developing a model and establishing a rigorous design for a comprehensive investigation, extensive preliminary work must be conducted to familiarise oneself with the situation's phenomena and to comprehend what is occurring' (Liu et al., 2022) It poses 'what?' and 'why?' queries (Wisker, 2008). This research is conducted to increase comprehension of the problem at hand. When data reveal a pattern regarding a phenomenon of interest, theories are developed and hypotheses are formulated for subsequent testing (Riesenegger & Hübner, 2022; Sekaran and Bougie, 2009); 'this research is commonly used when new knowledge is desired or certain behaviour and the causes for the presentation of symptoms, actions, or events need to be uncovered' (Kharola et al., 2022). This is exploratory research because little is known about sustainability practises, particularly in the oil and gas industry. To gain familiarity with sustainability practises in organisations, a comprehensive literature review was conducted, from which hypotheses were developed to be tested with questionnaire results.

4.7.4 Historical Research

Historical research is the systematic and objective gathering, evaluation, and synthesis of evidence to establish facts and draw conclusions about past events (Khoa et al., 2023; Wallman, 2011). It describes what occurred in the past and explains why and how it occurred. Historical research employs historical data in the form of artefacts, documents, and writing (Chong et al., 2022). This investigation attempts to answer questions such as where certain events occurred. Which individuals were involved? When did events occur? Furthermore, what type of human activity was involved?

4.7.5 Survey Research

Survey research is a method for collecting primary data through communication with a representative sample of people (Le et al., 2022; Zikmund et al, 2010). Survey

design provides a quantitative description of population trends, attitudes, or opinions by analysing a sample of that population (Rahamneh et al., 2023). The objective is to generalise from sample to population to draw conclusions about certain characteristics, attitudes, and behaviours of the population (Muzari et al., 2022). Surveys consist of self-administered questionnaires or structured telephone or in-person interviews (El Khatib et al., 2022; Creswell, 2011). Standardized questions, for which we are confident that all respondents will receive the same information, improve the efficacy of surveys (Chong et al., 2022). A survey is a positivist research method in which there is no provision for manipulating the variables under investigation. One characteristic of surveys is their capacity to describe large populations without bias and within a range of quantifiable degrees of uncertainty Le et al., 2022.

Forza (2002) categorizes survey research into three distinct approaches: exploratory, confirmatory, and descriptive. Each approach serves a specific purpose in the research process, and their explanations are outlined below:

- Exploratory survey research: This represents the initial phase of a research project aimed at gaining preliminary insights into a particular topic. It serves as a foundation for conducting more comprehensive studies on the subject in the future.
- Confirmatory survey research: This type of survey research focuses on testing theories using concepts, frameworks, and propositions. Researchers employ this technique when knowledge in a specific area has advanced to the point where hypotheses connecting different constructs can be proposed, and data can be collected to validate these connections.
- Descriptive survey research: This form of research is employed to enhance understanding of the adoption of a phenomenon and provide a detailed description of its distribution within a population. Although theory development is not the primary objective, the factual information gathered through descriptive research can prove valuable for constructing and refining theories.

4.7.6 Case Study Research

Case study methodologies originated in the fields of health, law, and social work (Padgett, 2016; Wisker, 2008). In case study, the case itself takes precedence over the variable (Schwandt, 2007). A case study is a methodical examination of a real-world situation that can result in a new theory. It has high validity with practitioners – the research's ultimate consumers (Morse et al., 2014). Because they are instrumentally useful for advancing comprehension of a particular problem, issue, or concept, cases can be selected and studied (Kelliher, 2022). It involves an empirical investigation of a contemporary phenomenon in its real-world context using a single or multiple evidence sources (Kelliher, 2022; Morse et al., 2014). "Case analysis entails categorising data according to specific cases for in-depth examination and comparison. The purpose of well-constructed case studies is to collect exhaustive, systematised, and in-depth information about each case of interest. It entails contextual analysis of similar situations in other organisations, where the nature and definition of the problem are identical to that of the present organisation (Çakar et al., 2021). Case study is one of the few available methods for studying uncommon or singular occurrences (George et al., 2019).

4.7.7 Research Strategy Position of this Research

As mentioned earlier, this study aims to identify the pathways and obstacles to sustainability and examine the relationship between pathways, obstacles, sustainability practices and their impact on sustainability and operational performance. A confirmatory survey research approach was employed to address this study's research questions and hypotheses. This approach allows for establishing causal relationships between the constructs under investigation. It facilitates hypothesis testing, as exploratory studies typically involve qualitative methods and subjective assessments of phenomena. In contrast, descriptive studies research is employed to enhance understanding of the adoption of a phenomenon and provide a detailed description of its distribution within a population that does not meet this study's specific objectives. Moreso, Exploratory studies are often based on case studies and qualitative analyses, lacking the quantitative nature required in this

research. Moreover, such studies focus on in-depth analysis within a specific context, limiting the generalization of the results and, therefore, unsuitable for this study.

Adopting a confirmatory survey aligns with the methodology commonly used in the analytics and supply chain research community. All the construct in this study are measurable indicators, and previous studies have recognized their quantifiable nature (Esfahbodi et al., 2017; Kamble et al., 2020; Balhadi et al., 2020; Wamba et al., 2020). When a study involves quantifiable indicators, a confirmatory or explanatory survey research design is considered the most appropriate (Dawadi et al., 2021; Rashid et al., 2021). This design facilitates the utilization of structural equation modelling for data analysis.

4.8 Time Horizon

Research can be categorised into two types based on time: longitudinal or successive independent samples and cross-sectional (Lee et al., 2023; Bryman & Bell, 2015). A longitudinal study involves observing a phenomenon or population over a specific period (Lee et al., 2023; Caruana et al., 2015). On the other hand, a cross-sectional study captures a "snapshot" of a phenomenon or a specific cross-section of the population at a single point in time (Lee et al., 2023; Setia, 2016). The following section provides a detailed explanation of both cross-sectional and longitudinal research, as well as the rationale for adopting cross-sectional research.

4.8.1 Cross Sectional

Cross-sectional research is a short-term study that involves gathering data only once, without repeated measurements (Bougie & Sekaran, 2020; Saunders et al., 2019; Bell et al., 2018). Such a study aims to collect relevant data to address specific research questions and obtaining data at a single point in time is sufficient. Cross-sectional research often employs a survey research strategy to explore the relationships between constructs across different organizations (Saunders et al., 2019). In the cross-sectional study, the researcher carried out pilot studies to gain in-depth information from the participants and the respondents within a shorter period planned for the study. This approach is financially feasible, relatively inexpensive, time-efficient, and straightforward (Bryman & Bell, 2015). Although cross-sectional

research is commonly associated with a quantitative research approach, it can also incorporate qualitative or mixed methods research strategies (Yin, 2018).

4.8.2 Longitudinal

In contrast, longitudinal research involves collecting data repeatedly over an extended period to achieve the research objectives (Melnikovas, 2018). It requires studying people or phenomena at multiple points in time to address the research question (Bougie & Sekaran, 2020). This research design offers researchers a degree of control over the variables being examined. It allows for the observation of changes over time and is often employed to understand the dynamics of a phenomenon (Bryman & Bell, 2015). Longitudinal studies can provide in-depth insights into the concept being studied, similar to case studies (Yin, 2018). However, longitudinal studies tend to align with an interpretivism epistemological position (Bell et al., 2018). It expands on the cross-sectional design by tracking certain factors over time to assess progress or identify potential causal relationships. Although more expensive, longitudinal studies can provide valuable insights (Bougie & Sekaran, 2020).

4.8.3 Time Horizon of the current study

Based on the research hypotheses, this study utilised a cross-sectional approach. The study aimed to capture a snapshot of current pathways/obstacles and sustainability practices and their potential impact on operational and sustainability performance. The intention was to empirically test the proposed model at a specific time without examining long-term changes or progress in pathways/obstacles and sustainability practices. Therefore, a longitudinal approach was deemed unsuitable for this study.

Cross-sectional research commonly employs a survey research strategy, allowing for examining a phenomenon or phenomena at a particular moment (Saunders et al., 2019). Furthermore, choosing a cross-sectional approach aligns with a positivist epistemological position and is well-suited for quantitative data collection methods. The selection of a cross-sectional design is also consistent with previous literature in the field, as evidenced by various studies (Catto et al., 2023 Ben & Pernvik, 2023; Benjamin et al., 2020; Aslam et al., 2018; Jadhav et al., 2019; Yusuf et al., 2013, 2014; Eckstein et al., 2015).

4.9 Data Collection

4.9.1 Sampling Approach

According to Forza (2002) and Brewerton and Millward (2001), as cited by Gye et al., (2020) a sample refers to a subset of the population that consists of selected members from the larger population. On the other hand, sampling involves studying a portion of the population and using the information obtained to make inferences about the entire population (Mohajan et al., 2020; Lasater et al., 2019; Kumar, 2011). It is the process of selecting a sufficient number of elements from the population so that by studying the sample and understanding the characteristics of the sample subjects, the researcher can deduce the attributes of the population elements (Mohajan et al., 2020). Sampling is employed to overcome the challenges associated with collecting data from the entire population, which can be impractical or unfeasible due to factors such as time, costs, and availability of resources (Kanaki et al., 2023).

4.9.2 The unit of analysis

The unit of analysis in business research refers to the person or object from which data is collected (Villena & Gioia, 2018). It addresses the question of what or who is being studied in the research (Li et al., 2017). A unit of analysis, according to Bougie and Sekaran (2020), is the level of aggregation at which information is analysed, and conclusions are derived. It encompasses the entire entity under investigation, including individuals, groups, organisations, countries, technologies, and objects that are the focus of the study (Hodge et al., 2020; Li et al., 2017). While identifying the analysis unit may seem straightforward, it is often overlooked in business research. It is not sufficient for a researcher to label a unit of analysis as an individual, a process, or a social artefact; what truly matters is clearly defining the specific unit of analysis. When conducting research, a researcher must deliberate whether they are studying managerial skills or managers, supervision or supervisors, the corporate sector, or corporate executives. Failure to do so may lead to drawing invalid conclusions.

Sustainability practices are typically implemented at the network level (Rothaermel and Hess, 2007). Fundamentally, the unit of analysis is determined by the research questions (Kumar, 2018; Grünbaum, 2007). Oil and gas companies are the units of

analysis, with supply chain managers and chief executives serving as the key respondents in this study. This was determined based on the proposed research questions, which aim to investigate the impact of pathways and barriers on sustainability practises and their overall impact on sustainability and operational performance.

4.9.3 The sample frames.

The sample frame serves as a representation of all the elements within the population from which the sample is derived (Bougie & Sekaran, 2020). This research focused on supply chain companies in the upstream and downstream sectors of the Nigerian oil and gas industry. Consequently, there were two different frames from which sampling units were selected—the first frame comprised companies within the Nigerian oil and gas industry implementing sustainability practices. The second frame consisted of individuals implementing these practices within the selected companies. To identify the industrial supply chain, this study utilised West Africa's Premier Oil & Gas Directory and the Nigerian Exchange Group (NGX Group) as sample frames. These databases provided comprehensive information, including company names, Director Information, email addresses and telephone numbers.

4.9.4 Sample design

Sample design is crucial to business management research surveys (Rungtusanatham et al., 2001). There are two main types of sampling designs: probabilistic and non-probabilistic sampling (Bougie & Sekaran, 2020; Bell et al., 2019; Easterby-Smith et al., 2021; Ghauri et al., 2020). Probabilistic sampling involves selecting elements from the population with a known probability, while non-probabilistic sampling does not have a predetermined probability (Bougie & Sekaran, 2020; Easterby-Smith et al., 2021). Probability sampling is used when sample representativeness is crucial for generalizability, whereas non-probabilistic sampling is employed when other factors outweigh the need for generalizability (Forza, 2002).

- **Probability sampling design** encompasses different methods: simple random, systematic, stratified, cluster, and multi-stage. Simple random sampling ensures an equal chance of selection for each member of the

population. Systematic sampling involves selecting every nth member after a random starting point generalisability (Bougie & Sekaran, 2020; Easterby-Smith et al., 2021; Ghauri et al., 2020; Forza, 2002). Stratified random sampling divides the population into meaningful categories and selects independent samples from each category. Cluster sampling involves selecting groups or clusters from the population, while multi-stage sampling includes selecting smaller sections from the survey area (Oakshott, 2012; Bougie & Sekaran, 2020; Ghauri et al., 2020).

- **Non-probability sampling designs** involve selecting elements from a population without known probabilities (Bougie & Sekaran, 2020). In this type of sampling, the likelihood of each entity in the population being included in the sample cannot be determined (Easterby-Smith et al., 2021). The probability of selecting any specific member of the population as a sample cannot be established. Consequently, it becomes more challenging for researchers to make confident assertions about the sample and generalise their findings to the larger population.

Therefore, Convenience sampling was deemed suitable for this study due to the absence of a comprehensive or standardised database of the oil and gas industry in Nigeria that identify the list of companies involved in sustainability implementation within their supply chain. Consequently, determining the exact number of these companies proved challenging. Convenience sampling was employed because it did not rely on large population size or prior knowledge of the organisations engaged in sustainability. Random sampling would have required a sufficiently large and known population (Jackson, 2011).

In certain cases, gathering information from specific target groups becomes necessary rather than relying on those who are readily available or convenient (Bougie & Sekaran, 2020). This type of sampling focuses on individuals who possess the desired information, either because they are the sole sources or because they meet certain criteria established by the researcher. Such a sampling approach is referred to as purposive sampling. With purposive sampling, the researcher is responsible for determining which individuals can provide the most relevant information to achieve the study's objectives (Campbell et al., 2020).

4.9.5 The sample sizes

Determining the appropriate sample size for a survey is not straightforward and can often be quite complex (Geyi et al., 2020). It is a question that lacks a definitive answer (Bryman & Bell, 2003). Various methods exist for estimating sample size, typically based on the statistical power required to report significance or non-significance accurately. Brewerton and Millward (2001) suggested that the necessary number of participants for a survey could range from 14 to 50 for a large effect size and from 35 to 133 for a medium effect size. Mbugua (2000) proposed a rule of thumb indicating that a minimum of 30 responses would be sufficient for industry-based research. Ghauri et al. (2020) and Bougie and Sekaran (2020) summarized the factors influencing decisions regarding sample size as follows:

- Research objectives
- Desired level of precision (confidence interval)
- Acceptable risk in predicting the desired precision (confidence level)
- Variability within the population being studied.
- Constraints related to cost and time.
- Size of the population itself

Furthermore, Hair et al., (2010) and (Kline 2023) recommended a range of 150 and 400 sample size for structural equation model analysis, depending on the complexity of the research model in terms of the numbers of posited variables. They recommend using a minimum of five samples per observed variable for SEM analysis that will make a factor analysis feasible.

4.9.6 The target Respondents

As mentioned above, a convenient and purposive sampling method was used to select companies and individual respondent in Nigeria's oil and gas industry. The aim was to find out companies that were implementing sustainability practices and expect in the oil and gas industry who are settled with the responsibility of implementing sustainability initiatives and could comfortable answer all the

questions about pathways and obstacles to sustainability implementation and companies' sustainability and operational performance.

Malhortra and Grover (1998) assert that the individuals surveyed can be representatives of their own selves, their expertise, their project and most importantly their companies. They maintain that the use of the firm as the unit of analysis is often represented by individuals in survey-based research conducted in operations and supply chain management. For this reason, Supply Chain Managers and Chief Executive Officers of the oil and gas companies were chosen as respondents of this study because they are better positioned to explain sustainability implementation in their companies.

4.9.7 Data Collection Method

This research employed a questionnaire survey to collect data and gather participants' views on the investigated subject. Survey research is the most suitable method for collecting real data, gathering opinions, and measuring attitudes within a specific population (Oakshott, 2016; Esktein et al., 2015; Aslam et al., 2018; 2020; Wamba et al., 2020). It allows for the exploration of broad patterns of social phenomena (Easterby-Smith et al. 2021). Questionnaires are pre-prepared written questions where respondents record their answers within predefined alternatives. They offer an efficient data collection mechanism when researchers clearly understand the required information and how to measure the variables of interest. Questionnaires are widely used in various areas of research related to human life (Sekaran and Bougie).

Therefore, the survey conducted through questionnaires was used in this research to collect and analyse primary data from Logistics, supply chain managers and Chief executive officers, who are considered the most appropriate informants regarding firm-level activities. Survey research through questionnaires is particularly suitable when examining causal relationships between variables (Sounders, et al, 2003), as this research aims to explore the relationships between pathways/obstacles and sustainability practices and their overall impact on oil and gas companies. It is a commonly employed research design in production, operations, and business

management research, where surveys are administered to homogeneous groups with shared characteristics such as industry or technology usage.

A positivist perspective and methodology inform the decision to use survey research through questionnaires in this study. Surveys by questionnaires are often favoured by those adopting a positivistic worldview (Pitura,2023; Tembo et al., 2022; Whisker, 2008). Additionally, as a positivist research design, this study aims to make generalisations about the population based on the results obtained from the sample. Administering a survey to a large sample is appropriate when the research focuses on generalisability to the entire population. Moreover, using survey research through questionnaires provided further insights and expanded the knowledge base of the research by allowing access to oil and gas companies that were implementing sustainability practices.

4.9.8 Questionnaire Design

A questionnaire serves as a tool for gathering information, which can be organized, analysed, and discussed. It is the most employed method in survey research, allowing researchers to collect data without personally approaching respondents. A questionnaire is a standardized list of carefully planned questions designed to gather information on opinions, behaviours, and attitudes (Lange et al., 2023; Stantcheva et al., 2022; Radford et al., 2022). Previous studies have focused on the design of self-administered questionnaires (Te et al., 2023; Audet et al., 2022). Prior to developing a questionnaire, it is crucial to identify the required evidence to achieve the research objectives. The aim of this research was to identify the pathways and obstacles to sustainability implementation, examine their impacts on sustainability and operational performance, and explore the mediating role of sustainable supply chain practices (SSCP) in linking these pathways and performance measures.

After reviewing existing literature on sustainability implementation and performance outcomes in supply chains, five constructs were identified: pathways, obstacles, sustainable supply chain practices, operational performance, and sustainability performance measures. A questionnaire was then created based on these constructs, with multiple items developed for measuring each construct. The scales followed the recommended procedure by Pallant (2013) for developing measurement

instruments. Designing a questionnaire requires a comprehensive strategy known as the total design method (TDM), which encompasses a broad range of questions tailored to the data types, analysis, and research questions at hand (Nachmias and Nachmias, 1992). Existing literature provides guidelines for constructing questionnaires that can enhance the quality of the collected data (Stantcheva, 2022; Bougie and Sekaran, 2020), In the design of this questionnaire, various aspects were taken into account to ensure its ability to address the research questions. The following sections discuss the aspects of good questionnaire design, as outlined in the literature, including considerations from Ghauri and Gronhaug (2005), Braun et al. (2012), and Sekaran and Bougie (2013).

4.9.8.1 Questionnaire Contents

The questionnaire consisted of six broad categories of questions, following the scheme offered in Appendix **A**. Sections **A** and **B** determined the general profile of the company and their level of sustainability practices, including the name of the companies, the position of respondent, year of establishment, workflow process, number of employees, number of years of professional experience, major product line stage of sustainability implementation and the amount of investment in sustainability practices. These were chosen as size indicators because they are reported to be the most used size measure in literature (Kimberly, 1976). Section **C** addressed pathways to sustainability as established in the literature, while Section **D** addressed obstacles to sustainability as identified in the literature. Section **E** addressed sustainable supply chain practices the respondents considered to be implemented, such as environmental and social sustainability practices, which are the most important facilitators for sustainability and operational performance. Section **F** probed investigated the sustainability performance the respondents planned to achieve, and the last part, section **G** looked at the various indicators of operational performance as suggested by Paulraj et al. (2017); Zhu et al. (2008, 2013); Kamble et al. (2020); Belhadi et al. (2020).

Furthermore, the questionnaire contains an introduction letter explaining the researcher's identity and conveying the study's purpose. This was meant to establish good cooperation with the respondents and encourage them to be involved. A cover

letter with the UCLAN logo was enclosed with the questionnaire survey addressed to participants. Assurance of confidentiality was included in this letter. This assurance was expected to elicit less biased responses (Sekaran & Bougie, 2013).

4.9.8.2 Scale of Measurement and Types of Response

Developing scales and measures to assess responses is a crucial research task (Forza, 2002). Measurement in scientific research involves assigning numbers or labels to the units of analysis to represent conceptual properties (Pallant, 2020). Scaling, conversely, is a method employed to quantify the extent of a property exhibited by a group of objects or events (Frankfort-Nachmias & Nachmias, 2007). Within the context of operations and supply chain management research, there are four measurement scales or data types: nominal, ordinal, interval, and ratio levels of measurement (Forza, 2002; Ghauri et al., 2020; Bougie & Sekaran, 2020). The selection of a specific measurement scale depends on the nature of the study or the research question guiding the data collection process.

Therefore, the questionnaire survey involved five-point Likert scale questions, a widely accepted and important measure for defining the interactions between pathways/obstacles, practices, and performance outcomes. This Likert-type scale was adopted because it can offer interval-or-ratio-based data. Respondents were asked to rate to what extent each pathway/obstacle and sustainable attributes influenced his or her organisation in recent years on a five-point Likert scale, where "1 = strongly disagree" and "5 = strongly agree" for pathways, obstacles, and sustainability practices, while "1 = very low" and "5 = very high" for sustainability and operational performance constructs. This five-point Likert scale, widely employed in quantitative research, is the most potent scale for statistical analysis and has been used in numerous academic studies (Hair et al., 2014; Tabachnick & Fidell, 2014; Pallant, 2013).

4.9.8.3 Wording and Language of the questionnaire

To ensure precision, questions should be structured using terms familiar to the target respondents. It is crucial to avoid ambiguous, abstract, or unclear wording. Additionally, it is important to avoid double-barreled questions that could confuse participants. A double-barreled question refers to one that encompasses more than

one aspect, making it challenging for respondents to provide a clear response if only one aspect is relevant to them (Ghauri and Gronhaug (2005) and Braun et al. (2012). Furthermore, the questions should be designed to be easily understandable to the practitioner (Sekaran and Bougie (2013). For instance, when designing questions about organizational strategy, rephrasing them using simple language rather than relying on academic terminology is preferable.

4.9.8.4 Sequence of questions

It is important to design a questionnaire in a suitable sequential order (Story & Tait, 2019). Essentially, the questionnaire should start with general questions and gradually progress to more specific ones, following a funnel approach (Geyi et al., 2020). This approach ensures that participants feel a sense of ease and smooth progression as they navigate through the questionnaire. In this research, the same principle was applied, where the questionnaire commenced with demographic information and then proceeded to capture the respondents' perceptions regarding pathways, obstacles, sustainability practices and performance outcomes.

4.9.8.5 General Appearance of the questionnaire

In questionnaire design, it is essential to consider both the wording and measurement aspects and the overall appearance of the questionnaire. The visual presentation plays a significant role in facilitating respondents' comprehension and engagement. A visually appealing and well-organized questionnaire with a suitable introduction, clear instructions, and well-structured questions and response options can enhance respondents' ease of answering. In this research, the questionnaire spanned seven pages, encompassing the cover, which established the researcher's identity and communicated the survey's purpose (refer to Appendix for details). This approach gave respondents a better understanding of the research's scope and background.

4.9.8.6 The review of the questionnaire design

Designing a high-quality questionnaire involves revisiting and adjusting it (Bougie and Sekaran (2020). In this research, we dedicated considerable attention to questionnaire design, particularly the review process. This process is instrumental in identifying and addressing potential errors in the questionnaire. As a result, several

improvements were made. For instance, the sequence of certain questions was adjusted to enhance the questionnaire's flow and eliminate potential ambiguities. This meticulous approach ensures that the questionnaire effectively captures the necessary information related to pathways and obstacles to sustainability implementation, thereby accurately addressing the research questions.

4.9.8.7 The type and form of questions

Questions can be categorized into closed and open-ended (Pallant, 2013; Bougie and Sekaran, 2020). Open-ended questions allow respondents to answer in their own words without being constrained by predetermined choices provided by the researcher. It grants participants the freedom to express their thoughts and opinions more freely. On the other hand, closed questions offer respondents a predetermined set of response choices. They are typically asked to indicate their response by marking a tick, cross, or circling an option. Unlike open-ended questions, closed questions enable respondents to make quick decisions by choosing from the available alternatives. They also assist researchers in easily coding the collected information for subsequent analysis.

In this study, the choice of question type is crucial, considering its impact on statistical analysis. The analysis methods employed in this study, such as correlation and structural equation modelling, require continuous scores that span a wide range from low to high (DeVellis, 2016). Therefore, careful consideration was given to the response format used when posing questions to the respondents.

4.10 Measures

4.10.1 Dependent Variable: Sustainability and Operational Performance

The variable that the researcher focuses on and is of primary interest is known as the dependent variable (Bougie & Sekaran, 2020). In this study, the dependent variables are sustainability and operational performance.

Economic, environmental, and social performance was used to measure sustainability performance. Economic performance was measured on a five-item scale, and environmental performance was measured on a five-item scale, while social performance was measured on four-item scale adopted from Geyi et al. (2020);

Esfahbodi et al. (2017); Singh et at. (2019); Hong et al. (2017); Wijethilake, (2017); Yu et al. (2017); Hojnik and Ruzzier (2017); Savero et al. (2017); Chan et al. (2016); Fairfield et al., (2011); Sarkis et al. (2010); Zhu et al. (2008 2013); Qu et al. (2015); Neely et al., (2005) and Abubakar (2014). These scale rate the extent to which implementation of sustainability practices improved the company's performance in terms of increase in sales volume, reduction in the cost of production, improvement in revenue growth, increase in profitability and increase in firms competitiveness as measures of economic performance, while the reduction in greenhouse gas emissions, reduction in material usage, reduction in consumption of hazardous/harmful materials, reduction in energy consumption and reduction in water usage as items of measuring environmental performance, while improved employee engagement, improved working conditions, improved safety and well-being of staff, improved community support and investment and improved stakeholders involvement as measures of social performance. The scale ranges from very low (1) to Very high (5).

Operational performance serves as a measure of long-term success as an indicator of the actual level of operational resources that will enhance future economic outcomes (Sveiby, 1997). The measures for evaluating operational performance were derived from previous studies, encompassing factors such as costs, quality, speed, reliability, flexibility, and innovation (Eckstein et al., 2015; Srinivasan & Swink, 2018; Kamble et al., 2020; Yusuf et al., 2007). In this research, a five-item scale was utilised to determine the extent to which the company accomplished its objectives in terms of operational performance. Following the approach of Yusuf et al. (2007), a five-point Likert scale was employed, ranging from "very low" (1) to "very high" (5), to assess operational performance. Initially, six items were adopted, but after conducting a factor analysis to determine whether these items belonged to a single dimension (see loading plot in Figure 5), the number was reduced to five.

4.10.2 Independent Variables: Pathways and Obstacles to Sustainability

The predictor or independent variable is a factor that influences the dependent or mediating variables in a specific manner, whether positive or negative, linear, or non-linear (Geyi, 2020; Oakshott, 2016). This study's predictor variables are pathways and

obstacles to sustainability implementation. Pathways are ways of achieving sustainability practices and performance. They are a set of initiatives that serve as an essential requirement for implementing sustainability practices which will improve the sustainability and operational performance of the companies within the supply chain. At the same time, obstacles are those factors that could inhibit the embracing of sustainability initiatives in the supply chain. Pathways are expected to positively influence sustainability implementation, while obstacles are assumed to affect sustainability negatively.

Pathways were measured on eight item-scales adopted from Costache, Dumitrascu and Maniu (2021); Chege and Wang (2020); Wijethilake (2017); George et al. (2016); Rauter et al. (2015); Wirtenberg et al. (2007); Fairfield et al., (2011); Bansal (2003); Yusuf et al. (2012); Collins et al. (2010); Linton et al. (2007); Zhu et al. (2005); Handfield et al. (2005). After considering the item loading, the initial number of adopted items was ten, which was reduced to eight. These scales measured the extent the companies have these qualities for building a sustainable supply chain practice. These qualities include top management commitment, sustainability values ingrained in the company, standardise metrics to measure sustainability performance, employee training and development, proper workplace management, Stricter laws and regulations, and support from the government, NGOs, and international organisations. Five-point Likert scoring format was used in these scales to measure items (ranging from 1 - "strongly disagree" to 5 – "strongly agree").

Obstacles to sustainability were measured on eight items scales adopted from Cantele & Cassia (2020); Klassen & Vereecke (2012); Kaur et al. (2018); Narimissa et al. (2020); Walker and Brammer (2009); Zhu & Sarkis (2004) and Correia et al., (2013). The original number of adopted items was nine, which was reduced to eight after considering the item's plot loading (see appendix). The scale assesses to what degree the obstacles hinder or could hinder the adoption of sustainability implementation using a five-point Likert scoring format used in these scales to measure items (ranging from 1 - "strongly disagree" to 5 – "strongly agree"). The identified obstacles are lack of awareness and understanding of sustainability issues, lack of adequate skills and

knowledge, inappropriate infrastructure, lack of trust-based collaborations, Resistance to change, lack of top management commitment, Gap in standard and approach, lack of support from international platforms and limited financial resources.

4.10.3 Mediating Variable: Sustainable Supply Chain Practices

A mediating variable, also known as an intervening variable, emerges between the activation of independent variables that influence the dependent variable and the point at which their impact is observed (Bougie & Sekaran, 2020). Introducing a mediating variable assists in modelling a process, as it arises from the independent variables' operations in each situation. It aids in conceptualising and elucidating how the independent variables influence the dependent variable (Oakshott, 2016; Bougie & Sekaran, 2020). It assumed that introducing a mediating variable would affect the relationship between the independent and dependent variables positively or negatively. In this study, sustainable supply chain practices mediate the link between pathways and sustainability performance and serve as a dependent variable to obstacles. The belief is that if the company has these pathways, it will influence the implementation of sustainability practices, improving sustainability performance, but these obstacles may hinder it. Sustainable supply chain was measured using environmental and social sustainability practices.

The measurement of Environmental sustainability practices utilised a seven-item scale that was adapted from various sources, namely Gimenez et al. (2012), Belhadi et al. (2020), Pullman et al. (2009), Zhu et al. (2008, 2013), and Paulraj et al. (2017). Initially, the scale consisted of nine items, but it was later reduced to seven after considering the item's plot loading. These scales assess the degree to which a company involves its primary suppliers in activities such as reducing energy consumption, minimizing the use of toxic materials, conserving water, and mitigating greenhouse gas emissions, among other factors (Zhu et al., 2008; Belhadi et al., 2020; Paulraj et al., 2017; Esfahbodi et al., 2017). Similar to the approach adopted by Belhadi et al. (2020) and Esfahbodi et al. (2017), a five-point Likert scoring format was employed to measure the items, ranging from 1 ("strongly disagree") to 5

("strongly agree"). The social sustainable practices were measured on an eight-item scale adopted from the previous literature. The original number of adopted items was nine, which was reduced to eight after considering the items plot loading. The scale also assesses the extent to which companies have capabilities to implement sustainability practices. These items include support employees in balancing work and life activities, involve employee's indecision that affect them, ensure the health and safety of employees, ensure accountability for ethnics at all levels, source product from our local suppliers, encourage and promote workplace diversity, source product from socially responsible suppliers and contribute to local event for social and environmental awareness.

4.11 Research Ethics

Research ethics plays a crucial role in any research project. Although operations and supply chain management researchers usually do not engage in studies that pose risks to the participants' lives, it is important to consider various ethical issues while collecting primary data. One fundamental principle is that researchers must ensure they do not cause harm to participants. Additionally, breaching confidentiality rules can lead to an informant's dismissal. Informed consent and the right to confidentiality are equally vital in operations and supply chain management research, just as in other fields like medical research. At the PhD level, researchers are guided by their university's ethical guidelines, which address vital ethical considerations (Bougie & Sekaran, 2020).

Therefore, this study strictly adhered to ethical principles regarding data collection and protection throughout the research process, following the regulations, policies, and practices of the University of Central Lancashire. The researcher obtained approval from the BAHSS Ethics Committee – University of Central Lancashire, with the application bearing the code number **BAHSS2 0249**, before conducting the pre-survey fieldwork and administering the questionnaire on a full scale. It is expected that the study will not cause any harm to the participants or the researcher.

4.12 Full Scale Administration of the Survey

There are four methods for distributing questionnaires, as suggested by Sekaran and Bougie (2009), as cited by Meng & Shun (2019). These methods include postal mail, telephone interviews, personal interviews, and online surveys via the internet. Postal questionnaires have advantages such as low cost and the ability to reach a large population quickly (Stantcheva, 2022; Lehdonvirta et al., 2021; Stedman et al., 2019; Meng & Shun, 2019; McLafferty, 2016; Sekaran & Bougie, 2009; Creswell, 2011). However, postal questionnaires often have low response rates (Lallukka et al., 2020; Story et al., 2019; Taylor & Scott, 2019; Seale & Barnard, 1998; Robson, 1993; Bryman & Bell, 2007). The choice of distribution method depends on factors such as efficiency, speed, cost, usage, and internet availability (Sekaran & Bougie, 2009).

In this research, mail questionnaires were used to distribute the questionnaire to respondents because they are easy, inexpensive, and efficient. The main consideration was efficiency due to time and budget constraints. Efficiency in this context refers to the ability to complete many questionnaires in a short period (Robson, 1999 as cited by Abubakar, 2014). Mail questionnaires were considered efficient in managing the researcher's time and effort, as they can provide a substantial amount of data in a short time (Robson, 2011). Furthermore, mail questionnaires were deemed appropriate since the research did not require collecting sensitive data. Respondents may hesitate to freely disclose sensitive information about their companies when using questionnaires (Bell & Bryman, 2007; Sekaran & Bougie, 2009).

Six hundred (600) questionnaires were sent directly to the sampled companies' Supply Chain Managers and Chief Executive Officers. Each envelope addressed to them contained a questionnaire, a cover letter explaining the purpose of the study, and a pre-paid, self-addressed return envelope. The cover letter was printed on the University letterhead. It included the name and signature of the director of the studies, a professor at the Lancashire School of Business and Enterprise of the University of Central Lancashire (UCLAN). The cover letter provided information about the researcher and the study's purpose and assured confidentiality. These

details can motivate respondents to participate (De Vaus, 2013, as cited by Ali et al., 2022 & 2021).

4.12.1 Response Rate

The response rate is representative of the organisation under investigation. Achieving a high response rate is always challenging in self-administered surveys, as mail questionnaires usually have low return rates (West et al., 2023; Sunders et al., 2021; Guinaliu et al., 2021). According to Sekaran and Bougie (2009), a 30% response rate is considered acceptable, while Robson (1993) and Saunders et al. (2003) argue that a 20% response rate is acceptable for questionnaires with scaled responses, all cited in Al-Madi et al. (2023). Previous studies' response rates can also inform the determination of sample size (Lakens, 2022).

For example, Stead and Stead (1995) achieved a response rate of 20.6% in their empirical survey on sustainability strategy implementation in industrial organisations, while Henri and Journeault (2008) obtained a response rate of 20.9% in their study on environmental performance indicators among Canadian manufacturing firms. It is important to note that a low response rate should not discourage researchers, as much published research works also encounter low response rates (Bryman & Bell, 2007). Following the variant version of the questionnaire, the finalised hard copies were mailed out to 600 addresses taken from West Africa's Premier Oil & Gas Directory and Nigerian Exchange Group (NGX Group). The questionnaire, alongside a cover letter and participant's information sheet, which explained the purpose of the research and instructions for completing the questionnaire, along with a postage-paid envelope, was included to assist with the return of the questionnaire. Furthermore, a phone call was made to non-responders two weeks after distributing the questionnaire (Frankfort-Nachmias & Nachmias, 2007). A total of 187 responses were received with a response rate of 30.3%, which was deemed acceptable in comparison to previous studies of similar lines (Chow et al., 2008; Power, Sohal, and Rahman, 2001; Sahay et al., 2003; Gopal, 2016; Geyi et al., 2020) with response rates ranging from 9 to 37%. However, only 170 of the 187 questionnaires received were utilised for data analysis, with the other 17 being unusable due to missing and insufficient data.

The strategies employed to enhance the response rate in this study were as follows: Firstly, a stamped and addressed envelope was included along with the questionnaire. Secondly, confidentiality measures were assured to safeguard the respondent's confidentiality. Thirdly, periodic follow-up telephone calls were conducted. Fourthly, the cover letter and a statement from the Director of Studies (DOS) emphasised that the responses would be utilised solely for research purposes and that the research findings would be made available to respondents if they expressed interest. These strategies motivated respondents to complete the questionnaire, expecting their sustainability practices to gain public awareness and potentially enhance societal acceptance.

4.13 Data Analysis

The questionnaire data was examined by employing SPSS and SPSS AMOS software, which are extensively utilised for statistical analysis in social sciences. The data were analysis through the statistical methodology of structural equation modelling. This approach aimed to investigate the relationships between independent and dependent variables. The use of structural equation modelling in this study served as a confirmatory method to analyse the data, assessing the extent to which the proposed model aligns with the collected data. This analysis enabled the identification of both direct and indirect relationships among the variables (Geyi et al. 2020; Byrne, 2016)

The data analysis section comprises several steps, which include demonstrating trends in variables through descriptive statistics, evaluating the reliability and validity of measurement scales using exploratory and confirmatory factor analysis, and testing research hypotheses using the technique of structural equation modelling. This methodology has been supported by studies conducted by Pallant (2020) and Byrne (2016).

4.13.1 Preliminary Analysis

The responses obtained from the survey were entered into IBM SPSS 22, a statistical analysis software facilitating the efficient interpretation of data through frequency, means, and standard deviations. Furthermore, this software enables inferential

analysis, investigating relationships and differences between variables, ultimately addressing the research questions. Conducting a preliminary analysis is crucial before performing statistical analysis (Pallant, 2016). This process serves the following purposes: (1) Examining the presence of missing data or outliers (2) Testing the normal distribution of data (3) Assessing the validity and reliability of the data (4) Identifying potential biases (Pallant, 2016; Tolmie et al., 2011; Sprinthall, 2007).

4.13.2 Treatment of Missing Data

It is unusual to collect data sets with no missing information. Normally, missing data result from a respondent failing to answer one or more survey items (Hair et al., 1995; Coakes, 2006). The most acceptable solution to missing value is not to have any (Hair et al. (2016). In this study, it was not possible to have the data set without missing values, though they were minimal. The missing values were dealt with using a linear interpolation method, as explained in **Chapter 5.** Furthermore, it is crucial to conduct an outlier check as an essential step before data analysis, aiming to identify and address any data points that significantly deviate from the rest of the dataset (Pallant, 2020). Outliers refer to observations located far away from the bulk of the data (Easterby-Smith et al., 2021; Bougie & Sekaran, 2020; Pallant, 2020). While outliers can occasionally arise from technical errors, they often represent genuine data points. However, even if outliers are not the result of errors, they have the potential to distort the results of statistical analysis. Therefore, a thorough investigation was conducted to identify and rectify any outliers.

4.13.3 Assessing the assumption of normality

A normality assessment is conducted to determine whether a given dataset conforms to a normal or Gaussian distribution (Defard et al., 2021). This assessment is a prerequisite for conducting parametric analyses such as t-tests, regression, and analysis of variance (ANOVA) (Tabachnick & Fidell, 2007; Pallant, 2016). Failure to meet this assumption could impact the accuracy of conclusions drawn from the data (Ghasemi & Zahediasl, 2012). However, in the case of a large dataset (consisting of more than 40 observations), violations of the normality assumption may not significantly affect the analysis (Tabachnick & Fidell, 2007; Ghasemi & Zahediasl, 2012), and parametric tests can still be conducted even if the data does not follow a

normal distribution. There are two main approaches to assessing normality: graphical and statistical. Graphical methods include histograms, stem-and-leaf plots, box plots, normal distribution plots, and detrended normal plots (Elliott et al., 2019). Statistical methods include the Kolmogorov–Smirnov (K-S) test, Shapiro-Wilk test, skewness, and kurtosis (Field, 2009; Ghasemi & Zahediasl, 2012).

4.13.4 Research Reliability and Validity of the Data

Researchers usually evaluate the quality of their survey instrument, such as a questionnaire, by considering its reliability and validity both content and construct validity (Sürücü & Maslakci, 2020). Assessing reliability is crucial to determine the consistency of the survey instrument, ensuring that it produces consistent results across multiple measurements and items over time (Pallant, 2016). On the other hand, validity is essential to confirm that the survey instrument accurately measures what it intends to measure. A reliable instrument should yield consistent results across different measurements and items, reflecting the same construct (Sekaran & Bougie, 2013).

Researchers commonly use the standard coefficient of internal consistency or Cronbach's alpha to evaluate reliability, which considers the number of items or questions within a construct and the average correlation between those items. For example, when assessing the pathways and obstacles to sustainability and their impact on sustainability and operational performance, it is important for the score to accurately reflect the true values of that construct with minimal random errors (Hinton, 2004). This can be observed through the correlation between items, where a high correlation indicates a consistent representation of the same construct and low error levels. Conversely, a low inter-item correlation suggests inconsistency in measuring the same construct and a higher occurrence of errors.

Cronbach's alpha values range from 0 to 1, with values closer to 1 indicating higher construct reliability. Generally, a Cronbach's alpha value above 0.8 is considered good, between 0.6 and 0.8 is considered adequate, while values below 0.6 are considered poor, and values below 0.5 are deemed unacceptable (Sekaran & Bougie, 2013).

The reliability tests were conducted for the main measures of the research instrument, which include entire questionnaire, pathways to sustainability components, obstacles to sustainability components, social and environmental sustainability practices components, economic, environmental, and social performance components, and operational performance components. The Table 4.3 present the reliability results of all the constructs using Cronbach's alpha coefficient. The total scale of Cronbach's alpha coefficient was 0.877 for the entire construct, suggesting excellent internal consistency reliability. In addition, the results in the Table 5.8 confirmed the reliability of all items, as Cronbach's Alpha values are greater than 0.7, as recommended by Nunnally (1978).

Table 4.4. Reliability Statistics for the study constructs

Constructs	No. Items	Cronbach's Alpha
Pathways to sustainability	10	0.826
Obstacles to sustainability	9	0.931
Environmentally Sustainable Practices	9	0.859
Social Sustainable Practices	9	0.918
Economic Sustainability Performance	5	0.926
Environmental Sustainability Performance	5	0.880
Social Sustainability Performance	4	0.881
Operational Performance	6	0.828
Entire construct	57	0.877

4.13.5 Assessing Validity of the Constructs

A research instrument's validity evaluates how well it measures what it intends to measure (Vilkaite-Vaitone et al., 2022; Kurdi et al., 2022; Saunders et al., 2009). Validity necessitates that the research instrument (questionnaire) accurately measures the study's concepts. Collecting empirical evidence about its application constitutes validity (Pallant, 2016). It examines if the results correspond to what the experiment supports measuring. The question is whether we are measuring the right idea. Validity is concerned with the veracity of cause-and-effect relationships (internal validity) and with their applicability to the external environment (external validity) (Sekaran & Bougie, 2013; Abubakar, 2014). Consequently, validity is

regarded as one of the essential characteristics of research quality that defines the extent to which the study's findings can be evaluated and generalised. Therefore, as mentioned above, there are three types of validity: face validity, content validity, and construct validity.

- **Face validity:** This type of validity measure implies the judgement by the scientific community to determine whether the indicators measure the constructs (Flake et al., 2022). It is a degree to which it looks like a instruments measure what it is supposed to measure. An instrument would have excellent face validity if the majority of experts agreed that the items in the instrument appear to measure what the instrument is designed to evaluate (Hu et al., 2022). It involves thoroughly pretesting the measurement using expected validation and a pilot study.

- **Content validity:** This refers to the sufficiency of a scale's sampling from the target universe or content domain (Pallant, 2016). This test verifies that the questionnaire contains a sufficient number of questions that probe the constructs. The stronger the content validity, the more accurately the scale items represent the measured constructs (Abubakar, 2014; Sekaran & Bougie, 2009). Content validity is obtained by identifying the established scale from the literature, obtaining expected opinions from academicians and practitioners alike regarding the instrument, and making necessary adjustments.

- **Construct validity:** This validity includes evaluating a scale based on hypotheses about the nature of underlying variables or concepts obtained from theory. Construct validity is investigated by examining its relationship with related (convergent validity) and unrelated (discriminant validity) constructs (Taylor, 2019; Hehman, et al., 2019; Pallant, 2016). This type of validity attests to how well the results produced using the scale or measure correspond to the theory upon which the test is based (Sekaran & Bougie, 2009). It is evaluated based on convergent and discriminant validity (Sekaran & Bougie, 2009). Therefore, convergent validity is established when two

different instruments measuring the same concept are highly correlated. While discriminant validity is established when the result of the two instruments measuring different concepts is uncorrelated, it should already be predicted as an assumption in theory.

Therefore, this study assessed validity using face and content validity and further empirically assessed using convergent and discriminant construct validity. In the face validity assessment, the developed instrument (questionnaire) was given to the academician and expert in operation and supply chain management to evaluate. A pre-test was also conducted to establish the link between the indicators and the construct, which was adjudged to be good, therefore the face validity was confirmed.

On the other hand, content validity was established since the scale was directly adopted from the existing literature (Buer et al., 2021), which had already been validated and utilised in other previously published studies (De Giovannia & Vinzi, 2012, Green et al., 2015); therefore, content validity was established. In addition, the measurement scale of content validity was subsequently confirmed by a systematic review of sustainable supply chain literature and a pilot study that included experts, academics, and practitioners from the industry in supply chain and sustainability. As such, the face and content validity of the adopted scales in this study thesis was confirmed.

In addition, several methods have been suggested for conducting convergent and discriminant construct validity, including exploratory factor analysis, correlation and Confirmatory Factor Analysis in SEM analysis (Alamer et al., 2022). In this study, convergent validity has been assessed using Exploratory Factor Analysis and discriminant validity was assessed using Confirmatory Factor Analysis in **chapter 5.**

4.13.6 Common method bias

Common method bias, also known as common method variance, is a technique used to examine the measurement error present in an instrument. It refers to the overlapping variances observed among quantified variables that arise from using a common assessment method (Siemsen et al., 2010). This evaluation holds significant importance as it is the responsibility of researchers to identify and mitigate this bias.

An erroneous instrument can impact the validity of conclusions derived from statistical analysis, particularly when the error level is substantial enough to influence the determination of relationships between variables (Eichhorn, 2014).

Procedural common method bias, a significant challenge in research, arises from various factors, such as respondent characteristics (e.g., consistency motive and social desirability), item characteristics (e.g., complex and ambiguous questions), item context effects (e.g., respondent's interpretation of one item in relation to another in the instrument), and measurement context (e.g., time, location, and medium for data collection) (Podsakoff et al., 2003). However, there is a silver lining. Several control measures, when implemented effectively, can mitigate procedural common method bias. These measures include obtaining predictors and dependent variables from different sources, safeguarding respondent information, structuring the order of questions, and enhancing the quality of scale items.

This study implemented all of these measures before distributing the questionnaire, except for the first item. This was because obtaining secondary data from the company proved challenging. Nonetheless, it should be noted that the selection of respondents in this research does not introduce significant bias to the information obtained from the survey, irrespective of relying on a single source.

To ensure the research instruments' validity, the questionnaire was shared with professionals from the industry and academia to obtain their feedback on the constructs and wording. The specific details of this procedure were previously outlined in the questionnaire validation section. While efforts were made to control procedural bias, the statistical approach also played a significant role in examining the impact of common method bias. There are four types of statistical common method bias that can be employed: Harman's single factor test, partial correlation procedure, controlling the effects of a directly measured latent method factor, and multiple methods factors (multi traits and multi-methods) involving confirmatory factor analysis, correlated unique model, and direct product model. In this study, Harman's single-factor test, widely utilized in the literature, was applied (Podsakoff et al., 2003).

The common method bias was checked before performing SEM analysis. Therefore, a good number of procedural controls were observed when developing the survey questionnaire to avoid common method bias, which includes conducting a pilot test of the questionnaire, common rata effects, that is, respondents perceived need to provide consistent or socially desirable responses was also lessened by guaranteeing participants confidentiality and that their responses would be kept anonymous - this also reduced common bias (Podsakoff et al., 2003). Moreover, all the research constructs were confidently based on the pre-existing valid measures directly adopted from existing literature. Furthermore, we also statistically assessed the potentiality of common method bias using Harman's one-factor test bias.

The result indicates that the total variance explained by the single factor was 27.7% less than the recommended 50% (Podsakoff et al., 2003). This shows that a single factor explained almost 28% of the variance. Thus, the data collected did not suffer from the common method bias issue. This reassures the claim that common method bias was absent in the data, as it was supported by a rigorous statistical assessment.

4.13.7 Descriptive statistics

The preceding sections provided an overview of the data screening procedures carried out in this study. The assessment of normality, reliability, as well as construct and external validity, were performed and discussed in detail. These assessments played a crucial role in determining the appropriate statistical analyses to be employed in this research. While descriptive statistics merely summarize observable data and have limited capability in addressing research questions, they are essential in presenting fundamental characteristics of the data in a more manageable format, such as graphs and cross-tables (Pallant, 2016).

4.13.7.1 The mode, mean, and standard deviation

The mode, which represents the most frequently occurring value in a dataset, can be easily identified by looking at the frequency distribution. It is visually depicted as the tallest bar in the distribution (Cooksey & Cooksey, 2020). However, one limitation of the mode is that there can be more than one value that occurs most frequently. In such cases, researchers need to exercise their judgment to interpret the data or consider alternative measures of central tendency, such as the median and the mean.

The mean, also known as the average score of the data, is a measure of central tendency (Cooksey & Cooksey, 2020). To calculate the mean, the data is summed and divided by the number of cases (Hill et al., 2023). Although the mean is commonly used to describe the average value, it has a drawback. Outliers, which are extreme scores, can significantly influence the mean and potentially misrepresent the data (Hill et al., 2023). Therefore, it is important to examine the data for outliers before using the mean to measure the average score. The standard deviation, as mentioned by Hill et al., (2023) and Cooksey & Cooksey, (2020) indicates the extent of deviation of values from the mean in a group. This standard deviation helps determine the appropriateness of using the mean to represent a dataset. If the standard deviation value is close to the mean value, the mean is a reliable dataset representation.

4.13.8 Inferential statistics

The earlier sections have already covered the descriptive statistics of this research. However, since the primary objective of the statistical analysis was to make conclusions about the industry, relying solely on the results of descriptive statistics may not be sufficient to address the research questions. Therefore, this section focuses on the inferential statistics of the study. By employing inferential statistics, a deeper understanding of the research is achieved by exploring the relationships between variables and calculating their correlations. Given that examining the entire population was impractical and time-consuming, inferential statistics' outcomes allow for generalisations about the research population (Freeman & Walters, 2013). This approach involved utilising probability theory to assess the connections between research constructs and facilitate drawing inferences for the oil and gas industry (Neuman, 2006).

4.13.8.1 Correlations analysis

Correlation refers to the degree of association between two variables. A strong correlation indicates a high level of association between the variables, whereas a weak correlation suggests minimal or no association. Correlation analysis involves examining the strength of this association in statistical data by calculating a correlation coefficient. The correlation coefficient, denoted as 'r', ranges from -1 to +1, representing the extent of the relationship between the variables (Hoy, 2010;

Pallant, 2016). A coefficient value closer to 1 or -1 signifies a stronger positive or negative relationship (Huizingh, 2007). A positive value indicates a direct relationship, meaning that one variable increases as the other variable's values increase (Field, 2009). Conversely, a negative value indicates an inverse relationship.

4.13.8.2 Regression analysis

Regression analysis is a statistical procedure used to examine the relationship between multiple variables (Maulud & Abdulazeez, 2020). It is a technique that can be employed to investigate the connection between a single (or more) continuous dependent variable and several independent variables, also known as predictors. While regression analysis is based on correlation, it allows for a more complex exploration of the interrelationships among the variables (Maulud & Abdulazeez, 2020). This makes it particularly suitable for examining relationships between constructs in operations management research. However, a strong understanding of the conceptual theory is crucial to ensure the meaningfulness of the analysis outcomes (Huizingh, 2007).

4.13.8.3 Factors analysis

Factor analysis is used to identify underlying variables, known as latent variables, based on a set of observed variables. These latent variables are fewer in number but carry the same important information (Schreiber et al., 2021). Unlike the observed variables, the latent variables are not directly measured but inferred through a mathematical model. If the latent variables remain constant, the observed variables become independent. Essentially, factor analysis examines the covariance pattern among the observed items. The same latent variable likely influences highly correlated items, while weakly correlated items are driven by different factors (Decoster & Hall, 1998). The purposes of factor analysis include refining and reducing a set of items into consistent subscales and transforming a large number of items into more manageable variables (Pallant, 2016). The factor analysis results can be utilized in regression or multivariate analysis of variance. When developing a new survey instrument, factor analysis is recommended to ensure that the subscales represent the intended construct. Additionally, items with low correlation values ($r < 0.3$) can be eliminated (Pallant, 2016). Several assumptions should be considered

when conducting factor analysis, such as sample size and the degree of relationships (correlation values) between items (Pallant, 2016).

Exploratory factor analysis (EFA) and Confirmatory factor analysis (CFA) are the two primary approaches to factor analysis. Exploratory factor analysis (EFA) is primarily concerned with investigating the relationships between a group of variables, and it is usually employed in the initial stages of research. In contrast, Confirmatory factor analysis (CFA) is often utilized in the later stages of research to assess specific hypotheses or theories that are derived from a set of variables (Pallant, 2016). Factor analysis offers seven extraction methods: principal components, unweighted least squares, generalized least squares, maximum likelihood, principal axis factoring, alpha factoring, and image factoring (IBM Corps., 2013). Among these methods, principal component analysis is the most used due to its straightforward mathematical techniques, making it popular for scale development and evaluation (Pallant, 2016).

4.13.8.3.1 Exploratory factor analysis (EFA)

Exploratory factor analysis is commonly employed to examine the interconnections between a group of variables and acquire valuable insights. It can also assist in reducing a large number of interrelated variables to a more manageable size, making them suitable for subsequent analysis, such as structural equation modelling (Tabachnick & Fidell, 2014). The process of conducting exploratory factor analysis involves three main steps. These steps encompass evaluating the appropriateness of the data for factor analysis, extracting the factors, and subsequently rotating and interpreting the obtained factors (Watkins et al., 2021; Pallant, 2013). These steps are explained in detailed bellow.

Step 1: Assess the suitability of the data for exploratory factory analysis

When determining the suitability of a data set for factor analysis, two main considerations should be considered: sample size and the strength of relationships among the variables or items. While there has yet to be a consensus among researchers regarding the ideal sample size, it is generally recommended to have a larger sample for more reliable results (Riva et al., 2022; Piguet et al., 2022). Small

samples tend to have less dependable correlation coefficients among variables, which can vary across different samples. Factors derived from smaller data sets do not generalise as effectively as those obtained from larger samples (Ali et al., 2022). Howard et al. (2023) and Garson et al. (2022) suggest that having a minimum of 300 cases for factor analysis is reassuring. However, they acknowledge that a smaller sample size of 150 cases could suffice if the solutions include several highly loading marker variables of around 0.80. Hair et al. (2014) proposes a sample size of 100 or more, while Pett et al. (2003) and Stevens (1996) argue that the sample size requirements for exploratory factor analysis have decreased over the years as more research has been conducted on the topic. These scholars assert that a sample size of 100 is poor, 200 is fair, 300 is good, 500 is very good, and 1000 is excellent (Stevens, 2009; Pett et al., 2003, as cited in Gye, 2020).

Some researchers suggest that it is not the overall sample size but rather the respondents' ratio to items (Hogarty et al., 2005). Nunnally (1978) recommends a ratio of 10 to 1, meaning ten cases for each item being factor analysed. Others suggest that a ratio of five cases for each item is sufficient in most situations (Tabachnick et al., 2013). In the present study, the sample size of 170 aligns with the recommendations of Tabachnick et al. (2007) and Hair et al. (2018).

The second consideration is the strength of the intercorrelations among the items. Tabachnick et al. (2013) proposes examining the correlation matrix for coefficients greater than 0.3, while Hair et al. (2010) categorise loadings as 0.30-minimal, 0.40-important, and 0.50-significant. If only a few correlations fall below these thresholds, factor analysis may not be appropriate. Additionally, SPSS provides two statistical measures to assess the factorability of the data: Bartlett's test of sphericity (Bartlett, 1954) and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (Kaiser, 1974). Bartlett's test of sphericity should yield a significant result ($p < 0.05$) for the factor analysis to be deemed suitable. The KMO index ranges from 0 to 1, with a value of 0.6 or higher suggested as the minimum for a good factor analysis (Tabachnick et al., 2013), while Hair et al. (2010) recommends a value of 0.80 as excellent.

Step 2: Extract the factors

Factor extraction aims to determine the optimal number of factors that can effectively represent the relationships among a set of variables. Various techniques are available to identify and extract the underlying factors or dimensions. Some commonly used extraction methods include principal components analysis, principal factor analysis, image factoring, maximum likelihood factoring, alpha factoring, unweighted least squares, and generalized least squares.

Principal components analysis is the most widely employed approach. It seeks to find a solution with the fewest factors while accounting for significant variance in the dataset. Tabachnick et al. (2013) recommends an exploratory approach, experimenting with different numbers of factors until a satisfactory solution is achieved. Several techniques aid in deciding the number of factors to retain, such as the eigenvalue rule, the Scree test, and parallel analysis.

The eigenvalue rule, also known as Kaiser's criterion, is a commonly used technique. According to this rule, only factors with eigenvalues of 1.0 or higher are retained for further examination. The eigenvalue represents the proportion of total variance explained by each factor. However, Kaiser's criterion has been criticized for potentially retaining too many factors.

Another approach is Cattell's scree test (Cattell, 1966). This involves plotting the eigenvalues of factors and observing the plot for a point where the curve changes direction and levels off. Cattell (1966) suggests retaining factors above the "elbow" or break in the plot, as these contribute the most to explaining the variance in the dataset.

Horn's parallel analysis (Horn, 1965) is gaining popularity, especially in social science literature (Choi et al., 2001). It involves comparing the eigenvalues obtained from the dataset with those obtained from a randomly generated dataset of the same size. Only eigenvalues exceeding the corresponding values from the random dataset are retained. This method has been shown to be the most accurate in determining the appropriate number of components to retain, as Kaiser's criterion and Cattell's scree test tend to overestimate the number of components (Hubbard & Allen, 1987).

Step 3: Rotate and interpret the factors.

When determining the number of factors to extract, it is essential to consider whether a variable may be related to more than one factor. Factor rotation helps present a pattern of loadings more interpretably (Williams et al., 2010; Pallant, 2013). There are two main approaches to rotation: orthogonal rotation and oblique rotation. According to Tabachnick and Fidell (2014), orthogonal rotation yields easier-to-interpret and report solutions. However, it assumes that the underlying constructs are independent and not correlated. Orthogonal rotation techniques include Varimax, Equimax, and Quartimax (Costello & Osborne, 2005; Thompson, 2007), with Varimax being the most used method. Varimax aims to minimize the number of variables with high loadings on each factor.

On the other hand, oblique rotation techniques, such as Direct Oblimin (Pallant, 2013), allow for correlated factors but are more challenging to interpret, describe, and report (Tabachnick & Fidell, 2013). In cases where the pattern of correlations among items is clear, orthogonal, and oblique rotation often yield similar solutions (Tabachnick & Fidell, 2013). Pallant (2013) suggests starting with oblique rotation to assess the degree of correlation between factors. This study used principal components analysis as the extraction method of exploratory factor analysis. This technique helped identify underlying factors that explain the correlation patterns within the study's constructs.

4.13.8.3.2 Confirmatory factor analysis (CFA)

Confirmatory factor analysis (CFA) is a quantitative data analysis technique within the structural equation modelling framework. Its purpose is to assess the extent to which observed variables align with predetermined constructs (Van et al., 2022). In this study, the CFA analysis involved several steps, including model specification, refinement through modification, and subsequent parameter estimation. Various goodness-of-fit measures were employed to evaluate how well the data conformed to the conceptual model. These measures encompass the $\chi 2/df$ ratio, likelihood ratio chi-square ($\chi 2$), GOF index (GFI), adjusted GOF (AGFI), Tucker-Lewis index (TLI), and root mean square error of approximation (RMSEA).

Absolute fit measures

The chi-square statistic (χ2) is widely recognized as the primary indicator of overall model fitness. Van et al. (2022) suggest that a model is deemed a good fit when it exhibits low values exceeding 0.05. In this context, low values, and significance levels greater than 0.05 provide evidence that the model accurately represents the data, indicating a favourable fit (Hair et al., 2010). The goodness-of-fit index (GFI) is an additional measure of overall model fitness. It is scored on a scale of 0 to 1, where 0 signifies a poor fit and 1 indicates a perfect fit (Van et al., 2022).

Various measures are employed to assess overall model fitness, including the root mean square error of approximation (RMSEA). The RMSEA is evaluated on a scale from 0.05 to 0.10. In terms of interpretation, a value below 0.05 indicates a good fit, while a value of 0.08 suggests a good fit. However, if the value falls within the range of 0.08 to 0.10, it signifies a mediocre fit, and values exceeding 0.10 indicate a poor fit.

Comparative fit measures are utilized to evaluate the adequacy of structural equation models, and they can be categorized as normed and non-normed fit indexes. The normed fit index (NFI) is a commonly employed fit index, ranging from 0 to 1. According to Yerpude et al. (2022) a value of 0 indicates a poor fit, while a value of 1 signifies a perfect fit. Comparative fit indices (CFI) represent an advanced version of the normed fit index (NFI). Typically, a CFI value exceeding 0.9 indicates a well-fitting model. Similarly, for the Tucker-Lewis index (TLI), a value above 0.9 indicates a well-fitting model (Yerpude et al., 2022)

Parsimonious fit measures are employed to assess the simplicity and efficiency of a model. The adjusted goodness-of-fit index (AGFI) is a commonly used measure in this context. AGFI is derived by adjusting the goodness-of-fit index (GFI) based on the ratio of degrees of freedom for the proposed model to the degrees of freedom for the null model. Yerpude et al. (2022) state that an AGFI value exceeding 0.9 indicates a good fit.

4.13.8.4 Structural Equation Modelling

Structural equation modelling (SEM) is a statistical technique for analysing the relationships between variables in a complex system. SEM combines factor analysis,

regression analysis, and path analysis to examine direct and indirect relationships among variables and assess the overall fit of a theoretical model to the data. SEM is commonly used in social sciences, psychology, and education research to test hypotheses about causal relationships between variables (Tabachnick and Fidell, 2001). In addition, SEM has become an important instrument for analysis that is widely used in academic research (Ahmad, 2007).

The primary objective of structural equation modelling (SEM) is to explain the pattern of a series of interdependent causal relations concurrently between a set of latent or unobserved constructs and one or more observable variables. SEM is predicated on causal linkages, in which a change in one variable (x1) is assumed to cause a change in another variable (y1), in which y1 influences x1. Not only does SEM seek to study latent constructs, especially the investigation of causal linkages between latent constructs, but it is also helpful for other sorts of analyses, such as estimating variance and covariance, testing hypotheses, traditional linear regression, and confirmatory factor analysis (Rathakrishnan et al., 2021).

SEM may also be used to evaluate each construct's unidimensionality, reliability, and validity (Kline, 1998; Kline, 2005). Additionally, it concurrently gives an overall test of model fit and individual parameter estimate tests, thereby identifying the model that best fits the data. Therefore, confirmatory factor analysis has been conducted in this thesis using SEM. Structural equation modelling software Analysis of Moment Structure (IBM SPSS AMOS 29) was used to determine the statistical relationship among the items of each factor and between the factor of independent and dependent variables. Furthermore, a researcher can specify, estimate, assess, and present the model as a causal path diagram to demonstrate linkages between variables using SEM. Also, the model for the goodness of fit has been empirically tested against paths of the model, and paths that are not fit are removed or modified.

Generally, there are two main approaches to conducting SEM analysis stated by Gerbing and Anderson (1988) and Kaplan (2000), and these include a one-step approach and a two-step approach. The one-step structural equation modelling (SEM) approach is fitting a SEM model to the data in a single step rather than in separate stages. The one-step approach combines the measurement and structural

models into a single model and simultaneously estimates all the model parameters. The one-step approach is appropriate for models with well-defined measurement models, where the measurement and structural models are closely related (Hair et al., 2010). It can also be helpful when the data are limited or when there is a high degree of measurement error in the data. However, the one-step approach may not be as flexible as the two-step approach and may not provide as much insight into the measurement model. In contrast, the two-step approach to structural equation modelling (SEM) is a method of fitting an SEM model to the data in two separate stages. In the first stage, the measurement model is estimated, which involves examining the fit of a specified set of indicators to a theoretical factor structure. The structural model is estimated in the second stage, specifying a set of regression equations, and estimating the relationships between variables.

The two-step approach provides more insight into the measurement model and allows more flexibility in estimating the structural model. This approach can be advantageous when the measurement model is complex or when there is a high degree of measurement error in the data. The two-step approach may be less efficient than the one-step approach, which estimates the entire model in a single step (Nusairat et al., 2020). However, the two-step approach provides more information about the measurement model and allows for a more detailed examination of the relationships between variables.

In this thesis, a two-step approach is used because of its importance, as mentioned above, when compared to a single–step approach and employing the six-stage procedure suggested by Hair et al. (2010). The six stages of structural equation modelling (SEM) are:

Stage1: Defining the individual constructs: In this stage, the research construct and goals of the analysis are defined, and the data to be used in the analysis are collected.

Stage2: Developing and specifying measurement model: In this stage, the measurement model is specified, which involves determining the number of latent variables, the indicators for a latent variable, and the measurement model for each indicator.

Stage3: Designing a study to produce empirical results: In this stage, the measurement and structural models are estimated, and the parameters of the models are estimated from the data. The adequacy of the sample is assessed, and the estimation method and how to treat missing data are explained.

Stage4: Assess measurement model validity: In this stage, the model's fit is assessed by examining the goodness-of-fit statistics and residuals.

Stage5: Specify structural model: In this stage, the model is modified based on the model fit assessment results, and the estimation and fit assessment process are repeated until an acceptable fit is obtained.

Stage6: Assess structural model validity: In this stage, the analysis results are interpreted, and hypotheses are tested. The findings are used to draw conclusions, make inferences about the relationships between variables, and address the research questions.

It is important to note that the six stages of SEM are not always sequential and may overlap or be repeated as needed. The six stages provide a general outline for conducting an SEM analysis. However, the specific steps and techniques used in each stage will depend on the research questions, the nature of the data, and the model's assumptions.

These six stages are widely used in SEM analysis; many researchers have used them to achieve accurate results and draw a generalised conclusion, such as Geyi et al. (2020), Zhu et al. (2013), Inman et al. (2011), and Green et al. (2012). Therefore, we addressed all these six stages in this and the previous chapter and some in the following chapter.

However, it is worth noting that there are other SEM software packages available, including LISREL, Mplus, EQS, and OpenMx, Stata, each of which has its strengths and weaknesses. This study used AMOS over other SEM software packages due to the following advantages AMOS have over others which include the following (Lavuri, 2022; Hair et al., 2014):

Integration with SPSS: AMOS is integrated with the SPSS statistical software suite, which provides researchers with a familiar and user-friendly environment for conducting statistical analysis.

Ease of use: AMOS has a graphical user interface (GUI) designed to make SEM analysis accessible to researchers who may not have a strong background in statistics or complex mathematical models.

Robust modelling capabilities: AMOS offers a range of modelling options, including multiple regression, path analysis, confirmatory factor analysis, and full SEM models. This allows researchers to address a wide range of research questions and hypotheses.

User-friendly output: AMOS provides clear and easy-to-read output, including visual representations of the models, goodness-of-fit statistics, and hypothesis tests.

Widely used: AMOS is a widely used SEM software package and is widely cited in the academic literature. It is a valuable resource for researchers who want to be part of a larger research community and build on existing research.

Therefore, IBM SPSS AMOS 29 was employed in this study to conduct CFA and test the constructs' causal relationship in the structural model.

4.13.9 Assessing the Fit of the Measurement and Structural Model

To evaluate measurement model, goodness-of-fit indexes are used to see whether the model fits the data. If it did not fit, it was necessary to co-vary and respecify the model until one was found that displayed both acceptable statistical fit and a meaningful theoretical description of the observed data (Tabachnick & Fidel, 2014). The fit between covariance matrices is an essential aspect of a good model (Geyi et al., 2020). SEM offers several fit indices. However, academics have no consensus over which ones should be reported. The researcher needs to assess how well the stated model account for data with one or more overall goodness of fit indices (Anderson & Gerbing, 1988). Kline (1998) suggests at least four indices, including GFI, NFI, CFI, NNFI, and SRMR. Jaccard and Wan (1996); Bollen and Long (1993); Hair et al. (1995), Holmes Smith (2006), and Ahmad (2007) recommend the use of at least three fit

indices, one for each of the categories of model fit: absolute, incremental, and parsimonious, to reflect various criteria and provide the best overall picture of model fit.

However, Hu and Bentler (1999), as cited by Gaskin et al. (2020), recommend the cut off criteria for fit indexes as reported in **table 4.4** and suggest a combination of CFI and SRMR with RMSEA to solidify evidence of good model fit further. The AMOS model fit summary output measures in the Plugin were used to assess the overall goodness of fit of both the measurement model and structural model.

Table 4.5: Summary of Goodness of Fit Indices

Measure	Terrible	Acceptable	Excellent
CMIN/DF	> 5	> 3	> 1
CFI	<0.90	<0.95	>0.95
SRMR	>0.10	>0.08	<0.08
RMSEA	>0.08	>0.06	<0.06
PClose	<0.01	<0.05	>0.05

(Source: Adopted from Gaskin, et al., 2022 "AMOS Plugin")

Key:
CMIN = Chi-square Value
DF = Degrees of Freedom
CFI = Comparative fit index
SRMR = Standardized Root Mean Square Residual
RMSEA =Root Means Square Error of Approximation
PClose = Parsimony Close

- **CMIN/DF:** Chi-square (X2) is regarded as the most basic measure of overall fit. The chi-square test determines whether the implied variance and covariance matrix differ considerably from the empirical sample's variance and covariance matrix. It is calculated to determine the discrepancy between implied variance and sample variance. It suggested that if the probability is greater than 0.05, the difference between the sample and fitted covariance is very small, arguing that the actual and the predicted input matrices are not statically significant. However, it has limitations due to its sensitivity to

sample size, but it is an important fit to evaluate a model (Gaskin et al., 2020; Kline, 2011).

- **CFI:** The CFI compares the fit of the proposed model to a baseline model, usually a null model, which represents the minimum amount of explanation for the data. The CFI ranges from 0 to 1, with values closer to 1 indicating a better fit. A CFI value of 0.95 or higher is often considered to indicate an acceptable fit. The CFI considers both the absolute fit of the model, as measured by the chi-square statistic, and the relative fit of the model compared to the null model. CFI is highly recommended, especially when a large sample is not available (Gaskin et al., 2020; Kline, 2011).

- **SRMR:** The Standardized Root Mean Square Residual (SRMR) measures the difference between the observed covariance matrix and the estimated covariance matrix under the proposed model, standardized by the sample size and the number of variables. The SRMR ranges from 0 to 1, with lower values indicating a better fit, and an SRMR value below 0.08 indicates an acceptable fit. The SRMR is particularly useful for models with large sample sizes, where the chi-square goodness-of-fit statistic can become overly sensitive to small differences in fit. The SRMR is a useful fit index for SEM practitioners who want to evaluate the fit of a model and ensure that it provides an adequate explanation for the data. By considering the SRMR along with other fit indices, researchers can make informed decisions about the suitability of a model for their data and hypotheses. (Gaskin et al., 2020; Kline, 2011).

- **RMSEA:** Root Mean Square Error of Approximation (RMSEA) is utilised as an absolute fit index measure. This statistic helps correct the tendency of the chi-square statistic to reject specified models. It accounts for population approximation mistakes and lowers the strict need that the model holds perfectly in the population. While Holmes-Smith et al. (2006) indicate that the RMSEA should be less than 0.05, MacCallum and Browne (1993) consider

values up to 1.0 acceptable. However, it has been determined that a range of 0.05 to 0.08 is often acceptable (Hair et al., 1995).

- **PClose:** The Parsimony Close (PCLOSE) index measures a model's complexity relative to the data's complexity. The PCLOSE index is calculated as the difference between the model's log-likelihood and the null model's log-likelihood, divided by the model's degrees of freedom (df). A lower PCLOSE index indicates a more parsimonious model, which is preferred as it provides a better balance between model complexity and goodness of fit. Furthermore, the PCLOSE index is a valuable tool for SEM practitioners who want to evaluate the parsimony of a model and ensure that the model provides an adequate balance between model complexity and goodness of fit. The threshold is less than 0.05, and greater than 0.05 indicate an excellent fit, while less than 0.01 show a terrible fit (Cummins et al., 2022; Gaskin, 2020; Ayuba et al., 2019)

4.13.10 Mediation analysis

This study aimed to examine how sustainable supply chain practices influence the connection between pathways to sustainability and sustainability performance. A statistical analysis tool, SPSS, was employed to achieve this objective, explicitly using an SPSS AMOS to estimate the indirect effects within multiple mediation models. These models, depicted in Figure 3.3, illustrate various paths and effects (direct, indirect, and total) of independent variables on dependent variables. The mediation test necessitates using unstandardized coefficients (Preacher & Hayes, 2008). Figure 3.3 demonstrates the relationship between X and the proposed mediator M, where the impact of the relationship is represented by path A, while path b represents the influence of M on Y. To determine the indirect effect of X on Y, the product of a and b (ab) needs to be calculated. The total effect of X on Y, as depicted in Figure 3.3, is determined by adding the direct and indirect effects, i.e., c=c’ + ab.

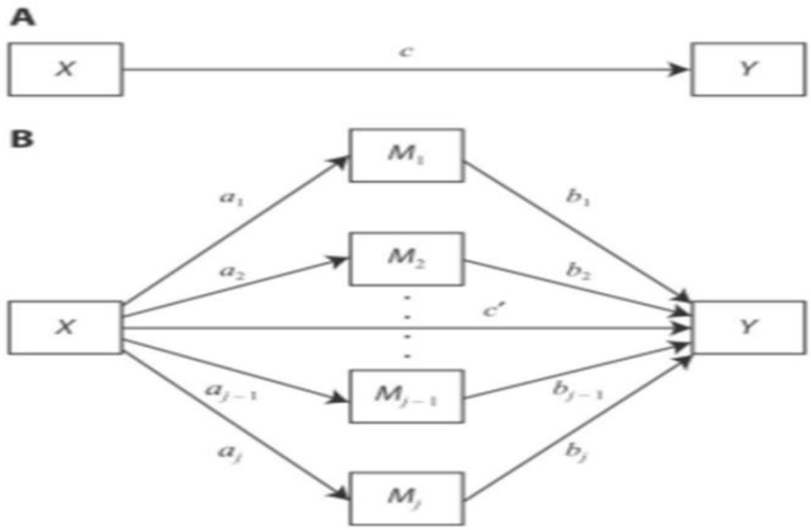

Figure 3. 3: Illustration of a multiple mediation design. (A) × affects Y. (B) × is hypothesised to exert an indirect effect on Y through M1, M2, … Mj (Preacher and Hayes, 2008).

4.14 Chapter Summary

The chapter provides a comprehensive overview of the methodological approaches utilised in this study. In terms of philosophical position, the study adopts objectivism as an ontological stance, and a positivist epistemological position. The study's deductive research approach and the adoption of quantitative research methods, which align with objectivist and positivist philosophies, further enhance the study's comprehensiveness. The research strategy, a confirmatory survey research approach, was employed to address this study's objectives. The data collection method and analysis were thoroughly discussed. The study utilised mail questionnaires to collect data, ensuring a wide reach and diverse responses, and SEM analysis was proposed as the study analysis approach based on the research framework, guaranteeing a comprehensive understanding of the data.

Furthermore, other attributes of the methodological issues were discussed, such as sample approach and size, frames and design, unit of analysis, target population, questionnaire design, and variables. Furthermore, the chapter also presented the treatment of missing data and common methods bias. The following chapter presents the survey analysis by questionnaire and its findings.

Chapter Five: Analysis and Results

5.1 Introduction

This chapter centres on analysing and interpreting questionnaire data and empirical results. The chapter has been divided into preliminary data analysis and assessing the research objectives. Preliminary data analysis includes data preparation, administration and descriptive statistics that explain the variables' trends. In the second section, the research objectives were evaluated using structural equation modelling; before doing so, both Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were used to assess the measurement scales, reliability, validity and multi-collinearity.

5.2 Data preparation and administration

After collecting data from supply chain managers and chief executive officers, the data were edited to ensure the absence of errors, completeness, and consistency. Data editing is regarded as part of the data processing and analysis stage (Ahmad, 2007). Using the suggestion of Sekaran (2013), this thesis includes all respondents who completed at least 75% of the questionnaire questions in the analysis, while those who left more than 25% of the questions unanswered are omitted (17 surveys were excluded). Any missing data has been regarded as missing values (Ahmad, 2007).

Coding was used to provide numbers to each response (Holtom, et al., 2022; Wu et al., 2022) and permits the transfer of the questionnaire to SPSS. Such procedures can be performed either before (pre-coding) or after (post-coding) questionnaire completion (Jager et al., 2022; Shearer, 2021). In this thesis, the coding procedure was undertaken by establishing a data file in SPSS. All questionnaire items were pre-coded with numerical values (see questionnaire in Appendix 1). After data were entered into the data file, data editing procedures were performed to discover any data entry errors. The data file's out-of-range values were adjusted by referencing the original questionnaire. According to Archibald et al. (2019) and Field (2009), before undertaking any statistical analysis, two essential concerns regarding the suitability of the collected data must be checked using appropriate methods. These are missing data and the normal distribution of data.

5.3 Treatment of missing data

The SPSS data screening revealed that every variable contained at most 5 per cent missing data. Fewer than 5% of missing data is acceptable (Churchill, 1995). Furthermore, the randomness of missing data was evaluated to guarantee no systematic error in the responses (Hair et al., 1995). Hence, the missing data were randomly distributed. Also, the pattern of missing data was analysed, and it was determined that only random occurrences occurred. This indicates no issue with the data and that it may be further analysed.

Given the minimal missing data and the fact that they were distributed randomly, a decision was made to replace missing responses using a linear interpolation method. This method, chosen after careful consideration, examines the last valid value before the missing data, then examines the next valid value after the missing data and imputes a value between those two values. This method was deemed to be most appropriate because it can provide a simple and efficient way to fill in missing values, especially for small gaps in the data, unlike the deletion of variables with missing data, which would result in a substantial loss of the overall sample (Tabachnick & Fidell, 2001).

5.4 Profile Characteristics of Respondents

The Table 5.1 shows the respondents' demographics, including the number of employees, age of business, designation of respondents, production process flow, and sustainability investment in Naira. The Table 5.2 shows the respondents' major product lines, the level of their sustainability practices, respondents' years of experience, and years of sustainability adoptions within the companies. As indicated earlier, the sample comprises 170 oil and gas companies in Nigeria.

The company's size was determined by the number of employees, as presented in Table 5.1. The table reveals that approximately 21.7% of the surveyed respondents had less than 200 employees, while 78.3% represented organisations with 201 or more employees. This outcome indicates that most surveyed companies were large-scale, with a range of respondents spanning small and medium-sized enterprises (SMEs). The Table 5.1 shows the age of the sample companies. About 71.1% of the

responding organisations have spent over 11 years in existence, while 28.9% have spent less than 10 years.

Furthermore, the Table 5.1 shows the respondents' designation of the sample companies. According to the Table, most participating firms, accounting for 57.5%, were represented by Managing Directors (MDs), chief executive officers (CEOs), or Directors. Supply chain managers/Directors constituted 22.3% of the total, while procurement/purchasing managers comprised 20.2% of the respondents. The research specifically targeted CEOs of oil and gas companies, as sustainability practices are managerial decisions that only CEOs can provide accurate information on.

Table 5.1 demonstrates that most surveyed companies employ the project production process, accounting for 48.2% of the respondents. Afterwards, organisations using continuous production processes constitute 34.1.1% of the total. Jobbing production processes were reported by 7.1% of the respondents. Additionally, a few organisations utilise project production (5.3%), mass production (4.7%), and batch production processes (0.6%).

Also, the result of the company's investment in the Table 5.1 shows that 64.7% of the responding firms have invested between 1 million to 10 million in sustainability. In comparison, 27% of the responding companies have invested over 10 million in sustainability initiatives, and the table also indicates that 7.1% have invested less than 1 million Naira in their sustainability practices. Even though the result indicates significant progress, a lot must be done on sustainability investment.

Table 5.1: Descriptives Statistics of the Respondents Profile

Criteria	Per cent
Size by number of employees	
1 – 50 employees	8.2
51 – 100 employees	11.7
101 – 200 employees	1.8
201 – 300 employees	7.1
301 or more employees	71.2
Total	100
Age of business	
Up to 5 years	12.4
6 to 10 years	16.5
11 to 20 years	41.2

21 to 30 years	24.1
31 years or more	5.8
Total	100
Respondents' designation	
Supply chain management	22.3
Procurement/Purchasing management	57.5
MDs, CEOs and or Directors	20.2
Total	100
Production processes Flow of Responding Organisations	
Project	5.3
Production	48.2
Continuous	34.1
Mass	4.7
Jobbing	7.1
Batch	0.6
Total	100
Sustainability Investment	
Less than #1m	7.1
#1m to #10m	64.7
Over #10m	27.6
Total	100

Furthermore, the Table 5.2 vividly illustrates the distribution of organisations across different sectors within the oil industry. The majority, comprising 34%, belong to the Bases, Logistics, Catering, Transport, Storage, and allied services sectors. Engineering services include reservoir, drilling, well engineering, and facilities engineering, accounting for 22% of the represented companies. About 18% of the organisations are involved in the exploration and production sector, while 13.5% are associated with Automobile and automotive assembly, parts, components, and accessories. Consultations, including geographical services, constitute 9% of the companies, while Maritime, subsea services, and allied services make up 2%. Lastly, electrical and electronic equipment, components, and allied products are represented by 1.5% of the organisations. The results from Table 5.2 highlight the vibrant and diverse nature of the oil industry, characterised by a wide range of companies with varying backgrounds and specialities.

The Table 5.2 provides encouraging data on the oil industry's commitment to sustainability. A promising 58.8% of the responding organisations have made significant strides in sustainability implementation, and an encouraging 41.2% have recently implemented sustainability practices. This data is a clear testament to the industry's commitment to sustainability. Table 5.2 further provides insightful data on

the professional involvement and experience of the respondents, indicating a robust foundation of experienced individuals in the oil and gas industry's supply chain. It suggests that the respondents possess relevant expertise and knowledge regarding sustainability and agility, making their responses reasonably reliable to a certain extent.

The Table 5.2 reveals an interesting trend in the oil industry's sustainability practices. About 70.5% of the responding organisations have spent less than 11 years implementing sustainability practices, while only 29.5% have spent 11 years or above. This data suggests that sustainability implementation in most organisations is a relatively new development, indicating a shift towards more environmentally conscious practices in the industry.

Table 5.2: Descriptives Statistics of the Respondents Profile (Continues)

Criteria	Per cent
Major Product Line	
Exploration and production	18
Bases, Logistics, Catering, Transport, Storage, and allied services	34
Consultations including geographical services	9
Automobile and automotive assembly, parts, component, and accessories	13.5
Engineering services (reservoir, well drilling, facilities management)	22
Maritime, subsea services and allied services	2
Electricals and electronic equipment, components, and allied product	1.5
Total	100
Level of Sustainability Practices	
Recent and on-going implementation	41.2
Made significant progress in implementation	58.8
Total	100
Respondents Years of Experience	
1 - 5 Years	32.4
6 - 10 Years	31.2
11 - 15 Years	14.7
16 - 20 Years	11.2
21 Years and Above	10.6
Total	100
Years of Sustainability Adoption	
Less than 5 years	40.0
5 to 10 years	33.5
11 to 15 years	12.4
16 to 20 years	5.3
Over 20 years	8.8
Total	100

5.5 Descriptive statistics

Descriptive statistics were employed to outline the features of the sample, aiming to assess variables for potential deviations from the assumptions essential to the statistical methods applied for addressing particular research objectives. The assessment of assumptions includes assessing the profile characteristics of respondents and obtaining central tendency measures for variables. These descriptive statistics encompass the percentage, mean, standard deviation, score range, skewness, and kurtosis, facilitating a comprehensive comparison of scores across various characteristics within the research sample (Bougie and Sekaran, 2020). Consequently, this approach aids in recognising whether a significant difference exists among the respondents.

5.5.1 Descriptive statistics of the constructs and Assessing normality of data

After addressing missing data, assessing the data distribution characteristics is helpful to ascertain whether the data are normally distributed. Indeed, normality is a necessary condition for performing both factor analysis and structural equation modelling. IBM SPSS statistical package version 29.00 was used. We greatly appreciate the respondents' valuable input, as they were asked to answer the survey regarding pathways and obstacles to sustainability, sustainable supply chain practices and sustainability and operational performance measures. The Tables 5.3-5.7 present the descriptive statistics, including mean, standard deviation, skewness, kurtosis, and maximum and minimum values for variables.

The Table 5.3 presents the descriptive statistics results for pathways to sustainability. The mean values of pathways to sustainability were high, 4.219 to 3.471, and the standard deviation range ranged between 1.204 and 0.802. This confirms evidence that the items in the questionnaire are pathways to sustainability implementation. These findings are particularly relevant for the oil and gas industry, highlighting its crucial role in the global sustainability efforts.

Table 5.3 Descriptive statistics for Pathways to sustainability Construct

Research variables			N	Minimum	Maximum	Mean	Std. Dev.	Skewness	Kurtosis
Pathways to sustainability (PWS)	Scale items	Scale items Codes							
	Top management Commitment	PWS1	170	1	5	4.035	.941	-2.008	4.691
	Government Regulations/Legislations	PWS2	170	2	5	4.194	.859	-1.010	.528
	Stakeholders Support	PWS3	170	1	5	4.218	.933	-1.379	1.807
	Ingrained Culture in oraganisation	PWS4	170	1	5	4.312	.858	-1.445	2.021
	Information Technology Advancement	PWS5	170	1	5	3.882	.928	-1.873	3.930
	Training and Development	PWS6	170	2	5	4.194	.802	-1.133	1.369
	Customer Support	PWS7	170	1	5	3.929	.933	-1.715	3.930
	Collaboration with Suppliers	PWS8	170	1	5	3.758	1.204	-1.129	.500
	Stockholders Support	PWS9	170	1	5	3.471	1.141	-.880	.050
	Environmental Standards	PWS10	170	1	5	4.465	.831	-1.932	3.793

Note:
Items PWS1-PWS10: 1= strongly disagree, 2= Disagree, 3=Do not know, 4=Agree, 5=strongly agree; N is the number of respondents companies; Std. Dev. = standard deviation.

The Table 5.4 shows the descriptive statistics results of obstacles to sustainability implementation. The mean values of obstacles to sustainability were relatively good (3.424 to 2.100), and the standard deviation ranged between 1.245 and 1.088. This confirms evidence that the scale items are obstacles to sustainability implementation in the oil and gas industry in Nigerian.

5.4 Descriptive statistics for Obstacles to sustainability Construct

Research variables			N	Minimum	Maximum	Mean	Std. dev.	Skewness	Kurtosis
Obstacles to sustainability (OBS)	Scale items	Scale items Codes							
	Lack of awareness and understanding of sustainability	OBS1	170	1	5	2.188	1.245	.1.014	.043
	Resistance to change	OBS2	170	1	5	2.142	1.152	1.244	.727
	Cost of adopting sustainability	OBS3	170	1	5	2.135	1.240	1.077	.152
	Lack of trust-based relations	OBS4	170	1	5	3.424	1.349	-.055	-1.061
	Lack of information technologies	OBS5	170	1	5	2.165	1.170	1.132	.435
	Inappropriate infrastructures	OBS6	170	1	5	2.153	1.093	1.176	.638
	Lack of top management commitment	OBS7	170	1	5	2.200	1.165	1.013	.196
	Limited financial resources	OBS8	170	1	5	2.100	1.229	1.258	.561
	Lack of support from government and international organisations	0BS9	170	1	5	2.253	1.088	1.266	.942

Note:
Items OBS1 - OBS10: 1= strongly disagree, 2= Disagree, 3=Do not know, 4=Agree, 5=strongly agree; N is the number of respondents companies; Std. Dev. = standard deviation.

The Table 5.5 shows better descriptives statistics results for sustainable supply chain practices. The mean values of sustainable supply chain practices were relatively high (4.18 to 2.37), and the standard deviation range ranged between 1.89 and 0.818. This confirms evidence that some oil and gas supply chain companies are implementing sustainable supply chain practices.

Table 5.5 Descriptive statistics for Sustainable Supply Chain Practices Construct

Research variables			N	Minimum	Maximum	Mean	Std. Dev.	Skewness	Kurtosis
Sustainable supply chain practices									
Environmental supply chain Practices (ESP)	Scale items	Scale items Codes							
	Production is designed to reduce carbon dioxide	ESP1	170	1	5	3.641	.946	-1.179	1.413
	Products and packaging are designed to be reusable and recyclable	ESP2	170	1	5	4.129	.914	-1.437	2.189
	Products are sourced from environment friendly suppliers.	ESP3	170	1	5	3.971	.988	-1.656	2.905
	We design our products for consuming low materials and energy	ESP4	170	1	5	3.424	.978	-.552	-3.78
	Environment friendly technologies are used to save the environment	ESP5	170	1	5	3.794	1.026	-1.374	1.774
	We use eco-friendly (e.g Fuel efficient transportation)	ESP6	170	1	5	3.747	1.049	-.969	.503
	Environmentally friendly materials are used in the production processes	ESP7	170	1	5	3.718	1.016	-1.190	1.435
	We provide environmental training to the staff	ESP8	170	1	5	4.112	1.0172	-1.421	1.616
	We conduct environmental audits	ESP9	170	1	5	3.918	1.096	-1.420	1.529
Social sustainable									
	Support employees in balancing work and life activities	SSP1	170	1	5	3.618	1.152	-.621	-2.99
	Involve employees in decisions that affect them	SSP2	170	1	5	3.588	1.189	-.778	-202
	Ensure accountability for ethics at all levels	SSP3	170	2	5	4.494	.664	-1.574	3.535

supply chain practices (SSP)	Ensure the health and safety of employees	SSP4	170	1	5	3.782	1.133	-1.118	.646
	Source product from our local suppliers	SSP5	170	1	5	3.524	1.256	-.889	-.277
	Encourage and promote workplace diversity	SSP6	170	1	5	3.877	1.177	-.967	.086
	Ensure payment of taxes and levies to government	SSP7	170	1	5	3.777	1.064	-1.031	.749
	We source product from socially responsible suppliers	SSP8	170	1	5	3.777	1.160	-1.003	.253
	We ensure fair compensation for the employees	SSP9	170	1	5	3.635	1.155	-.906	.093

Note:
Items ESP1 – ESP9, SSP1 – SSP9: 1= strongly disagree, 2= Disagree, 3=Do not know, 4=Agree, 5=strongly agree; N is the number of respondents companies; Std. Dev. = standard deviation.

The Table 5.6 below shows the descriptive statistics for the sustainability performance construct. The results presented in Table 5.6 show that the oil and gas industry broadly understand the importance of implementing sustainable supply chain practices to improve their sustainability and operational performance, with mean values of 4.277 and 3.906 and a standard deviation ranging from 1.154 to 0.772.

Table 5.6 Descriptive statistics for Sustainability Performance Construct

Research variables			N	Minimum	Maximum	Mean	Std. Dev.	Skewness	Kurtosis
Sustainability Performance									
Economic Performance (ECP)	Scale items	Scale items Codes							
	Increase in sales volume	ECP1	170	1	5	3.971	.994	-1.332	1.905
	Reduced cost of production	ECP2	170	1	5	4.100	.888	-1.839	4.485
	Improved revenue growth	ECP3	170	1	5	3.965	.991	-1.371	2.153
	Increase in profitability	ECP4	170	1	5	4.218	.887	-1.627	3.285
	Decrease cost of material purchasing and energy consumption	ECP5	170	1	5	4.094	.912	-1.420	2.572
Environmental Performance (ENP)									
	Reduction in greenhouse gas emissions	ENP1	170	1	5	3.918	1.117	-1.537	1.821
	Reduction in material usage	ENP2	170	1	5	4.077	.985	-1.282	1.359

	Reduction in consumption of hazardous materials	ENP3	170	1	5	4.100	.1.134	-1.578	1.929
	Reduction in energy consumption	ENP4	170	1	5	3.994	.958	-1.133	.846
	Reduction in energy consumption	ENP5	170	1	5	4.112	1.154	-1.625	1.975
Social Performance (SOP)									
	Improved employee engagement	SOP1	170	1	5	3.906	1.067	-1.347	1.297
	Improved working condition	SOP2	170	1	5	4.159	.772	-1.532	3.928
	Improved safety and well-being staff	SOP3	170	1	5	4.277	.814	-1.615	3.556
	Improved stakeholder involvement	SOP4	170	1	5	4.218	.874	-1.464	2.652

Note:
Items ECP1 – ECP5, ENP1 – ENP5, SOP1 – SOP4: 1= Very Low, 2= Low, 3= Don't know, 4= High, 5= Very High; N is the number of respondents companies; Std. Dev. = standard deviation.

In addition, the table 5.7 shows descriptives statistics results for operational performance construct. The mean operational performance values were relatively high 4.447 to 4.076, and the standard deviation ranged between 0.769 and 0.684. This confirms evidence that implementing sustainable supply chain practices will improve operational performance.

5. 7. Descriptive statistics for Operational sustainability Performance Construct

Research variables			N	Minimum	Maximum	Mean	Std. Dev.	Skewness	Kurtosis
Operational Performance (OPP)	Scale items	Scale items Codes							
	Decrease of fine for environmental accidents	OPP1	170	1	5	4.076	.709	-1.609	5.702
	Improved company image	OPP2	170	1	5	4.324	.684	-1.411	4.294
	Improved quality of products and process	OPP3	170	1	5	4.341	.688	-1.773	6.576
	Reduced lead-time	OPP4	170	1	5	4.247	.695	-1.232	3.509
	Increased customer satisfaction and loyalty	OPP5	170	1	5	4.447	.762	-2.178	6.914
	Increase in customer awareness level	OPP6	170	2	5	4.371	.768	-1.460	2.402

Note:
Items OPP1 – OPP6: 1= Very Low, 2= Low, 3= Don't know, 4= High, 5= Very High; N is the number of respondents companies; Std. Dev. = standard deviation.

Although the results in Tables 5.3 – 5.7 are insufficient to reach this conclusion, the data must be analysed further using other statistical techniques, such as factor analysis or structural equation modelling (SEM).

Furthermore, the tables 5.3 – 5.7 above also provide some information concerning Skewness and kurtosis. It was recommended that the absolute values of Skewness and kurtosis should not be greater than three (3) and ten (10), respectively. An examination of Skewness and kurtosis in the Tables revealed that the absolute values were within the recommended range. This confirms that we have a normal data distribution.

5.6 Exploratory factor analysis (EFA)

Exploratory Factor Analysis (EFA) is another method of assessing construct validity; therefore, this section seeks to assess the validity of the construct using EFA. Exploratory factor analysis is frequently employed in the preliminary stages of research to determine the interrelationships between a group of variables.

Therefore, in this thesis, we perform the EFA using the SPSS version 29.0 software package. The EFA was conducted for each research construct in the study. The principal component analysis was used as the statistical extraction method for all measures, which was generated and represented through eigenvalues (Field, 2009). The Promax rotation method was employed as a factor analysis rotation technique. Furthermore, where one-factor solutions were not achieved, the item preventing them are removed and another EFA was conducted to ensure that all remaining items account for a single underlying factor. Also, Hair et al. (2010) recommended that if removing one item will not yield a one-factor solution, continue to remove other items that are not converging until a one-factor solution is reached. It is important to note that when one factor is extracted from measuring items of a measure, SPSS does not produce a loading plot concerning a rotation solution.

The factor analysis results for each research measure are presented below, as indicated in the SPSS output. Kaiser (1974) and Wang et al. (2023) recommended that KMO values should be equal to or greater than 0.6 and eigenvalue should be 1 or above.

The table 5.8 present the results of KMO and eigenvalues for all the measurement items. The analysis of the results in the table indicates a very strong sample sufficiency for all the measurement items.

Table 5.8: KMO and Eigenvalues for Measurement items

Measurement items	Kaiser-Meyer-Olkin (KMO) Values	Eigenvalues
Pathways to Sustainability	0.880	5.377
Obstacles to Sustainability	0.925	6.391
Environmentally sustainable supply chain practices (SSPC)	0.923	5.014
Social sustainable supply chain Practices (SSCP)	0.928	5.589
Economic sustainability performance measure (SP)	0.856	3.873
Environmental sustainability performance measures (SP)	0.789	3.389
Social sustainability performance measures (SP)	0.789	3.077
Operational Performance Measures	0.833	3.353

Key:
SSCP: Sustainable Supply Chain Practices
SP: Sustainability Performance

5.6.1 Pathways to sustainability Measures

In the questionnaire, the pathways measure has ten measurement items. Factor analysis was conducted to determine whether these ten items belonged to one dimension. Figure 5.1 below displays the factor analysis loading plot for the pathways to sustainability measure. The factor analysis showed two-factor solutions for the pathways to sustainability measure, indicating that PWS9 (Stockholders Support) and PWS8 (Collaboration with Suppliers) are far from other items, preventing them from converging as one factor. We made the decision to remove PWS9 (Stockholders Support) from the measurement because its distance from other items was wider than that of PWS8 (Collaboration with Suppliers), suggesting that it was less likely that PWS9 was influencing the other items to converge as one factor.

Figure 5.2 below displays the factor analysis loading plot for the pathways to sustainability measure. The exclusion of PWS9 (Stockholders Support) resulted in another two-factor solution. Therefore, we removed PWS8 (Collaboration with Suppliers) and conducted the factor analysis again, resulting in a one-factor solution.

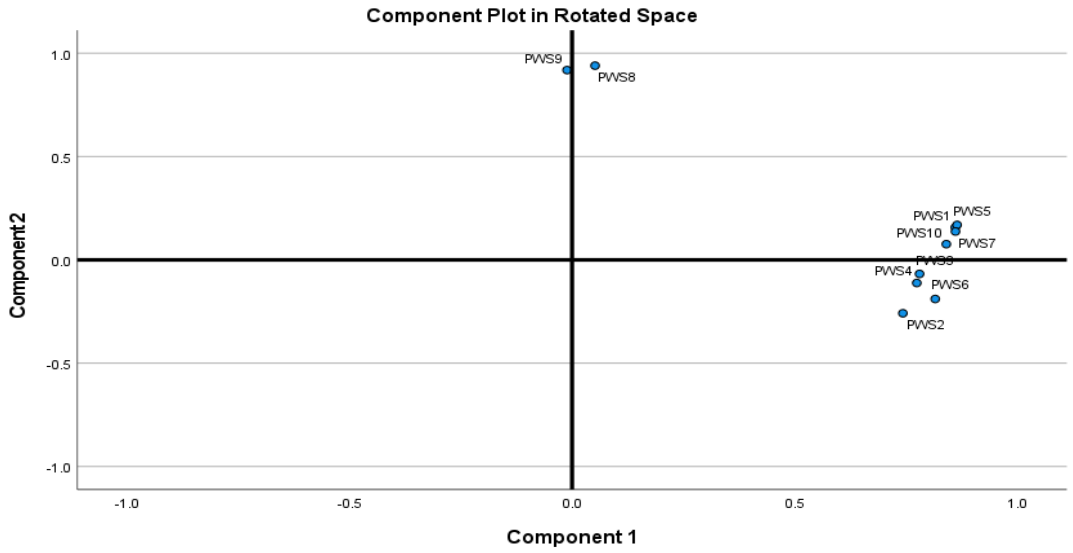

Figure 5.1 Factor analysis for pathways to sustainability component: Rotation and loading plot.

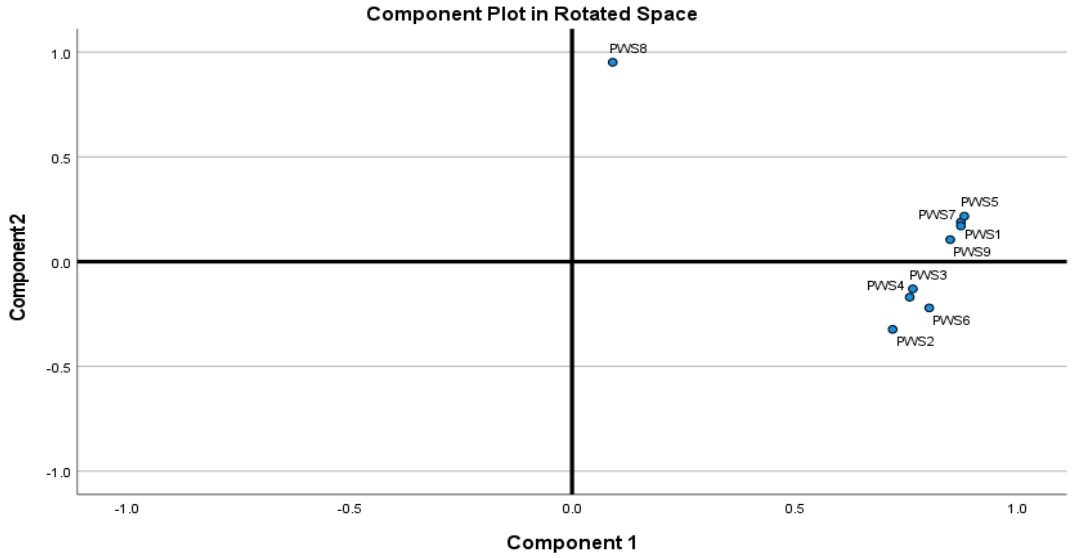

Figure 5.2 Factor analysis for pathways to sustainability component: Rotation and loading plot (with PWS9 excluded)

Key:

PWS1 = Top management Commitment
PWS2 = Government Regulations/Legislations
PWS3 = Stakeholders Support
PWS4 = Ingrained Culture in oraganisation
PWS5 = Information Technology Advancement
PWS6 = Training and Development
PWS7 = Customer Support
PWS8 = Collaboration with Suppliers
PWS9 = Stockholders Support
Component 1 = common variation
Component 2 = unique variation

5.6.2 Obstacles to sustainability Measurement items

In the questionnaire, the obstacles were measured using nine measurement items. Factor analysis determined whether these nine items belonged to one dimension. Figure 5.3 below displays the factor analysis loading plot for the Obstacles to Sustainability measure. The factor analysis showed two-factor solutions for the measure of obstacles, as in the pathway measure, indicating that one-factor solutions still needed to be achieved. We identify the measure that does not converge as a one-factor solution, as shown in **Figure 5.3**. We conducted another factor analysis to accomplish a one-factor solution by excluding OBS4 (Lack of trust-based relations) because of its distance from other items. This leads to a one-factor solution indicating that all items represent obstacles measured. Therefore, the construct validity was achieved after removing OBS4 (Lack of trust-based relations).

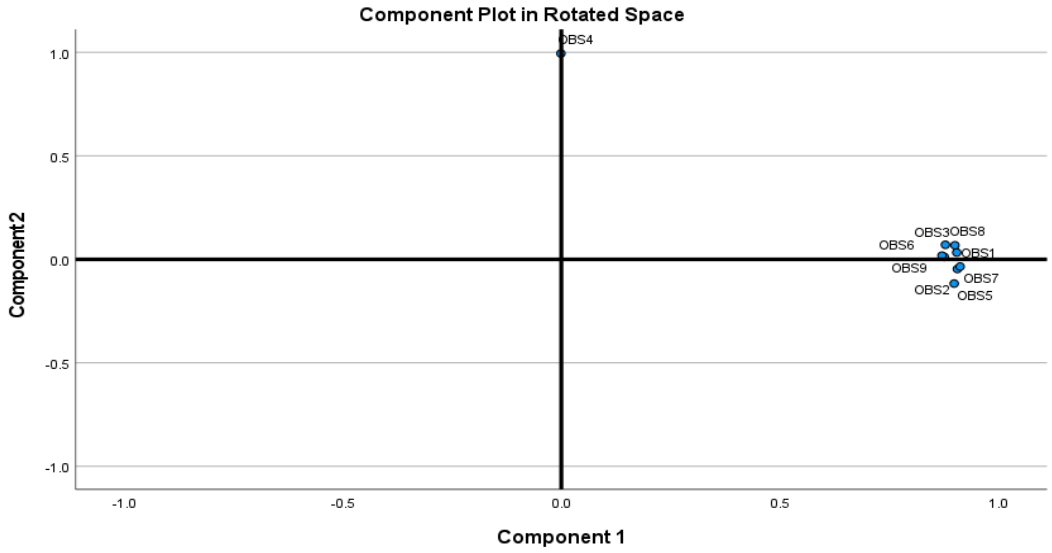

Figure 5.3 Factor analysis for obstacles to sustainability component: rotation and loading plot.

Key:
OBS1 = Lack of awareness and understanding of sustainability
OBS2 = Resistance to change
OBS3 = Cost of adopting sustainability
OBS4 = Lack of trust-based relations
OBS5 = Lack of information technologies
OBS6 = Inappropriate infrastructures
OBS7 = Lack of top management commitment
OBS8 = Lack of sustainability standard and regulations
OBS9 = Lack of support from government and international organisations
Component 1 = common variation
Component 2 = unique variation

5.6.3 Sustainable Supply Chain Practices Measure

5.6.3.1 Environmentally sustainable supply chain practices

In the questionnaire, the measure of environmentally sustainable supply chain practices has nine measurement items. Factor analysis was conducted to determine whether these nine items belonged to one dimension. Figure 5.4 below displays the factor analysis loading plot for measuring environmentally sustainable supply chain practices. However, factor analysis, like obstacles to sustainability measures, showed two-factor solutions for measuring environmentally sustainable supply chain practices, indicating that one-factor solutions still needed to be achieved. A one-factor solution is important as it indicates that all the items in our measure are measuring the same underlying construct, in this case, environmentally sustainable supply chain practices. We identify ESP4 (We design our products for consuming low materials and energy) and ESP6 (We use eco-friendly, e.g. Fuel-efficient transportation) as the two items preventing the measure from converging as a one-factor solution, as shown in figure 5.4.

Figure 5.5 below displays the factor analysis loading plot for the environmentally sustainable supply chain practices measure with the exclusion of ESP4. We conducted another factor analysis to achieve a one-factor solution by excluding ESP4 because of its distance from other items compared to ESP6. To our surprise, this resulted in another two-factor solution (see Figure 5.5), adding a layer of intrigue to our research.

After a careful and iterative process, which involved multiple rounds of factor analysis and item removal, we removed ESP6 and conducted the factor analysis again. This time, we achieved a one-factor solution, indicating the successful achievement of construct validity. This outcome is significant as it enhances the accuracy and reliability of our measure for environmentally sustainable supply chain practices.

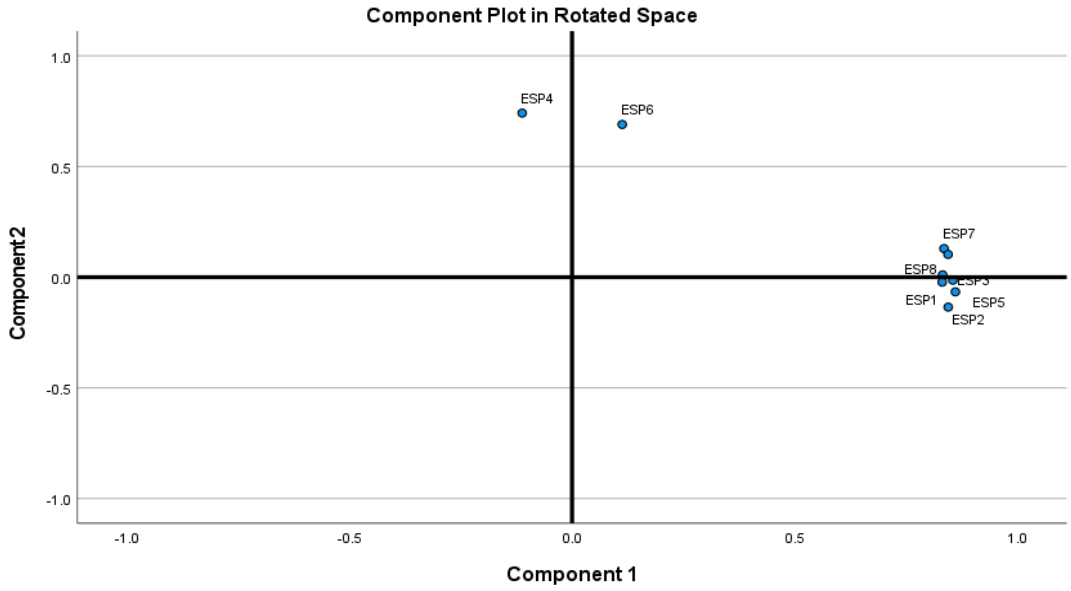

Figure 5.4 Factor analysis for Environmentally sustainable supply chain practices component: Rotation and loading plot.

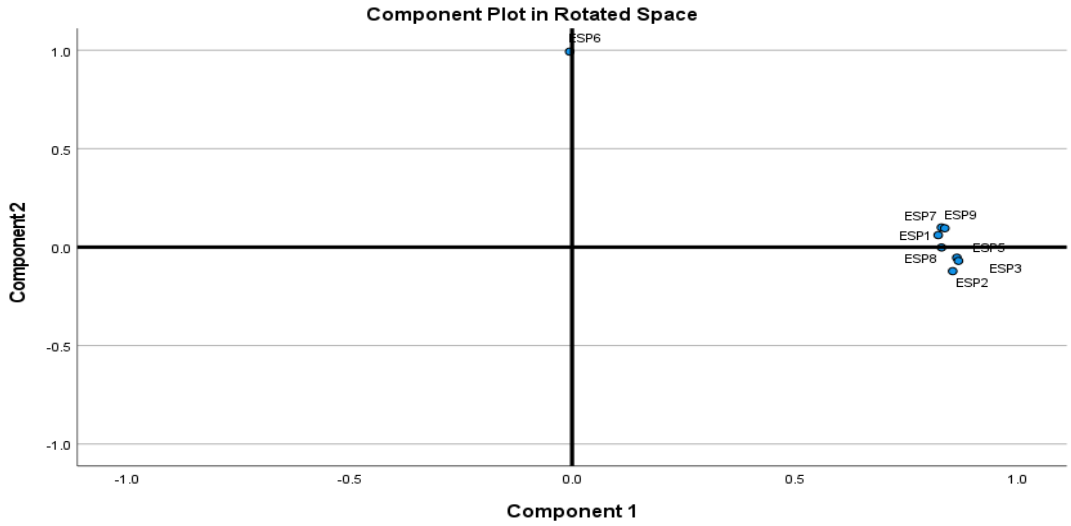

Figure 5.5 Factor analysis for Environmentally sustainable supply chain practices component: Rotation and loading plot (ESP4 excluded)

Key:

ESP1 = Production and delivery processes are designed to reduce carbon dioxide
ESP2 = Products and packaging are designed to be reusable and recyclable
ESP3 = Products are sourced from environment friendly suppliers
ESP4 = We design our products for consuming low materials and energy
ESP5 = Environment friendly technologies are used to save the environment
ESP6 = We use eco-friendly (e.g Fuel efficient transportation)
ESP7 = Environmentally friendly materials are used in the production processes
ESP8 = We provide environmental training to the staff
ESP9 = We conduct environmental audits
Component 1 = common variation
Component 2 = unique variation

5.6.3.2 Social sustainable supply chain Practices

The questionnaire's socially sustainable supply chain practices measure has nine items. Factor analysis was conducted to determine whether these nine items belonged to one dimension. Figure 5.6 below displays the factor analysis loading plot for socially sustainable supply chain practices. However, factor analysis showed two-factor solutions for socially sustainable supply chain practices, such as the measure of environmental sustainability practices, indicating that one-factor solutions still needed to be achieved. We identify the measure that does not converge as a one-factor solution, as shown in **Figure 5.6**. We conducted another factor analysis to accomplish a one-factor solution by excluding SSP3 (Ensuring accountability for ethics at all levels) because of its distance from other items. This leads to a one-factor solution indicating that all items represent socially sustainable supply chain practices measures. Therefore, the construct validity was achieved after removing SSP3.

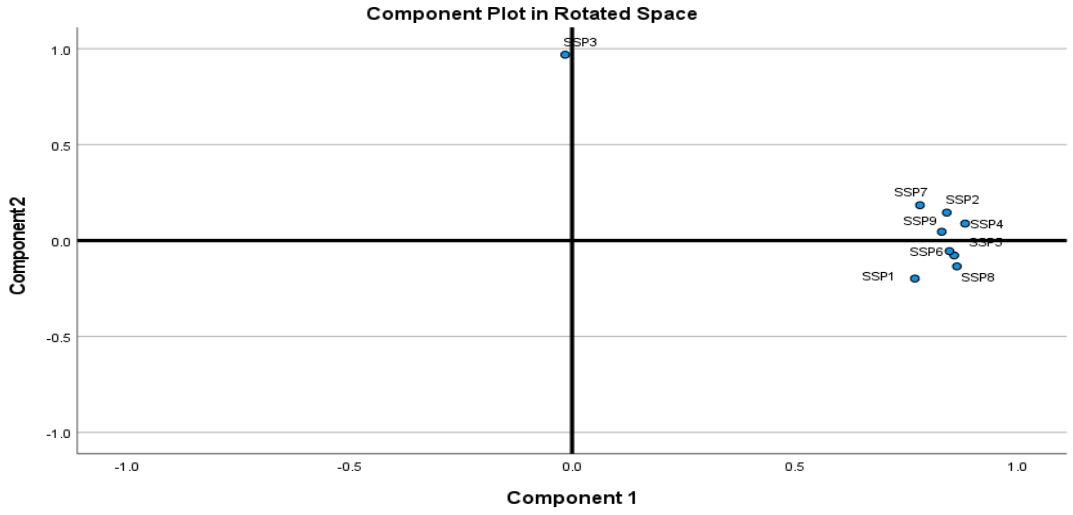

Figure 5.6 Factor analysis for social sustainable supply chain practices component: Rotation and loading plot.

Key:

SSP1 = Support employees in balancing work and life activities
SSP2 = Involve employees in decisions that affect them
SSP3 = Ensure accountability for ethics at all levels
SSP4 = Ensure the health and safety of employees
SSP5 = Source product from our local suppliers
SSP6 = Encourage and promote workplace diversity
SSP7 = Ensure payment of taxes and levies to government
SSP8 = We source product from socially responsible suppliers
SSP9 = We ensure fair compensation for the employees
Component 1 = common variation
Component 2 = unique variation

5.6.4 Sustainability Performance Measures

Another construct in the questionnaire is sustainability performance with three dimensions: economics, environmental and social performance and their construct validity are explained below.

5.6.4.1 Economic sustainability performance measure

The economic measure in the questionnaire has five measurement items and Factor analysis was conducted to determine whether these five items belonged to one dimension. A loading plot was not produced in the SPSS output, and the expected one factor was extracted among the economic performance measuring items. Hence, the construct's convergent validity was achieved.

5.6.4.2 Environmental sustainability performance measures

The environmental performance measure in the questionnaire has five measurement items and Factor analysis was conducted to determine whether these five items belonged to one dimension. Like economic performance, a loading plot was not produced in the SPSS output, and the expected one factor was extracted among the environmental performance measuring items. Hence, the construct's convergent validity was achieved.

5.6.4.3 Social sustainability performance measures

The social performance measure in the questionnaire has four measure items and Factor analysis was conducted to determine whether these four items belonged to one dimension. Like environmental performance, a loading plot was not produced in the SPSS output, and the expected one factor was extracted among the social performance measuring items. Hence, the construct's convergent validity was achieved.

5.6.5 Operational Performance Measures

The operational performance measure in the questionnaire has six measure items and Factor analysis was conducted to determine whether these six items belonged to one dimension. Figure 5.7 below displays the factor analysis loading plot for the operational performance measure. The factor analysis showed two-factor solutions for the operational performance measure. This indicates that one-factor solutions still need to be achieved. Using SPSS output, we identify the measure that does not

converge as a one-factor solution, as shown in Figure 5.7. We conducted another factor analysis to achieve a one-factor solution by excluding OPP6 (Increase in customer awareness level) because of its distance from other items. This leads to a one-factor solution indicating that all items represent operational performance measured. Therefore, the construct validity was achieved after removing OPP6.

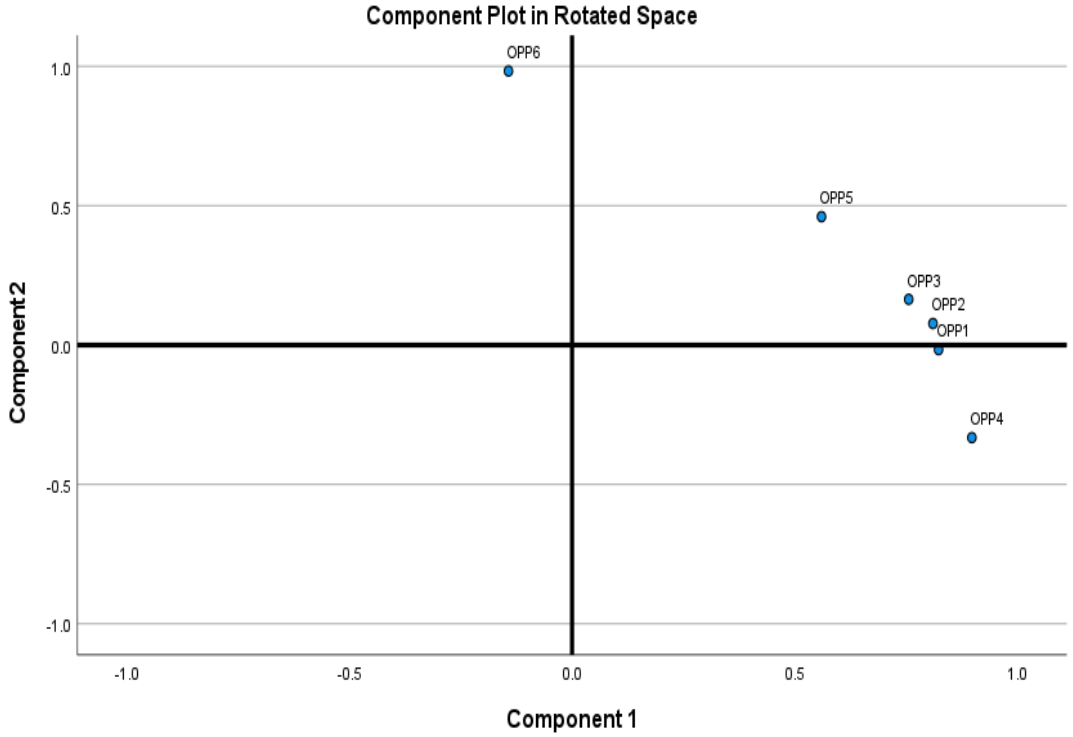

Figure 5.7 Factor analysis for Operational performance component: Rotation and loading plot.

Key:

OPP1 = Decrease of fine for environmental accidents
OPP2 = Improved company image
OPP3 = Improved quality of products and process
OPP4 = Reduced lead-time
OPP5 = Increased customer satisfaction and loyalty
OPP6 = Increase in customer awareness level
Component 1 = common variation
Component 2 = unique variation

5.6.6 Summary of exploratory factor analysis

After performing factor analysis for individual measures, we conduct the factor analysis of all the measures, excluding PWS8, PWS9, OBS4, ESP4, ESP6, SSP3 and OPP6 measuring items. The Table 5.9 presents the KMO and Bartlett's Test results for all constructs. The KMO (Kaiser-Meyer-Olkin) value of 0.880 represents very strong sample sufficiency, indicating that the data is suitable for factor analysis. The chi-square of Bartlett's Test of Sphericity (Bartlett, 1954) reached a statistical significance value of (<0.000) with a value of 7589.673 for 1225 degrees of freedom. This indicates that the correlation matrix is not an identity matrix, supporting the factorability of the correlation matrix. The total variance explained was over 60%, with a total value of 73.699%, confirming the null hypothesis of no correlation.

Table 5.9: KMO and Bartlett's Test for the entire constructs

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.880
Bartlett's Test of Sphericity	Approx. Chi-Square	7589.673
	df	1225
	Sig.	.000

The Table 5.10 presents exploratory factor analysis for the research variables, including the pattern matrix (factor loadings) and extracted communalities. The pattern matrix revealed eight distinct constructs, as was initially expected. All the items were loaded onto their respective constructs with factor loadings greater than 0.50. In addition, eigenvalues for the eight constructs exceeded the minimum value of 1(Hair et al., 2010). The results confirmed eight main latent factors: obstacles to sustainability, socially sustainable supply chain practices, pathways to sustainability, environmentally sustainable supply chain practices, economic performance, environmental performance, social performance, and operational performance. As shown in the Table 5.10, component 1 is an obstacle to sustainability (OBS) with eight items, and Component 3 is pathways to sustainability (PWS) with eight items. The components of sustainable supply chain practices include components 2 and 4, related social supply chain sustainability with seven items and environmental supply chain sustainability with eight items, respectively. In contrast, components 5, 6 and 8 are components of sustainability performance that include economics performance

(5 items), environmental performance (5 items) and social performance (4 items) labelled as ECP, ENV and SOP, respectively, and components 7 is operational performance (OPP) with five items.

Principal components analysis was used as the factor extraction approach to performing exploratory factor analysis, and the Promax rotation method was also applied. The Table 5.10 also shows the extracted communalities for all the items.

Table 5.10 Exploratory factor analysis: factor loadings for all variables

			Exploratory factor analysis: factor loadings								
			Factor loadings								
Research variables		Scale items Codes	1 OBS	2 SSP	3 PWS	4 ESP	5 ECP	6 ENP	7 OPP	8 SOP	Extracted Communalities
Pathways to sustainability (PWS)		PWS1			.735						.706
		PWS2			.766						.671
		PWS3			.847						.658
		PWS4			.763						.634
		PWS5			.852						.706
		PWS6			.842						.730
		PWS7			.802						.712
		PWS10			.882						.734
Obstacles to sustainability (OBS)		OBS1	.958								.845
		OBS2	.870								.817
		OBS3	.949								.845
		OBS5	.834								.793
		OBS6	.899								.784
		OBS7	.915								.831
		OBS8	.909								.793
		OBS9	.812								.773
Sustainable supply chain practices	**Environmental supply chain Practices (ESP)**	ESP1				.773					.692
		ESP2				.759					.747
		ESP3				.749					.729
		ESP5				.912					.748
		ESP7				.808					.724
		ESP8				.818					.682
		ESP9				.788					.751
	Social sustainable supply chain	SSP1		.675							.584
		SSP2		.865							.746
		SSP4		.852							.795
		SSP5		.949							.768

	practices (SSP)	SSP6		.755					.706
		SSP7		.706					.671
		SSP8		.828					.729
		SSP9		.810					.707
Sustainability Performance	**Economic Performance (ECP)**	ECP1			.933				.828
		ECP2			.848				.808
		ECP3			.913				.842
		ECP4			.706				.552
		ECP5			.926				.884
	Environmental Performance (ENP)	ENP1				.745			.719
		ENP2				.690			.687
		ENP3				.882			.816
		ENP4				.763			.519
		ENP5				.935			.880
	Social Performance (SOP)	SOP1						.740	.568
		SOP2						.895	.866
		SOP3						.927	.883
		SOP4						.883	.821
Operational Performance (OPP)		OPP1					.768		.678
		OPP2					.864		.761
		OPP3					.856		.730
		OPP4					.705		.558
		OPP5					.799		.641

Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

5.7 Confirmatory factor analysis (CFA)

To perform CFA, we first updated our dataset based on the previous EFA result by deleting PWS8, PWS9, OBS4, ESP4, ESP6, SSP3 and OPP6 and created a new dataset without these items in SPSS. The CFA was conducted using IBM SPSS AMOS software to test the measurement model. Generally, when the CFA is performed, the SPSS AMOS software suggests a number of modification indices to delete item (s) and add covariance between items where possible to improve the model fit.

5.7.1 Assessing the Fit of the Measurement Model

The table 5.11 presents the results of the goodness of fit indices values for the CFA model (measurement) before adjusting the model to obtain good fit indices. Also, Figure 5.8 below presents the CFA model before respecifying the model to obtain a

good fit. The result in table 5.11 indicates the Normed Chi-Square result of 1.613, the RMSEA result of 0.060, the Comparative Fit Index (CFI) result of 0.903, the SRMR result of 0.064, and the PClose of 0.001 showing a pretty good model fit indices but some not within an acceptable level. Therefore, it is normal for studies like these to have such results when developing a model (Byrne, 1998, as cited in Ali, 2017). It is the responsibility of the researchers to respecify the model to achieve acceptable model fit indices, as this is a crucial step in the research process.

Table 5.11: Goodness of fit indices values for the CFA (measurement) models before Modifications

Measure	CMIN	DF	CMIN/DF	CFI	SRMR	RMSEA	PClose
Estimate	1850.159	1147.000	1.613	0.903	0.064	0.060	0.001
Threshold	-----	------	Between 1 and 3	>0.95	<0.08	<0.06	>0.05
Interpretation	-----	------	Excellent	Acceptable	Excellent	Excellent	Terrible

Key:
CMIN = Chi-square Value
DF = Degrees of Freedom
CFI = Comparative fit index
SRMR = Standardized Root Mean Square Residual
RMSEA =Root Means Square Error of Approximation
PClose = Parsimony Close

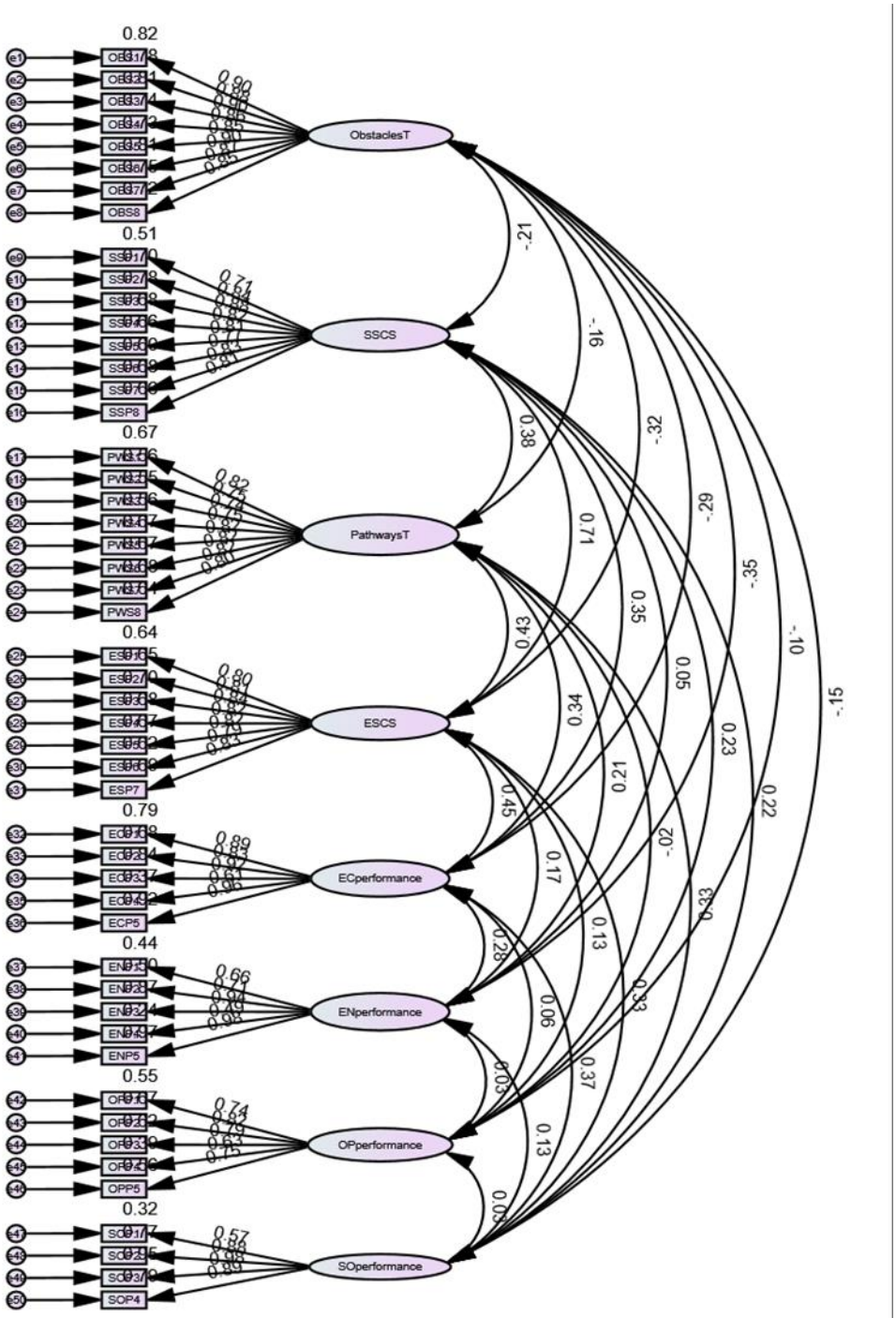

Figure 5.8: The CFA model before Modifications- SPSS AMOS output

Given this, two items were removed, and two were co-varied based on trial and error, as suggested in the modification indices in SPSS AMOS. Hence, the items deleted are OBS1 and ECP2, and those co-varied include OBS5 and OBS7 and SOP1 and SOP2. The table 5.12 represents the results of the goodness of fit indices for the CFA model after

performing modifications. Further, Figure 5.9 shows the SPSS output of the CFA model after the modifications were performed.

After these modifications, the CFA result was produced, indicating that all values were within their expected acceptance levels. The Normed Chi-Square result of 1.486, the RMSEA result of 0.054, the Comparative Fit Index (CFI) result of 0.922, the SRMR result of 0.064, and the PClose result of 0.122 indicate excellent fit.

Table 5.12: Goodness of fit indices values for the CFA (measurement) models after Modifications

Measure	CMIN	DF	CMIN/DF	CFI	SRMR	RMSEA	PClose
Estimate	1559.877	1050.000	1.486	0.922	0.064	0.054	0.144
Threshold	-----	------	Between 1 and 3	>0.95	<0.08	<0.06	>0.05
Interpretation	-----	------	Excellent	Acceptable	Excellent	Excellent	Excellent

Key:
CMIN = Chi-square Value
DF = Degrees of Freedom
CFI = Comparative fit index
SRMR = Standardized Root Mean Square Residual
RMSEA =Root Means Square Error of Approximation
PClose = Parsimony Close

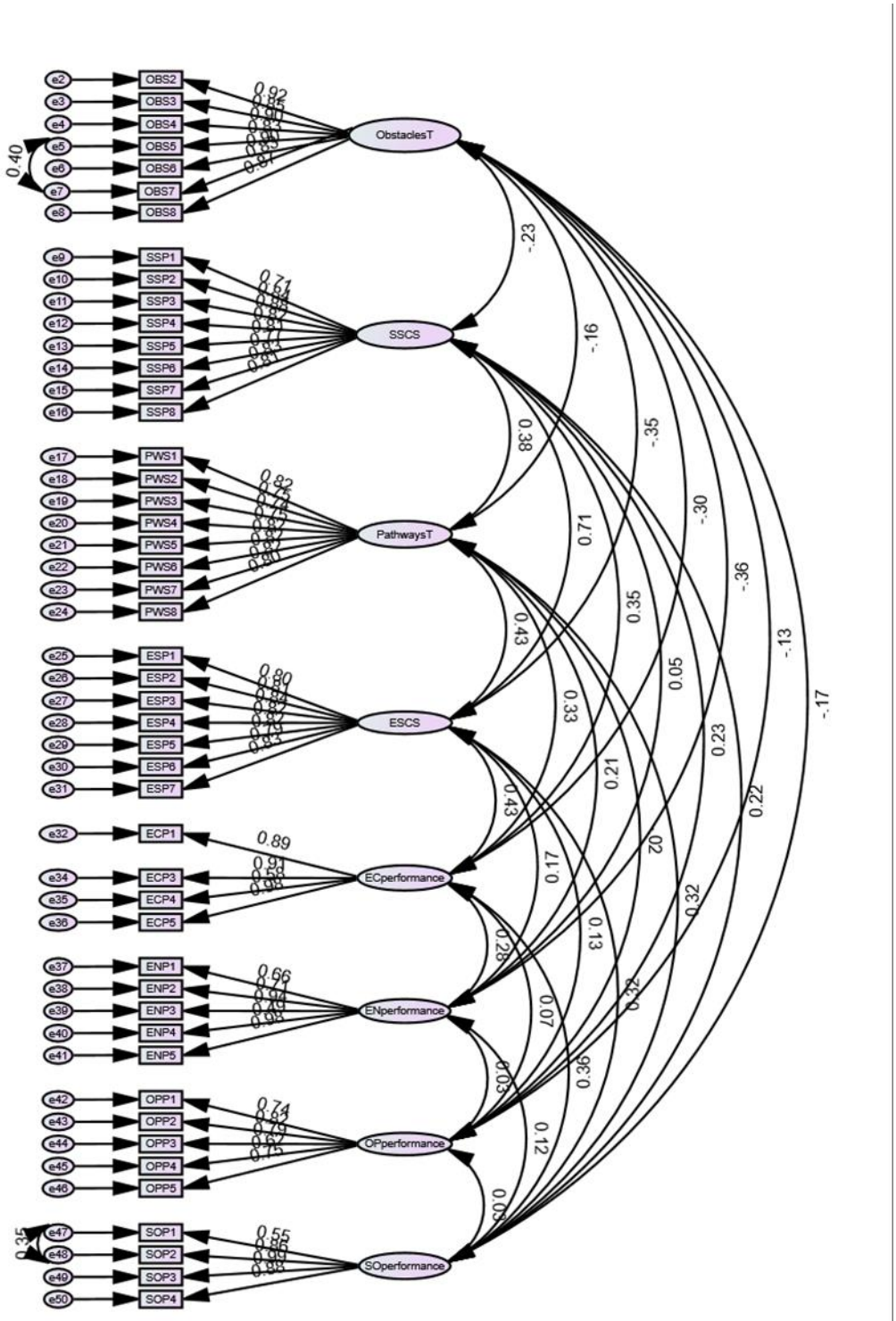

Figure 5.9 The CFA (Measurement) model after Modifications- SPSS AMOS output

5.8 Reassessing Reliability, Validity and Multi-collinearity of the Constructs

Once the goodness of fit for the CFA model is established, it is crucial to reevaluate the constructs' reliability and test their validity and multi-collinearity (De Wulf et al., 2001; Ahmad, 2007; Ali, 2017). This reassessment, conducted using Cronbach's alpha, construct reliability (CR), and average variance extracted (AVE), is a pivotal step in ensuring the robustness of our findings. Similarly, the assessment of validity, including both convergent and discriminant validity, is of utmost importance.

The reliability and validity assessment, as presented in table 5.13, put confidence in the robustness of our study. The Cronbach's alpha coefficient results indicate that all constructs surpass the recommended threshold of 0.70. Similarly, construct's reliability (CR) and Average variance extracted (AVE) for all the constructs exceed the recommended values of 0.60 and 0.50, respectively. These evaluations affirm the reliability of the constructs, which were well within the acceptable range.

To assess validity, results from goodness-of-fit indices, which are statistical measures used to evaluate how well a model fits the data, discussed above showed construct validity in this study. As for the support of convergent validity, all factor loadings for items designed to measure the same construct are statistically significant. As shown in the Table 5.13, all factors' loadings (Standardised items loadings) are greater than 0.50 and were statistically significant (P <0.001). Thus, support was found for the convergent validity. The results of the average variance extracted in the Table 5.14 also provide additional support for convergent validity.

Table 5.13: The reliability and Validity of the study constructs: Cronbach's Alpha, Construct Reliability and Average Variance Extracted

Research variables	Standardised items loadings	Cronbach's Alpha	CR	AVE
Entire construct		**.892**		
Pathways to sustainability		**.929**	**.930**	**.625**
Top management Commitment	.820			
Government Regulations/Legislations	.746			
Stakeholders Support	.743			
Ingrained Culture in oraganisation	.751			
Information Technology Advancement	.817			
Training and Development	.819			
Customer Support	.823			

Collaboration with Suppliers	.800			
Obstacles to Sustainability		**.964**	**.956**	**.758**
Resistance to change	.916			
Cost of adopting sustainability	.848			
Lack of trust-based relations	.903			
Lack of information technologies	.826			
Inappropriate infrastructures	.898			
Lack of top management commitment	.831			
Limited financial resources	.866			
Sustainable supply chain sustainability (Environmental and Social)				
Environmental Sustainability practices		**.932**	**.933**	**.664**
Production is designed to reduce carbon dioxide	.800			
Products and packaging are designed to be reusable and recyclable	.806			
Products are sourced from environment friendly suppliers.	.839			
We design our products for consuming low materials and energy	.825			
Environment friendly technologies are used to save the environment	.820			
We use eco-friendly (e.g Fuel efficient transportation)	.788			
Environmentally friendly materials are used in the production processes	.827			
Social Sustainability practices		**.938**	**.938**	**.657**
Support employees in balancing work and life activities	.885			
Involve employees in decisions that affect them	.910			
Ensure accountability for ethics at all levels	.579			
Ensure the health and safety of employees	.975			
Source product from our local suppliers	.661			
Encourage and promote workplace diversity	.706			
Ensure payment of taxes and levies to government	.936			
We source product from socially responsible suppliers	.593			
Sustainability Performance (Economic, Environment and social)				
Economic Performance		**.926**	**.910**	**.724**
Increase in sales volume	.885			
Improved revenue growth	.910			
Increase in profitability	.579			
Decrease cost of material purchasing and energy consumption	.975			
Environmental Performance		**.880**	**.879**	**.605**
Reduction in greenhouse gas emissions	.661			
Reduction in material usage	.706			

Reduction in consumption of hazardous materials	.936			
Reduction in energy consumption	.593			
Reduction in energy consumption	.985			
Social Performance		**.881**	**.900**	**.700**
Improved employee engagement	.546			
Improved working condition	.864			
Improved safety and well-being staff	.988			
Improved stakeholder involvement	.882			
Operational Performance		**.859**	**.862**	**.558**
Decrease of fine for environmental accidents	.744			
Improved company image	.819			
Improved quality of products and process	.785			
Reduced lead-time	.625			
Increased customer satisfaction and loyalty	.747			

Key:
CR = Construct Reliability
AVE = Average Variance Extracted

The Table 5.14 indicates the square root of the average variance extracted as bold in the diagonal. The entire construct's correlations were found to be less than the square root of the average variance extracted for the individual construct. As such, strong evidence was found for discriminant validity between each possible pair of factors.

Table 5.14: Correlation matrix and discriminant validity test of the study constructs.

Constructs	OPP	OBS	SSP	PWS	ESP	ECP	ENP	SOP
OPP	**0.747**							
OBS	-0.131	**0.870**						
SSP	0.229	-0.227	**0.810**					
PWS	-0.021	-0.164	0.384	**0.791**				
ESP	0.130	-0.354	0.707	0.428	**0.815**			
ECP	0.066	-0.297	0.346	0.328	0.435	**0.851**		
ENP	0.034	-0.362	0.051	0.212	0.171	0.277	**0.778**	
SOP	0.026	-0.169	0.217	0.322	0.320	0.356	0.125	**0.836**

Square root of Average Variance Extracted (AVE) shown as bold in diagonal.
**Correlation is significant at the 0.01 level (2-tailed)
KEY:
OPP = Operational Performance
OBS = Obstacles to Sustainability
SSP = Social sustainability practices
PWS = Pathways to Sustainability
ESP = Environmental sustainability practices
ECP = Economic sustainability performance
ENP = Environmental sustainability performance
SOP = Social sustainability performance

Furthermore, multi-collinearity was also checked. The variance inflation factor (VIF) was used to measure multi-collinearity severity, and a VIF value greater than 10 indicates a high degree of multi-collinearity. The SPSS was used to check for multi-collinearity by computing each regressing coefficient's variance inflation factor value. The results indicate that all values are below 2.0, ranging from 1.00 to 1.28, which is less than the threshold of 10.0. This provides evidence against the potential threat from multi-collinearity. Importantly, it further suggests that multi-collinearity is no threat to the structural model for this thesis, a key finding that underscores the robustness of the model.

5.9 Structural equation model (SEM)

After assessing and validating the measurements in previous sections, we can now use SEM to analyse the structure and strength of relationships among variables in a structural model and to test theoretical models and paths. This is done by using path analysis, which involves estimating the relationships among variables using regression techniques.

5.9.1 Assessing the fit of the Structural equation model

To evaluate the structural model, goodness-of-fit indexes are first used to see whether the estimated structural model fits the data. The results of these indexes, as presented in Table 5.17, are a normed chi-square (chi-square/degree of freedom) value of (1.490, $P < 0.05$); CFI value of 0.922; SRMR value of 0.079; RMSEA value of 0.054 and PClose value of 0.125. These values collectively indicate that the model provides a good fit.

Table 5.16: Goodness of fit values of the structural model

Measure	CMIN	DF	CMIN/DF	CFI	SRMR	RMSEA	PClose
Estimate	1590.173	1065.000	1.491	0.922	0.079	0.054	0.125
Threshold	-----	------	Between 1 and 3	>0.95	<0.08	<0.06	>0.05
Interpretation	-----	------	Excellent	Acceptable	Excellent	Excellent	Excellent

Key:
CMIN = Chi-square Value
DF = Degrees of Freedom
CFI = Comparative fit index
SRMR = Standardized Root Mean Square Residual
RMSEA =Root Means Square Error of Approximation
PClose = Parsimony Close

5.9.2 Testing the Research Objectives

The structural equation model (SEM) was used to examine the causal relationship between five different constructs in the model. Following the analysis of the structural equation model in SPSS AMOS, the results are presented below to address Research Objectives 2, 3 and 4. The **Table 5.17** reports the regression model between pathways to sustainability, obstacles to sustainability, Sustainable Supply Chain Practices, sustainability, and operational performance.

First, the study assessed the impact of pathways to sustainability on sustainable supply chain practices and sustainability performance. The impact of pathways to sustainability on the sustainable supply chain was positive and significant (b =0.424, t = 5.033, P = 0.000), suggesting that each unit increase in pathways to sustainability would increase sustainable supply practices by 0.424. And the impact of pathways to sustainability on sustainability performance was positive and significant (b =0.315, t = 2.391, P = 0.017), suggesting that each unit increase in pathways to sustainability would increase sustainability performance by 0.315.

Second, the table reports the impact of obstacles to sustainability on sustainable supply chain practices and sustainability performance. The impact of obstacles to sustainability on sustainable supply chain practices was negative and significant (b = -0.306, t -3.764, P<0.000), suggesting that each unit increase in obstacles to sustainability would lead to a decrease in sustainable supply chain practices with 0.306. The impact of obstacles to sustainability on sustainability performance was negative but significant (b = -0.304, t -2.582, P = 0.010), suggesting that with each unit, an increase in obstacles to sustainability would lead to a decrease in sustainability performance with 0.304.

In addition, the table also reports the impact of sustainable supply chain practices on sustainability and operational performance. The impact of sustainable supply chain practices on sustainability performance was positive and significant (b =0.396, t = 2.622, P = 0.009), indicating that each increase in sustainable supply chain practices will increase sustainability performance by 0.396. Similarly, the table presents the impact of sustainable supply chain practices on operational performance. The impact

of sustainable supply chain practices on operational performance was positive but insignificant (b =0.164, t = 1.770, P = 0.077).

Table 5.17: Standardized Regression Weights of the interaction between the study constructs

Correlations			Estimate	S.E.	C.R.	P	Label
Sustainability Practices	<---	Pathways to Sustainability	.424	.076	5.033	***	a_path
Sustainability Practices	<---	Obstacles to Sustainability	-.306	.060	-3.764	***	
Sustainability Performance	<---	Obstacles to Sustainability	-.304	.035	-2.582	.010	
Sustainability Performance	<---	Pathways to Sustainability	.315	.048	2.391	.017	
Sustainability Performance	<---	Sustainability Practices	.396	.060	2.622	.009	b_path
Operational Performance	<---	Sustainability Practices	.164	.069	1.770	.077	

The table 5.18 presents the results Squared Multiple Correlations (R-Square). The R-Square values in Table 5.19 are significant indicators of the impact of pathways and obstacles to sustainability on sustainable supply chain practices. With a value of 0.274, it's clear that 27.4% of the variance in sustainable supply chain practices is influenced by these factors, leaving 72.6% unaccounted for.

Table 5.19 reveals the collective influence of sustainable supply chain practices, pathways to sustainability, and obstacles to sustainability on sustainability performance. With an R-Square value of 0.528, these factors account for a significant 52.8% of the variance, leaving 47.2% unexplained.

The R Square value of 0.027 in Table 5.19 underscores the limited explanatory power of sustainable supply chain practices in operational performance. While they can account for 2.7% of the variation, it's clear that other factors play a much more significant role, explaining 97.3%.

Table 5.18: Squared Multiple Correlations (R-Square)

	Estimate
Sustainable Supply Chain Practices	.274
Sustainability Performance	.528
Operational Performance	.027

5.9.3 Assessing Mediation effect of Sustainable Supply chain Practices on the relationship between Pathways to Sustainability and Sustainability performance

Using IBM SPSS AMOS 29, we performed mediation analysis using the direct and indirect effects of bootstrap procedures (500 samples) and bias-corrected bootstrap confidence interval (90%) to address Research question 5. The Tables 5.19 and 5.20 present the result of mediation, which shows that sustainable supply chain practices mediate the link between pathways and sustainability performance (b = 0.061, P = 0.080). The P value (P = 0.080) is more significant than 0.05, indicating there is mediation. This result suggests the strengthening effects of sustainable supply chain practices on the company's sustainability performance are influenced by pathways to sustainability.

Table 5.19: Result of Mediation Estimate (User-defined)

Parameter	Estimate	Lower	Upper	P
SM	.061	.002	.188	.080

SM = a_path* b_path

Table 5.20: Results of the mediation effect of sustainable supply chain practices

Correlations	Direct effect	Indirect effect	Total effect	Results
Pathways to Sustainability → Sustainable supply chain practices →Sustainability Performance	0.315	0.061	0.375	Supported

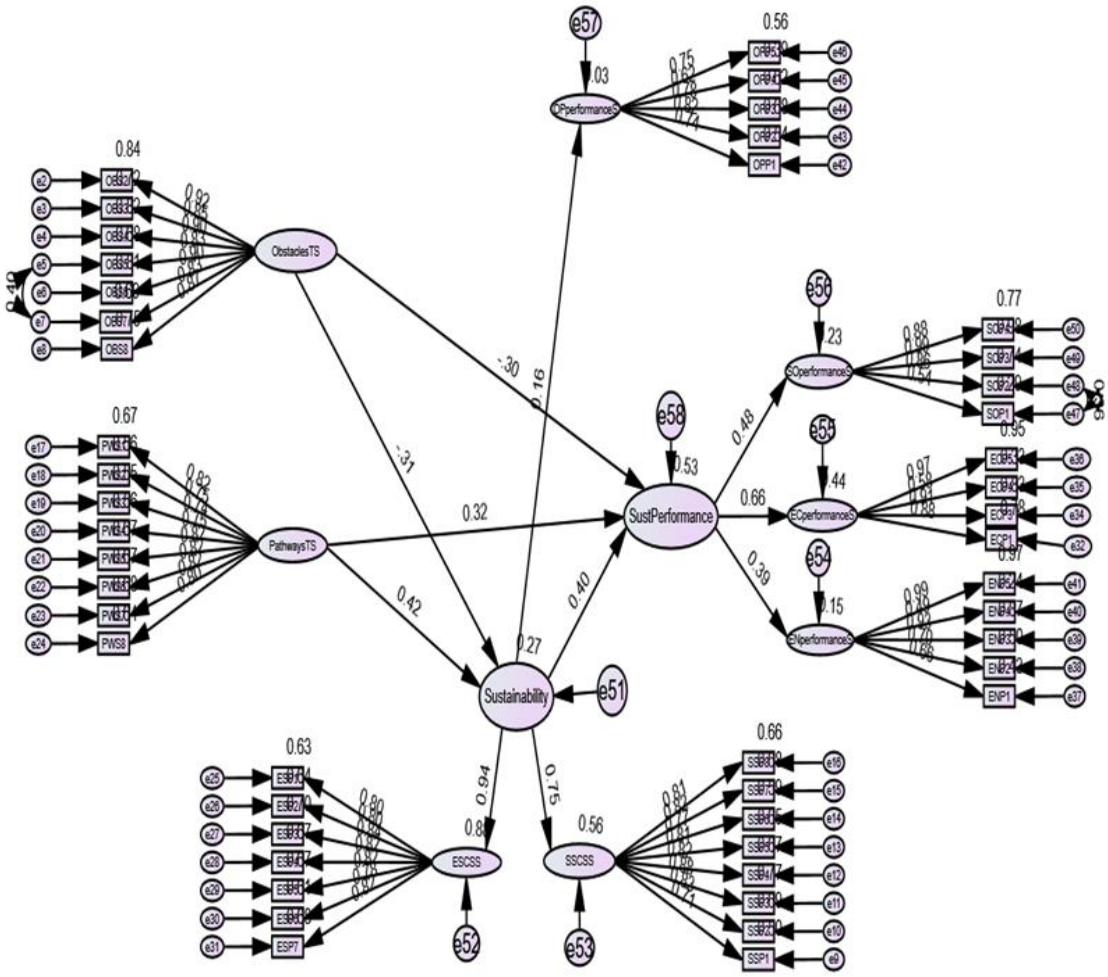

Figure 5.10 Thesis Structural Model

5.10 Chapter summary

The first part of this chapter deals with data preparation and administration, Treatment of missing data and statistical distribution of data before the presentation of data analysis and results using SPSS and AMOS SPSS to conduct both EFA, CFA and structural models.

The second part of this chapter is dedicated to the essential statistical method of Exploratory Factor Analysis (EFA). In this study, the principal component analysis was used as the statistical extraction method for all measures, represented through eigenvalues. The Promax rotation method, a widely used factor analysis rotation technique, was employed. A comprehensive summary of the EFA is also presented in this section, providing a clear understanding of its role in the research.

The final part of this chapter delves into the intricate process of Structural Equation Modelling (SEM) analysis, which was conducted in two stages: the measurement and structural models. The first stage, the measurement model, was assessed using CFA. The initial results indicate that some indices are within the acceptable level while others are not, prompting modifications to ensure all are within the satisfactory level. Both convergent and discriminant validity were conducted, and the results provide strong evidence for construct validity.

The structural model was tested in the second stage of SEM analysis, including seven paths after establishing the overall model fit indices for the structural model. Also, a test for the mediating role of sustainable supply chain practices on the link between pathways to sustainability and sustainability performance was conducted. The next chapter discusses the results in detail to address the research objectives in chapter one.

Chapter Six: Discussion

6.1 Introduction

This chapter presents the results that examined the relationship between constructs identified in chapter three. This chapter aims to interpret the results reported in chapter five, which examines the impact of pathways and obstacles on sustainable supply chain practices and their overall impact on sustainability and operational performance. The chapter further discusses the mediating role of sustainable supply chain practices on the relationship between pathways and sustainability performance. In addition, the chapter addressed the implications of stakeholder theory on the findings.

6.2 Summary of the result

This thesis developed and empirically tested a model that leads to a better understanding of the relationships between pathways and obstacles to sustainability implementation within the supply chain of the oil and gas industry. In order to address the research objectives, this model examines the impact of pathways to sustainability on sustainable supply chain practices and sustainability performance. Further, examine the impact of obstacles to sustainability on sustainable supply chain practices and sustainability performance. And the impact of sustainable supply chain practice on both sustainability and operational performance, and finally, the mediating influence of sustainable supply chain practices on the relationship between pathways to sustainability and sustainability performance. The underlying constructs used to examine the proposed theoretical model were conceptualised following a literature review. Reliable and valid measures were used to measure these constructs and were developed based on this literature.

The results of this thesis largely support the relationships proposed in the conceptual model. In particular, the results provide evidence that pathways to sustainability have a positive and significant impact on sustainable supply chain practices and sustainability performance, obstacles to sustainability negatively influence both sustainable supply chain practices and sustainability performance, and sustainable supply chain practices positively impact operational performance but are

insignificant. Moreover, sustainable supply chain practices were found to mediate the relationships between pathways to sustainability and sustainability performance.

6.3 The impact of Pathways to Sustainability on Sustainable supply Chain Practices and Sustainability Performance

This section explains the results of testing the relationships between pathways to sustainability and sustainable supply chain practices and sustainability performance. These two relationships have aimed to test the following research Objective:

RO2: To investigate the impact of pathways on sustainable supply chain practices and sustainability performance in oil and gas supply chains in Nigeria.

6.3.1 The impact of Pathways to sustainability on Sustainable Supply Chain Practices

The section explains the result of the relationship between pathways to sustainability and sustainable supply chain practices. Hence the result of RO2a was reported.

RO2a: To investigate the impact of pathways on sustainable supply chain practices in oil and gas supply chains in Nigeria.

In the model of this thesis, the studies propose that pathways to sustainability can affect the implementation of sustainable supply chain practices. The results of the studies found that pathways to sustainability positively and significantly affect sustainable supply chain practices, which shows that pathways to sustainability are essential for implementing sustainable supply chain practices. The positive relationship between pathways and sustainable supply chain can be explain in the following perspectives.

From the perspective of government regulation as one of the pathways to sustainable supply chain practice, we can argue that through laws and policies, governments can establish standards and guidelines for companies in the oil and gas industry to follow to protect the environment and promote sustainability implementation. For instance, governments can establish regulations that companies will employ to protect natural resources, reduce pollution, and mitigate the impacts of climate change. Additionally, regulations can set targets for renewable energy use and standards for energy efficiency in oil and gas companies'

operation and supply chain practices. This finding, in agreement with Michael, et al., (2024) and Asiegbu et al. (2024), reiterates the growing importance of legislation as a means to implement sustainable supply practices in Nigeria's oil and gas sector. It suggests that such legislation is progressively gaining dominance. Costache et al. (2021) and Adebanjo et al. (2016) also echo this viewpoint, noting that organizations worldwide are increasingly subject to legislation that compels them to mitigate the environmental impact of their product and process activities.

Also, top management commitment is a crucial pathway to sustainability. It significantly and positively influences the implementation and success of sustainable supply chain practices in the oil and gas industry. The findings of this study are consistent with the research of Madrid-Guijarro & Duréndez (2024) and Westman et al. (2019), which also highlight the owners' and managers' commitment as a core driver for achieving environmentally sustainable policies. Similarly, Huang & Huang (2024) and Omorodion and Joseph (2024) have found that management commitments exert pressure on adopting sustainable supply practices in the Nigerian upstream sector of oil and gas firms. Importantly, Cormican et al. (2021) and Costache et al. (2021) have underscored the pivotal role of top management in effectively administering knowledge and promoting awareness about the benefits of sustainable development, thereby emphasizing their responsibility in sustainability implementation.

In addition, to support these findings on pathways to sustainability, Emeka-Okoli et al. (2024) and Simpa et al. (2024) identified investors, non-governmental organisations' support, and customer awareness as enablers of sustainability implementation in the Nigerian oil and gas industry. In the same vein, Gandhi et al. (2018) and Revell et al. (2010) noted that incentives in the form of loans, grants, tax concessions and other economic benefits facilitate easy adoption and behavioural change in companies towards sustainable practices.

Furthermore, these findings were consistent with studies by Chege & Wang (2020); Chan *et al.* (2020); Wirtenberg et al.'s 2007; and Bansal (2003), which found that government support, incentives and capacity building, coordination across sectors

and sustainability metrics and are an essential mechanism for achieving sustainability practices.

6.3.2 The impact of Pathways to sustainability-on-Sustainability Performance

The section explains the result of the relationship between pathways to sustainability and sustainability performance. Hence the result of RO2b was reported.

RO2b: To investigate the impact of pathways on sustainability performance in oil and gas supply chains in Nigeria.

This research objective examines whether pathways to sustainability can influence sustainability performance, which includes economic, environmental, and social performance. The analysis of the results in this thesis shows that pathways to sustainability and sustainability performance were found to be positive and significant. This suggests that pathways to sustainability can increase the adoption of sustainability-related initiatives, which is vital to access relational capabilities helpful in responding to the requirement of sustainability practices which will improve sustainability performance (Paulraj, 2011).

Pathways to sustainability such as performance measures, compliance with regulations, training, awareness, and support from top management, government and international organisations have played an important role in achieving environmental sustainability performance (Duque-Grisales et al., 2020; Sarkis et al., 2010; Paulraj, 2011; Handfield et al., 2005). These pathways serve as triggers for implementing sustainable supply chain practices, for instance, funding research and development of sustainable technologies, supporting training and programs, and investing in sustainable infrastructure or top management commitment will drive positive change, reduce the environmental impact of human activities, and create more sustainable practices, which will improve environmental sustainability performance in the Nigerian oil and gas industry (Emeka-Okoli et al., 2024; Simpa et al., 2024).

Furthermore, performance measurement, that is, by providing a framework for tracking and reporting progress towards sustainability implementation and monitoring sustainability performance, companies can identify areas for improvement, set targets for reducing environmental impacts, and evaluate the

effectiveness of sustainability initiatives that can improve sustainability performance. Moreover, performance indicators such as environmental, social, and financial metrics can be used to track sustainability performance (Neri et al., 2021). Hence performance measurement can drive sustainability practices that impact sustainability performance. This finding aligns with the studies of Qorri et al. (2018) and Handfield et al. (2005), who noted that companies must measure and manage their supply chain sustainability performance effectively and efficiently to improve their competitive advantages. Similarly, Bai and Sarki (2014) state that analysing performance measurement supports managers' focus on core supply chain sustainability-related decisions.

Another pathway that influences sustainability performance is ingraining culture into organisation activities; that is, shaping the values, beliefs, and behaviour of employees in an organisation can influence sustainability performance (Qasim et al., 2023). For instance, a culture that encourages recycling and discourages wasteful practices can significantly reduce an organisation's environmental footprint. Similarly, a culture that promotes diversity and inclusion can lead to more socially sustainable practices. Awareness can also increase sustainability performance. Suppose people are aware of their actions' environmental and social effects (Csutora et al., 2012). In that case, they are more likely to adopt sustainable practices and make more sustainable choices daily, improving their organisations' overall sustainability performance (Ameer & Othman, 2012).

In addition, employee training can also lead to more sustainable practices, which will enhance sustainability performance within the organisation. Training employees on energy management, waste reduction, sustainable procurements, and reducing the impact of social risk and hazards in their daily work can lead to cost savings, improved environmental performance, and enhanced reputation (Walker & Phillips, 2009; Green et al., 1996). Furthermore, setting regulations and enforcing compliance for companies will improve sustainability performance (Chege & Wang, 2020). If regulations are put on energy efficiency, waste reductions, emission control and child labour and forcing companies to comply with these regulations can improve sustainability performance (Huo et al., 2019).

Huo et al., (2019) argued that using specific regulations across the supply chain may have significant consequences for sustainable performance, and this further suggests that compliance requirements may serve as paths to sustainability performance. Additionally, given the importance of training in generating knowledge, employees at all levels must be authorised to approach sustainability initiatives through exploring, creating, pioneering, and inventing (Paulraj, 2011).

6.4 The impact of Obstacles to Sustainability on Sustainable Supply Chain Practices and Sustainability Performance

This thesis proposed that obstacles have a negative effect on both sustainable supply chain and sustainability performance. The relationship was tested using research objective RO3 as stated below:

RO3: To investigate the impact of obstacles on sustainable supply chain practices and sustainability performance in oil and gas supply chains in Nigeria.

6.4.1 The Impact of Obstacles to sustainability on Sustainable Supply Chain Practices

RO3a: To investigate the impact of obstacles on sustainable supply chain practices in oil and gas supply chains in Nigeria.

The research findings, as anticipated, highlight the detrimental impact of obstacles on sustainable supply chain practices. These findings, consistent with previous studies, point to the significant role of legal and administrative complexity, including inconsistency regulations and lack of standards, particularly in the Nigerian oil and gas industry. These challenges, when not addressed, can impede companies' efforts to implement sustainable supply chain practices, leading to issues of misunderstanding, inconsistency, and lack of transparency (Karkare et al., 2022; Olawuyi et al., 2018; Raut et al., 2017).

In addition, a lack of resources, such as sustainable materials technologies, and inadequate infrastructure can increase costs, making it difficult to implement sustainable supply chain practices, leading to a reluctance to invest in sustainability initiatives in the oil and gas industry in Nigeria (Olisah, 2023; Ahmad et al., 2017; Abubakar, 2014). This complex issue requires a comprehensive approach to be

effectively addressed. Another obstacle is awareness of sustainability initiatives (Raut et al., 2017). Access to information is essential for making informed decisions about sustainable supply chain practices. However, more access to information about the environmental impact of supply chains, suppliers, and products can hinder the ability to make informed decisions and take appropriate actions, positively affecting sustainability implementation. This information paradox is a multifaceted challenge that needs to be understood and managed. Other obstacles are resistance to change by the employees, management, and stakeholders to implement sustainable supply chain practices because they need to see value in sustainability practices (Ojo et al., 2014). This resistance is a complex issue that requires a nuanced approach to be overcome. Other obstacles are a lack of skills, education, and empowerment of procurers and suppliers, which are also essential issues inhibiting the execution of sustainable supply chain practices (Zaidi et al., 2019; Zhu & Sarkis, 2004).

It also agreed with Ayarkwa et al. (2020), who reported financial constraints as a leading barrier to sustainable procurement. Other studies have found support for a negative correlation between obstacles and sustainability practices (Yadav *et al.,* 2018; Raut et al., 2017; Koh et al., 2012). This indicates that obstacles hamper the implementation of sustainable supply chain practices. It is also consistent with Batoola et al. (2022) that these obstacles negatively impact the initiation stage of sustainability in the supply chain. Further examination of the research questions to evaluate the effects of sustainable supply chain practices on pathways and obstacles indicates that pathways and obstacles can explain 27% of the variation in sustainable supply chain practices.

6.4.2 The impact of Obstacles to sustainability on Sustainability Performance

RO3b: To investigate the impact of obstacles on sustainability performance in oil and gas supply chains in Nigeria.

Furthering the aim of investigating obstacles as a consequence of sustainability performance and sustainable supply chain practices, it was proposed that obstacles would negatively influence sustainability performance. Therefore, research RO3b was formulated to examine this relationship.

The analysis of the results revealed that obstacles to sustainability negatively and significantly impact sustainability performance. This suggests that obstacles hamper sustainability performance, and it is in line with the study of Guimarães et al., (2022) which argued that sustainability performance could be hindered by a plethora of obstacles which include financial constraints, lack of customer awareness, legal and administrative complexity, lack of skills and resources, education. In addition, the literature confirms that the inability to leave old habits and prevailing culture are the common features of resistance to change (Heinrich, 2004; Trice et al., 1991), which is one of the most common obstacles to sustainability performance.

For example, financial constraints can significantly impact sustainability performance, as companies prioritize short-term financial goals over long-term sustainability initiatives. This can result in limited investment in sustainable practices, reduced access to capital, pressure to prioritize profitability over sustainability, limited resources for innovation, and reduced ability to comply with regulations. In addition, Legislative and administrative complexity can make it difficult for companies to understand and comply with sustainability regulations (Amoah & Eweje, 2022). This can lead to a lack of investment in sustainability initiatives, as companies may view compliance as too costly or time-consuming. Without sufficient investment in sustainability initiatives, a company's environmental impact may increase, resulting in adverse environmental and societal consequences (Epstein, 2018).

Furthermore, it's essential to recognize that customer awareness, when not properly managed, can have a detrimental impact on sustainability performance. This is particularly evident in the practices of greenwashing, where false or exaggerated claims about the environmental benefits of products or services are made. Equally significant is consumer scepticism, a lack of trust or belief in the environmental claims made by organizations. This lack of trust can lead to a significant decrease in the demand for sustainable products and services, underscoring the importance of fostering and maintaining customer trust.

Greenwashing, a practice that misleads customers into believing that products or services are more environmentally friendly than they are, can have a detrimental

impact on sustainability performance. This can lead to a decrease in demand for sustainable products and services, as customers may become disillusioned with sustainability claims and lose trust in organizations (Aji & Sutikno, 2015). The erosion of consumer trust is a significant consequence of greenwashing, as it can damage an organization's reputation and undermine its efforts to promote sustainability, ultimately hindering sustainability performance.

Moreover, consumer scepticism can negatively affect sustainability performance by reducing demand for sustainable products and services (Leonidou & Skarmeas, 2017). When customers believe in something other than the environmental claims made by organizations, they may choose to refrain from purchasing sustainable products and services, reducing demand and hindering sustainability performance. Therefore, this finding provides strong empirical evidence that obstacles negatively affect sustainability performance.

6.5 The impact of Sustainable Supply Chain Practices on Sustainability and Operational Performance

This section explains the results of testing the impact of Sustainable supply chain practices on sustainability performance and operational performance. The relationship was tested using research objective RO4 as stated below:

RO4: To examine the impact of sustainable supply chain practices on sustainability and operational performance across oil and gas supply chains in Nigeria.

6.5.1 The impact of Sustainable Supply Chain Practices on Sustainability Performance

RO4a: To examine the impact of sustainable supply chain practices on sustainability performance across oil and gas supply chains in Nigeria.

The model proposes that Sustainable supply chain practices could positively impact sustainability performance. The results revealed a positive and significant relationship between sustainable supply chain practices and sustainability performance. This means the selected firms have adopted and implemented sustainable practices or indicated their interest in sustainability. This could help firms gain a competitive advantage, improving their sustainability performance. This result

confirmed previous studies asserting that proactive sustainability practices will reduce energy consumption, material usage and waste management (Govindan et al., 2014; Geyi et al., 2020). Others argued that effective management of suppliers could lessen costs; and encourage recycling, reuse, and remanufacturing activities (Sarkis et al., 2010; Kleindorferet al., 2005). This result of a study added to the body of knowledge on sustainable supply chain practices and sustainability performance. It confirmed that two attributes of sustainable supply chain practices: social and environmental practices have the potential to achieve sustainable performance in the oil and gas industry. In addition, the R^2 was 0.528, indicating that 52.8% of the variance in sustainability performance can be explained by pathways and obstacles to sustainability and sustainable supply chain practices (social and environmentally sustainable practices)

6.5.2 The impact of Sustainable Supply Chain Practices on Operational Performance

RO4b: To examine the impact of sustainable supply chain practices on operational performance across oil and gas supply chains in Nigeria.

The empirical findings show that Sustainable supply chain practices positively affect operational performance. Therefore, these findings are in agreement with the study of Alzubi & Akkerman, (2022), which stated that sustainable supply chain practices are used to avoid environmental and social behaviour to encourage desirable actions through organisations. These actions and behaviours are associated with an organisational performance by improving the cost of materials, processes, services, and legal compliance. On the revenue side, these practices can enhance the reputation and offer differentiated services and products, improve organisations' market share, marginal profit (Stubbs, 2019; Li, 2014; Alzubi & Akkerman, 2022) and non-financial performance. Hansen et al. (2009) list six potential benefits of implementing sustainable supply practices, including a decrease in risk, increased efficiency and cost reduction, assurance of legitimacy, planning reliability, new customers and market segments, and new product and service segments. Ameer & Othman (2012) argued that firms implementing sustainable practices are better positioned to gain superior outcomes over competitors due to their intangibility and

difficulty replicating. In addition, Gomez-Conde et al., (2019) stated that implementing sustainable practices will let to less pollutive, recycling more waste and residuals or even being more resource efficient. Similarly, Peattie, (2016) argued that the misuse of natural resources generates waste that will reduce value and could also be symptomatic of problems in processes, services, or products, which will be addressed by implementing sustainable practices and improving their performance.

6.6 Mediating role of Sustainable Supply Chain Practices on the relationship between Pathways and Sustainability Performance

This section explains the result of testing the research question related to Sustainable supply chain practices mediating the relationship between pathways and sustainability performance. This linkage has aimed to address RO5, as stated below:

RO5: To Examine the mediating roles of sustainable supply chain practices on the relationship between pathways and sustainability performance across oil and gas supply chains in Nigeria.

To examine the mediation effect of sustainable supply chain practices on the relationship between pathways to sustainability and sustainability performance, a test of direct, indirect, and total effects in AMOS SPSS was used. The indirect and total effects of the mediator (SSCP) on pathways to sustainability and sustainability performance are presented in the Table 5.19 and table 5.20 above. Based on an in-depth mediation analysis, sustainable supply chain practices were found to mediate the relationship between pathways and sustainability performance. The result indicates the vital role that sustainable supply chain practices can play in achieving sustainable performance. The successful implementation of sustainable supply chain practices depends significantly on these pathways to sustainability like top management commitment (Wirtenberg et al., 2007; Bansal, 2003), regulations (Yusuf et al., 2012; Costache, Dumitrascu and Maniu, 2021), customers and stakeholders' collaborations (Geyi et al., 2020), training and innovation. Therefore, having these sustainability requirements can trigger the implementation of sustainable supply chain practices, which will increase sustainability performance. In addition, these pathways can help organisations develop capabilities that can play an invaluable role

in influencing organisations' sustainable initiatives (Antony, 2011). Therefore, organisations must realise the importance of these requirements in implementing sustainability practices to improve their sustainability performance.

6.7 Theoretical implications

6.7.1 Stakeholder theory

Stakeholder theory is an organisational framework which asserts that organisations should consider the interests and concerns of all individuals or groups affected by their actions, not just shareholders (McGahan, 2023). It acknowledges that companies are responsible to a broader set of stakeholders, including employees, customers, suppliers, communities, and the environment, beyond solely maximising profits for shareholders. The potential impact of sustainable supply practices and the influence of supply chain partners and other stakeholders raise intriguing questions about the necessity for oil and gas companies to implement such practices that enhance operational performance and sustainability. This study examines these questions from stakeholder theory perspectives.

Therefore, from the stakeholder theoretical perspective, this study suggests that pressures and commitment from stakeholders can directly influence oil and gas companies in Nigeria to implement sustainable supply chain practices, which will enhance their sustainability and operational performance. To reiterate, the outcomes of this study confirm that these pressures influence the oil and gas companies in Nigeria to implement sustainable supply chain practices, which in turn affect their sustainability and operational performance. This is supported by studies conducted by Omorodion and Joseph, 2024, Michael et al., 2024, Westman et al. 2019), and Adebanjo et al., 2016) which found that regulation, top management commitment, training and implementation of ISO 14 001 are more likely to pressure companies to implement sustainable practices.

6.8 Summary

This chapter has presented a detailed discussion of research findings from an empirical examination of the theoretical relationships that address the research objectives. The chapter follows a logical flow, beginning with a summary of the results informed by the outcome of the model testing. It then proceeds to give a detailed discussion of the relationships between pathways to sustainability and sustainable supply chain practices and sustainability performance, followed by empirical findings on the linkages between obstacles to sustainability and sustainable supply chain practices and sustainability performance that indicate the negative link. In this respect, the research results also discussed the link between sustainable supply chain practices and sustainability and operational performance, which indicates both positive relations as established in the literature. The chapter also discussed the result of the mediation role of a sustainable supply chain on the link between pathways and sustainability performance and discussed the theoretical implications of the results. The next chapter concludes this thesis and highlights the study's contributions, managerial implications, research limitations and future directions.

Chapter Seven: Conclusion

7.1 Introduction

This chapter presents the conclusions drawn from the study. It restates the research aims, objectives, methodology, and major tasks undertaken. In addition, it presents the conclusion by restating the research objectives and providing the findings and justifications. The chapter also outlines the study's contributions to theory and practice and highlights its limitations, underlining their potential impact. Finally, the chapter concludes with suggestions for future researchers.

7.2 An Overview of the Research

This research aimed to study the pathways and obstacles to sustainability within the supply chain and determine their overall impact on sustainable supply chain practice and sustainability performance and the impact of sustainable supply chain practice on sustainability and operational performance. In addition, the study seeks to determine the mediating role of sustainable supply chain practices on the relationship between pathways and sustainability performance and to develop a conceptual framework of the relationships between pathways, obstacles, SSCP, Sustainability and operational performance in the oil and gas industry in Nigeria.

The concept of sustainability in the context of a sustainable supply chain has been discussed using a number of terms in the literature. Sustainability has become a global priority. As a result, motivated companies are re-evaluating their supply chain operations in light of their supply chains' environmental and social consequences (Tay et al., 2015). Increasing discourse on climate change and the need to reduce carbon footprint forced organisations to adopt sustainable practices (Ågerfalk, et al., 2022; Farrukh et al., 2022). The goal is to ensure that activities in the world have minimal effects on the environment and that they prioritise the protection of available natural resources so that the needs of future generations are not compromised (Muhammed, 2019).

The initial literature review conducted for this study revealed a research gap in current sustainable supply chain implementation in the context of the oil and gas industry in Nigeria. The controversy surrounding sustainability implementation is

deliberated by both academics and practitioners with conflicting results. In order to clearly understand sustainable supply chain practices, both antecedents and consequences of sustainable supply chain practices were investigated. The antecedents to sustainable supply chain practices are the pathways and obstacles to the implementation of sustainability, while the consequences are what result from practising sustainability (performance outcome) within the supply chain in a company. Understanding both the antecedents and the consequence of sustainability allows an organisation to introduce sustainable supply chain practices at a proper level (Lin, 2022).

The first type of antecedent is pathways to sustainability. Pathways are ways of achieving sustainable results. These are strategic factors that serve as essential requirements for sustainability implementation. The next set of antecedents is obstacles to sustainability. Obstacles here refer to factors that could inhibit embracing sustainability practices in the supply chain. These are sustainable supply chain practices impediments that hinder an organisation from successfully implementing sustainability practices. Moreover, they lead to unfavourable sustainability and operational performance.

The consequence of sustainable supply chain practices is the performance of the firm both sustainability and operational performance. The firm's performance reflects the efficiency and effectiveness of its processes in producing its products and services (Ausat et al., 2022). Firm sustainability performance can be measured in terms of environmental, economic, and social performance, while operational performance can be measured in terms cost, time, reliability and product quality.

Furthermore, the literature review and stakeholder theory were used to develop a conceptual framework consisting of five concepts. The framework explained the influence of pathways and obstacles on sustainable supply chain practice and their overall impact on sustainability and operational performance. It conceptualised the interconnections between these concepts. A survey by questionnaire was employed to examine the relationship between the constructs. The study used Statistical tools for social science (SPSS and IBM SPSS AMOS 29) to analyse the questionnaire data. In addition, structural equation modelling is employed as a confirmatory approach to

data analysis, examining the research model to assess its consistency with the data. This investigation establishes the direct and indirect correlations between the variables.

The findings, which are in alignment with previous studies, indicate that pathways to sustainability have a positive and significant impact on sustainable supply chain practices and sustainability performance. Conversely, obstacles to sustainability have a negative and significant impact on these areas. The research also confirms that sustainable supply chain practices have a positive and significant impact on sustainability performance, although their effect on operational performance is insignificant. This finding is consistent with previous studies that have identified a positive and robust relationship between sustainable supply chain practices and sustainability performance, while studies that have argued otherwise have been rejected. Moreover, the study underlines the role of sustainable supply chain practices as a mediator in the relationship between pathways and sustainability performance.

7.3 Findings of the research

The purpose of this research is to study the impact of pathways and obstacles to sustainability on sustainable supply chain practices and sustainability performance and the impact of sustainable supply chain practices on sustainability and operational performance. Further, to examines the mediating role of sustainable supply chain practices in the relationship between pathways and sustainability performance of the Nigerian oil and gas industry supply chain. To achieve this, five research objectives were investigated, the findings of which are as follows:

7.3.1 Research objective 1

RO1: To identify the pathways and obstacles to sustainable supply chain practices in oil and gas supply chains in Nigeria.

Pathways to sustainability are ways of achieving sustainable results. They also refer to essential requirements or enablers for achieving sustainable supply chain practice and performance. On the other hand, obstacles to sustainability are inhibitors that make implementing sustainable supply chain practices and sustainability

performance difficult for oil and gas companies in Nigeria. To address this research objective, the study conducted an extensive literature review regarding the pathways and obstacles to sustainability implementation. In doing this, the relevant pathways and obstacles to sustainability were identified.

Therefore, the Key pathways for implementing sustainability practices in the Nigerian oil and gas industry include top management support, strategic centrality of sustainability initiatives, system alignment, sustainability metrics, holistic integration, and most importantly, stakeholder engagement. This active involvement of stakeholders is crucial for the success of sustainability initiatives. Other key factors include performance measures, compliance with regulations, training, awareness, and support from government and international organizations, and culture. Literature and empirical results indicate these are essential enablers for implementing sustainable supply chain practices and performance; for example, oil and gas companies in Nigeria are driven to reduce supply chain environmental impacts due to global environmental concerns. Further, maintaining competitiveness requires adherence to regulations, making regulatory compliance crucial for proactive sustainability strategies and achieving sustainable performance.

Furthermore, the study findings identify internal and external obstacles to sustainability. Internal obstacles include financial constraints, collaboration issues, team misalignment, information gaps, lack of expertise, outdated structures, lack of leadership commitment, and process complexity. External obstacles encompass customers' limited understanding, supplier capabilities, insufficient government support, limited technology access, low demand for eco-friendly products, inadequate infrastructure, and cultural barriers. For example, employee resistance to sustainability practices is caused by employees' lack of knowledge and communication gap, affecting sustainability implementation.

7.3.2 Research Objective 2

RO2: To investigate the impact of pathways on sustainable supply chain practices and sustainability performance in oil and gas supply chains in Nigeria.

The research objective is based on the expression that pathways influence sustainable supply chain practices and sustainability performance. However, there is

a lack of studies on the potential impact of pathways to sustainability on sustainable supply chain practices (Kodua et al., 2022; Saha et al., 2022; Mardani et al., 2020), and conflicting findings regarding the impact of sustainable supply chain practices on sustainability performance in Nigerian oil and gas industry (Herbert et al., 2020; Ahmad et al., 2017). Therefore, addressing this objective is significant because it underpins the assertion that these pathways to sustainability implementation are influential pressures for attaining sustainable supply chain practices, which, in turn, improve sustainability performance and show that the Nigerian oil and gas industry is not an exception in this case.

The researcher has explained the relationship between these pathways and sustainable supply chain practices and sustainability performance through a literature review and empirically examined their relationship and impact to address this objective. The results from the structural equation modelling revealed that pathways have a positive and significant impact on sustainable supply chain practices and sustainability performance. This shows that pathways can potentially impact sustainable supply chain practices and sustainability performance in Nigerian oil and gas industry.

These research findings suggest that these pathways are necessary to implement sustainable supply chain practices and improve sustainability performance. With these pathways, it will likely be possible for Nigeria's oil and gas industry to implement sustainable supply chain practices. This further confirms that pressure from the government, regulations, and other stakeholders regarding sustainability implementations is deemed necessary and sufficient for adopting sustainability practices and improving sustainability performance.

7.3.3 Research Objective 3

RO3: To investigate the impact of obstacles on sustainable supply chain practices and sustainability performance in oil and gas supply chains in Nigeria.

The research objective is engrained in the realisation that obstacles, such as regulatory constraints, financial limitations, technological challenges, and organizational resistance, can deeply and adversely affect sustainable supply chain practices and sustainability performance (Okeke et al., 2024, Anosike, 2017). The

intricate nature of these obstacles can significantly impede the progress of sustainability practices and performance (Cunha et al., 2024). To address this research objective, the study employed the structural equation modelling method, which allowed for a detailed examination of the impact of these obstacles on sustainable supply chain practice and sustainability performance.

The results revealed that obstacles negatively and significantly impact sustainable supply chain practices and sustainability performance. This confirmed that these obstacles are critical for comprehensive strategies to implement sustainability across operations and supply networks. It also supports previous studies' findings, which concluded that obstacles are important issues inhibiting the execution of sustainable development of supply chain practices. Therefore, the enhanced understanding of these obstacles to the sustainability implementation of Nigeria's oil and gas companies improves the possibility of successfully and effectively planning and implementing sustainable supply chain practices and sustainability performance.

7.3.4 Research objective 4

RO4: To examine the impact of sustainable supply chain practices on sustainability and operational performance across oil and gas supply chains in Nigeria.

This research question aims to address the uncertainty present in the current literature by conducting a comprehensive investigation into the ongoing debate regarding the impact of sustainable supply chain practices on sustainability and operational performance in the Nigerian oil and gas industry. There are conflicting findings regarding the influence of sustainable practices on organisational performance (Zhao et al., 2023; Larbi-Siaw et al., 2022). To address this objective, also through a literature review, this study has explained the interaction between sustainable supply chain practices, sustainability performance, and operational performance and empirically investigated their link and influence using structural equation modelling.

The results of the analysis show that sustainable supply chain practices positively and significantly impact sustainability performance. At the same time, the impact on operational performance is not significant. In all, sustainable supply chain practices impact sustainability performance by reducing environmental impact, improving

social and economic conditions for oil and gas companies, enhancing operational efficiency, and improving brand reputation. These benefits can lead to reduced costs, greater stakeholder engagement, a sustainable source of materials, fair wages, and safe working conditions for workers, thereby enhancing their lives.

Therefore, by implementing sustainable practices, oil and gas companies in Nigeria can better track their supply chain, identify inefficiencies, and address risks. Improved supply chain transparency can lead to better decision-making, as companies can identify opportunities for improvement and take action to optimize their operations. Reducing costs is another benefit of sustainable supply chain practices. For example, companies can reduce costs by optimizing transportation routes, reducing waste, and improving energy efficiency.

7.3.5 Research objective 5

RO5: To Examine the mediating roles of sustainable supply chain practices on the relationship between pathways and sustainability performance across oil and gas supply chains in Nigeria.

The research Objective is based on whether sustainable supply chain practices mediate the relationship between pathways and sustainability performance. Studies show that there is a lack of empirical evidence on the role of sustainable supply chain practices in mediating the relationship between pathways and sustainability performance, which this research objective seeks to fill the gap.

To address this research objective, a test of direct, indirect, and total effects in AMOS SPSS was used. Based on an in-depth mediation analysis, sustainable supply chain practices were established to mediate the relationship between pathways and sustainability performance. The outcomes show the vital role that sustainability practices can play in attaining sustainable performance. The successful implementation of sustainable supply chain practices depends significantly on these pathways. Therefore, these sustainability requirements can trigger sustainable supply chain implementation, increasing sustainability performance.

7.4 Contributions to Knowledge

Despite the significant contributions made over the last few years, a gap remains in our understanding of the pathways and obstacles to sustainability implementation

and how they affect the overall performance of the Nigerian oil and gas industry. This study, therefore, seeks to add to the existing literature by investigating and assessing the impact of these pathways/obstacles on sustainable supply chain practices and performance (sustainability and operational) within the context of the Nigerian oil and gas industry. The significance contributions of this study are outlined below.

1 This study contributes to the theoretical discussion on sustainability management in the oil and gas sector by providing empirical evidence on one of the oil- and gas-rich emerging nations. As a result, several conference papers have been developed as a result of the theoretical contribution of this study. This deepens our understanding of this topic and helps scholars and practitioners comprehend Nigeria's current state of sustainability research. Moreover, it paves the way for future case studies, offering a proven mechanism that might be tested and analysed in Nigeria or elsewhere, inspiring further research and exploration.

The result of this study, along with confirming previous research, extends earlier work by bringing together previously divergent theoretical ideas and disconnected empirical evidence concerning specific sustainability antecedents and their impacts. While this model draws on prior research on the essential requirements for implementing sustainability, it focuses on the unique characteristics of sustainability practices in Nigeria's oil and gas supply chain industry. It connects the critical components identified as requirements for implementing sustainable supply chain practices and organizational performance. It lets us see the combined effects of various sustainability requirements (pathways) and obstacles to implementing sustainable supply chain practices.

2. Given the conflicting results in the literature on whether implementing sustainable supply chain practices improves or hampers sustainability performance, matched with growing pressure from various stakeholders for organisations to adopt sustainability in their supply chain, organisations are in a dilemma on maintaining sustainability practices. This study has given insight into how they can obtain better financial performance by implementing sustainability practices for practitioners and policymakers. Therefore, the study enables managers to better understand the relationships between sustainability requirements as pathways, obstacles,

sustainable supply chain practices and organisations' performance, ensuring more effective coordination of their respective activities to attain a significant improvement in sustainability performance so that operational performance can be achieved in the long term.

3. This study has validated and applied the stakeholder theory from Nigeria's perspective, and practitioners and researchers may benefit from its findings. Identifying pathways to sustainability and providing solutions to obstacles through the lens of stakeholder theory will contribute to knowledge.

4. Another contribution of this research to sustainability literature is the identification of the pathways to sustainability implementation. Though there is significant research on the impact of sustainability implementation on organisational performance, be it sustainability or operational performance, only a few studies look at the pathways to sustainability, especially in less developed countries like Nigeria. Therefore, this study contributes to the literature by identifying pathways to sustainability as a requirement for sustainability implementation. In addition, another contribution is the empirical findings of these pathways' impact on sustainability practices and performance that are specific to companies in Nigeria's oil and gas industry.

5. The study has identified and grouped many factors that could hamper the implementation of sustainability practices within the supply chain of the oil and gas sector in Nigeria using multiple sources of evidence. It was found in the literature that several factors hinder the implementation of sustainable supply chain practices. However, most of these studies and findings are based on studies in Western and developed nations. Hence, the findings of this study provide some specific factors relevant to the Nigerian context. In addition, the empirical result of obstacles to sustainability practices in the oil and gas companies is yet another contribution of this research to sustainability literature. This is because where these obstacles were discussed in the literature, they needed to be more specific to the types of companies in a given industry. As such, these findings enormously fill the gap in the literature.

In short, this study has provided insight into the impact of implementing sustainability in the oil and gas sector by identifying the pathways and obstacles to sustainability implementation and empirically confirming the relationship between pathways and obstacles to sustainability, sustainable supply chain practices and organisational performance from the perspective of oil and gas industry in Nigerian. In addition, the study provides an empirically validated conceptual framework for evaluating the interrelated impact of pathways and obstacles to sustainability implementation on sustainability and operational performance. The conceptual framework shows critical requirements and obstacles for sustainability implementation, which can help the government, regulators, practitioners, policymakers, employees, and customers to identify those areas where improvement is required and should be prioritised.

7.5 Limitations

This research covers pathways to sustainability, obstacles to sustainability, sustainable supply chain practices (focusing on environmental and social practices), sustainability performance (environmental, economic, and social) and operational performance. The study identified pathways and obstacles to sustainability practices and their overall impact on sustainability and operational performance. More importantly, the result indicates the positive and negative impact of pathways and obstacles to sustainability. Even though this study provides fresh insights for supply chain practitioners and scholars, it is important to stress that it also has limitations. Some of the limitations of this research are as follows:

First, the study was limited to Nigeria's oil and gas industry, so the generalisation of results may not be extended to other industrial sectors. In addition, the selected geographical area of analysis was Nigeria, and the data were collected from a single country. Hence, the research findings may not be entirely extendable to other oil and gas industries and geographical contexts.

Second, the use of a questionnaire as a method of data collection is another limitation of the study. However, steps were taken to minimise response bias, misinterpretation of questions, limited response options, small sample size and

incomplete data by ensuring anonymity and confidentiality of the respondents, pre-testing the questionnaire, and using appropriate statistical methods for data analysis, yet their impact on the quality of the data collected may have potentially affected the accuracy and reliability of the findings. These limitations may reduce the generalisability of the findings.

Third, the study employs a single method that involves a quantitative approach to data analysis in the Nigerian oil and gas industry. Quantitative data analysis methods permitted statistical analysis of data only, which may have overlooked contextual aspects that are difficult to quantify, such as cultural norms or individual experiences. As a result, the findings of this study may not fully capture the complexity of the phenomenon under investigation.

Fourth, several possible antecedents to sustainability implementation still exist, in addition to the pathways and obstacles enumerated in the model within the oil and gas industry. Further, the sustainable supply chain practices used in the model are environmental and social only. The sustainability field is fundamentally multidisciplinary and interconnected. Obviously, the research does not claim that all potential antecedents have been accounted for in the research model, nor can the model provide exhaustive insight into all sustainability variables. The model could add more constructs, which were not mentioned within the current scope of this research.

7.6 Future Research Suggestions

Based on the findings of this research and the limitations set out above, the following research is proposed to address opportunities for further research.

7.6.1 Introduction

There is a pressing need for businesses and organisations to transition towards sustainable practices. Understanding the dynamics that serve as pathways or obstacles to sustainable supply chain practices is crucial for fostering widespread implementation. Also, there is a dearth of literature on the impact of these dynamics on sustainable supply chain practices. Furthermore, there are conflicting results on the relationship between sustainability practices and organisational performance. In

addition, the role of sustainable supply chain practices in mediating the link between pathways and performance outcomes remains unclear. This study has identified some of the pathways and obstacles to sustainability and shows the impact of these pathways and obstacles on sustainability practices. Further, make headway on the impact of pathways and obstacles on organisational performance and the role of SSCP in mediating the relationship between pathways and sustainability performance in the oil and gas industries.

However, several possible antecedents to sustainability implementation still exist. There remains a need to study more antecedents to sustainability, specifically investigating the moderating role of technological innovations, such as blockchain and AI, in enhancing transparency and traceability, which could offer valuable insights. Further investigations are recommended within related industries in Nigeria and other geographical areas. Therefore, the study aim to study pathways and obstacles to sustainability by investigating the moderating role of technological innovations.

7.6.2 Significance

The significant contribution of this research will be the development of a framework that depicts the links between the antecedents and outcomes of implementing sustainable supply chain practices. This will add to the growing body of sustainable supply network management. Before this study, evidence of sustainability antecedent was purely subjective. The present study will assess the obstacles to sustainability implementation and examine the pathways to overcoming sustainability challenges across manufacturing enterprises in emerging economies. Also, to determine the moderating role of technological innovations in the relationship between pathways/obstacles and sustainable supply chain practices. Besides, the identified pathways/obstacles help provide a deeper understanding of what causes and hinders sustainability in the whole supply chain. The outcomes will enable Supply Chain Managers to evaluate the proposed framework and understand how these can be promoted and negotiated effectively with their supply chain partners.

7.6.3 Research method

The research intends to use mixed methods. In mixed methods both quantitative and qualitative research approaches are simultaneously used in a particular research project or at any stage of the research process. (Sreejesh & Mohapatra 2014). Even though they are used concurrently, they are analysed differently (Saunders & Thornhill 2007). The reason behind the mixed research approach is based on the objective of the study that intends to develop a new model of the relationship between Pathways, Obstacles, Technological Innovations, Sustainability practice and Organisational performance. The mixed research method provides a platform for reaching out to a broad spectrum of the research process, which helps address the limitations of using only one approach. Apart from covering a wide area of the study, which this study seeks to achieve, Tashakkori & Teddlie (2003) pointed out that the mixed research approach is preferable if it provides a better platform for meeting the research objectives by collecting different views about the research project.

7.7 Summary

This research aimed to identify the pathways and obstacles to sustainability implementation and to study its impact on the sustainability and operational performance of Nigerian oil and gas companies. An empirical study using a survey by questionnaire was conducted in the Nigerian oil and gas companies. Five research questions were asked and answered to achieve the research aim and objectives. Considering the study's findings, this research's aim and objectives have been met through answering the research questions. Further elaborations on how the research questions have been answered and the significance of answering those questions have been stated in this chapter. The limitations of the current research and suggestion for further research have also been presente

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Appendices

Appendix1: **Questionnaire survey on A Study of Pathways and Obstacles to Sustainability**

University of Central Lancashire
UCLan

27/07/2021

Dear Sir/Madam,

Questionnaire survey on A Study of Pathways and Obstacles to Sustainability

Dahiru Dauda Hammawa is undertaking a research project to investigate the pathways and obstacle to sustainability implementation within supply chains.

The research examines the obstacles and pathways to successful sustainability implementation within supply chains and determines if obstacles moderate the relationship between sustainability practices and overall organisational performance.

We would very much appreciate your contribution to this research by completing the enclosed survey form. It will take a short time (fifteen minutes) to complete this questionnaire as most of the questions require a tick (√). It will be very helpful if the survey form could be returned within four weeks duration using the self-addressed paid enveloped provided.

In the case that you are unable to complete the questions, we would encourage you passing the survey form to another person qualified to provide the necessary response.

All information provided is considered completely confidential and will be used for academic purposes only. Your name will not appear in any report resulting from this study. Should you be interested, the summary of the outcomes of this research will be made available for you.

If you have any queries, please contact Dahiru Dauda Hammawa by email at Dhdauda@uclan.ac.uk

Thanking you so much for your kind cooperation.

Professor Yahaya Yusuf
Director of Studies
School of Management
University of Central Lancashire
Preston PR1 2HE, UK

SURVEY ABOUT PATHWAYS AND OBSTACLES TO SUSTAINABILITY IN SUPPLY CHAINS

A. General Information

1. Name of the organization ……
2. Position of the respondent……
3. Year of establishment……
4. What is the workflow process used in your organisation?

		Tick
a.	Project	
b.	Production	
c.	Continuous	
d.	Mass	
e.	Jobbing	
f.	Batch	
g.	Other (please specify) …….	

5. Number of employees

   1 – 50 ☐ 51 – 100 ☐ 101 - 200 ☐ 201 – 300 ☐ above 301 ☐

6. Number of years of professional experience

   1- 5 years ☐ 6-10years ☐ 11-15years ☐ 16-20years ☐ 21years and above ☐

7. What is the main activity of your organisation?

Major Product Line	**Tick**
Exploration and production	
Bases, Logistics, Catering, Transport, Storage, and allied services	
Consultations including geographical services	
Automobile and automotive assembly, parts, component, and accessories	
Engineering services (reservoir, well drilling, facilities management and well engineering)	
Maritime, subsea services and allied services	
Electricals and electronic equipment, components, and allied products	
Others (please specify)	

8. What is the average sales turnover per annum of this company?.....

B. Level of sustainability Practices

9. Identify the stage of sustainability implementation in your company.

Adoption of sustainability practice	Tick
No plan for adoption now and in future	
Will adopt in future	
Recent and on-going implementation	
Made significant progress in implementation	

10. What is the initial (take up) investment made by your company on sustainability?.....

11. What is your total investment on sustainability practices over the past 5 years?
2017…….. 2018……. 2019……. 2020…… 2021……..

12. What do you plan spending on sustainability practices over the next five years?
2022…….. 2023…… 2024……. 2025…….. 2026…….

13. How long do your company adopted sustainability measures?
Less than 5 years ☐ 5- 10 years ☐ 11- 15 years ☐ 16 – 20 years ☐ over 20 years ☐

C. Pathways to sustainability implementation

14. Please indicate to what extent does your company have the following qualities for building a sustainable enterprise. (5 Point Likert Scale: where 1= strongly disagree, 2= Disagree, 3=Do not know, 4=Agree, 5=strongly agree). Tick (√) the most appropriate boxes provided below.

Pathways to Sustainability	**Strongly Disagree (1)**	**Disagree (2)**	**Do not know (3)**	**Agree (4)**	**Strongly Agree (5)**
Top management show public and unwavering support for sustainability					
Stricter laws and regulations to support sustainability from governments and regulatory bodies.					
Stakeholders Support to sustainability implementation					
Key values related to sustainability are deeply ingrained in the company					
Information Technology Advancement and adoption					
Company provides employee training and development related to sustainability					
Encouragement and support from customers					
We get groups across the company that are working more closely together on sustainability-related initiatives					
Stockholders Support					
Company has standardised metrics to measure sustainability performance					
Other (please specify)……					

D. Obstacles to sustainability implementation

15. In your opinion, to what degree does each of the following obstacles hindered or could hinder the adoption of sustainability practices in your company? (5 Point Likert Scale: where 1= strongly disagree, 2= Disagree, 3= Do not know, 4= Agree, 5= strongly agree)

Obstacles to sustainability implementation	**Strongly Disagree (1)**	**Disagree (2)**	**Do not know (3)**	**Agree (4)**	**Strongly Agree (5)**
Lack of specific ideas on what to do and when to do it					
Lack of awareness and understanding					
Lack of standardized metrics or performance benchmarks					
Lack of adequate skills and knowledge					
Inappropriate infrastructures					
Government bureaucracy and instability					
Resistance to change					
Lack of supplier's capabilities					
Lack of trust-based collaboration					
Lack management commitment					
Gap in standards and approaches					
Cultural barriers					
Lack of support from international platforms					
Unclear or weak business case					
Limited financial resources					
Other (please specify) ……					

F. Sustainable Supply Chain Practices

16. Please indicate to what extent does your company have capabilities in place to do the following? (5 Point Likert Scale: where 1= strongly disagree, 2= Disagree, 3= Do not know, 4= Agree, 5= strongly agree) Tick (√) the most appropriate boxes provided below

Environmentally Sustainable Supply Chain Practices	**Strongly Disagree (1)**	**Disagree (2)**	**Do not know (3)**	**Agree (4)**	**Strongly Agree (5)**
Production and delivery processes are designed to reduce carbon dioxide					
Products and packaging are designed to be reusable and recyclable					
Products are sourced from environment friendly suppliers					
We design our products for consuming low materials and energy					
Environment friendly technologies are used to save the environment					
We use eco-friendly (e.g Fuel efficient transportation)					
Environmentally friendly materials are used in the production processes					
We provide environmental training to the staff					
We conduct environmental audits (e.g sudden visit to suppliers					
Social Sustainable Supply Chain Practices	**Strongly Disagree (1)**	**Disagree (2)**	**Do not know (3)**	**Agree (4)**	**Strongly Agree (5)**
Support employees in balancing work and life activities					

Involve employees in decisions that affect them					
Ensure the health and safety of employees					
Ensure accountability for ethics at all levels					
Source product from our local suppliers					
Encourage and promote workplace diversity irrespective of race, gender and background of our staff					
Ensure payment of taxes and levies to government					
We source product from socially responsible suppliers (e.g Child labour free)					
We contribute to local events/activities for social and environmental awareness					
We ensure fair compensation for the employees					

G. Sustainability Performance

17. How would you rate the following compared to last 5 years (5 Point Likert Scale: where 1= Very Low, 2= Low, 3= Don't know, 4= High, 5= Very High) Tick (√) the most appropriate boxes provided below

Economic Performance	**Very Low (1)**	**Low (2)**	**Don't know (3)**	**High (4)**	**Very High (5)**
Increase in sales volume					
Reduced cost of production					
Improved revenue growth					
Increase in profitability					
Decrease cost of material purchasing and energy consumption					
Increased in firm's competitiveness					
Environmental Performance	**Very Low (1)**	**Low (2)**	**Don't know (3)**	**High (4)**	**Very High (5)**
Reduction in greenhouse gas emissions					
Reduction in material usage					
Reduction in consumption of hazardous/harmful materials.					
Reduction in energy consumption					
Reduction in water usage					
Social Performance	**Very Low (1)**	**Low (2)**	**Don't know (3)**	**High (4)**	**Very High (5)**
Improved employee engagement					
Improved working condition					
Improved safety and well-being staff					
Improved community support and investment					
Improved stakeholder involvement					
Other (please specify) ……					

H. Operational Performance

18. How would you rate the following compared to last 5 years (5 Point Likert Scale: where 1= Very Low, 2= Low, 3= Don't know, 4= High, 5= Very High) Tick (√) the most appropriate boxes provided below

Operational Performance	Very Low (1)	Low (2)	Don't know (3)	High (4)	Very High (5)
Decrease of fine for environmental accidents					
Improved company image					
Increase in customer awareness level					
Improved quality of products and process					
Reduced lead-time					
Increased customer satisfaction and loyalty					
Other (please specify) ……					

19. would your company like to participate in the second stage of this research, which is an industrial case studies involving five companies? Yes. ☐ NO. ☐

Please comment freely on any aspect of supply chain management in your organization in the space below

……

……

……

……

Please return the questionnaire by email to Dhdauda@uclan.ac.uk or mail to:

Dahiru Dauda Hammawa
Department of Business Administration
Modibbo Adama University, Yola
Adamawa State

Appendix 2: Regression Weights

			Estimate	S.E.	C.R.	P	Label
Sustainability	<---	PathwaysTS	.385	.076	5.033	***	a_path
Sustainability	<---	ObstaclesTS	-.227	.060	-3.764	***	par_48
SustPerformance	<---	ObstaclesTS	-.090	.035	-2.582	.010	par_49
SustPerformance	<---	PathwaysTS	.114	.048	2.391	.017	par_50
SustPerformance	<---	Sustainability	.157	.060	2.622	.009	b_path

			Estimate	S.E.	C.R.	P	Label
SSCSS	<---	Sustainability	.865	.145	5.976	***	par_45
ESCSS	<---	Sustainability	1.000				
SOperformanceS	<---	SustPerformance	1.000				
ECperformanceS	<---	SustPerformance	2.077	.519	3.998	***	par_46
ENperformanceS	<---	SustPerformance	1.031	.349	2.957	.003	par_47
OPperformanceS	<---	Sustainability	.123	.069	1.770	.077	par_51
OBS2	<---	ObstaclesTS	1.121	.065	17.289	***	par_3

Appendix 3: Squared Multiple Correlations

	Estimate
Sustainability	.274
SustPerformance	.528
SOperformanceS	.231
OPperformanceS	.027
ENperformanceS	.152
ECperformanceS	.441

Appendix 4: User-defined estimands

SM	.061

Default model)

Parameter	Estimate	Lower	Upper	P
SM	.061	.006	.179	.045

Appendix 5: Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	109	1590.173	1067	.000	1.490
Saturated model	1176	.000	0		
Independence model	48	7797.049	1128	.000	6.912

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.079	.732	.705	.664
Saturated model	.000	1.000		
Independence model	.325	.183	.148	.175

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.796	.784	.922	.917	.922
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.946	.753	.872
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	523.173	420.189	634.118
Saturated model	.000	.000	.000
Independence model	6669.049	6392.580	6952.121

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	9.409	3.096	2.486	3.752
Saturated model	.000	.000	.000	.000
Independence model	46.136	39.462	37.826	41.137

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.054	.048	.059	.125
Independence model	.187	.183	.191	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	1808.173	1897.189	2149.975	2258.975
Saturated model	2352.000	3312.400	6039.699	7215.699
Independence model	7893.049	7932.249	8043.568	8091.568

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	10.699	10.090	11.356	11.226
Saturated model	13.917	13.917	13.917	19.600
Independence model	46.704	45.069	48.379	46.936

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	122	126
Independence model	27	27

Appendix 6: Validity Test

	CR	AVE	MSV	MaxR(H)	OPperform	Obstacles	SSCS	Pathways	ESCS	ECperform	ENperform	SOperformance
OPperform	0.862	0.558	0.052	0.872	**0.747**							
Obstacles	0.956	0.758	0.131	0.960	-0.131	**0.870**						
SSCS	0.938	0.657	0.500	0.943	0.229	-0.227	**0.810**					
Pathways	0.930	0.625	0.183	0.932	-0.021	-0.164	0.384	**0.791**				
ESCS	0.933	0.664	0.500	0.933	0.130	-0.354	0.707	0.428	**0.815**			
ECperform	0.910	0.724	0.189	0.966	0.066	-0.297	0.346	0.328	0.435	**0.851**		
ENperform	0.879	0.605	0.131	0.977	0.034	-0.362	0.051	0.212	0.171	0.277	**0.778**	
SOperform	0.900	0.700	0.127	0.980	0.026	-0.169	0.217	0.322	0.320	0.356	0.125	**0.836**

No Validity Concerns - Wahoo!

Appendix 7: Descriptives statistics

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
PWS1	170	1.00	5.00	4.0353	.94145	-2.008	.186	4.691	.370
PWS2	170	2.00	5.00	4.1941	.85863	-1.010	.186	.528	.370
PWS3	170	1.00	5.00	4.2176	.93247	-1.379	.186	1.807	.370
PWS4	170	1.00	5.00	4.3118	.85822	-1.445	.186	2.021	.370
PWS5	170	1.00	5.00	3.8824	.92834	-1.873	.186	3.930	.370
PWS6	170	2.00	5.00	4.1941	.80160	-1.133	.186	1.369	.370
PWS7	170	1.00	5.00	3.9294	.93313	-1.715	.186	3.592	.370
PWS8	170	1.00	5.00	3.7588	1.20431	-1.129	.186	.500	.370
PWS9	170	1.00	5.00	3.4706	1.14187	-.880	.186	.050	.370
PWS10	170	1.00	5.00	4.4647	.82952	-1.932	.186	3.793	.370
Valid N (listwise)	170								

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
OBS1	170	1.00	5.00	2.1882	1.24505	1.014	.186	.043	.370
OBS2	170	1.00	5.00	2.1412	1.15285	1.244	.186	.727	.370
OBS3	170	1.00	5.00	2.1353	1.24008	1.077	.186	.152	.370
OBS4	170	1.00	5.00	3.4235	1.34891	-.546	.186	-1.061	.370
OBS5	170	1.00	5.00	2.1647	1.17011	1.132	.186	.435	.370
OBS6	170	1.00	5.00	2.1529	1.09335	1.176	.186	.638	.370
OBS7	170	1.00	5.00	2.2000	1.16457	1.013	.186	.196	.370
OBS8	170	1.00	5.00	2.1000	1.22909	1.258	.186	.561	.370
OBS9	170	1.00	5.00	2.2529	1.08819	1.266	.186	.942	.370
Valid N (listwise)	170								

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
ESP1	170	1.00	5.00	3.6412	.94560	-1.179	.186	1.413	.370
ESP2	170	1.00	5.00	4.1294	.91391	-1.437	.186	2.189	.370
ESP3	170	1.00	5.00	3.9706	.98765	-1.656	.186	2.905	.370
ESP4	170	1.00	5.00	3.4235	.97758	-.552	.186	-.378	.370
ESP5	170	1.00	5.00	3.7941	1.02569	-1.374	.186	1.774	.370
ESP6	170	1.00	5.00	3.7471	1.04944	-.969	.186	.503	.370
ESP7	170	1.00	5.00	3.7176	1.01599	-1.190	.186	1.435	.370
ESP8	170	1.00	5.00	4.1118	1.01724	-1.421	.186	1.616	.370
ESP9	170	1.00	5.00	3.9176	1.09557	-1.420	.186	1.529	.370
SSP1	170	1.00	5.00	3.6176	1.15166	-.621	.186	-.299	.370
SSP2	170	1.00	5.00	3.5882	1.18964	-.778	.186	-.202	.370
SSP3	170	2.00	5.00	4.4941	.66392	-1.574	.186	3.535	.370
SSP4	170	1.00	5.00	3.7824	1.13301	-1.118	.186	.646	.370
SSP5	170	1.00	5.00	3.5235	1.25553	-.889	.186	-.277	.370
SSP6	170	1.00	5.00	3.8765	1.17772	-.967	.186	.086	.370
SSP7	170	1.00	5.00	3.7765	1.06451	-1.031	.186	.749	.370
SSP8	170	1.00	5.00	3.7765	1.16025	-1.003	.186	.253	.370
SSP9	170	1.00	5.00	3.6353	1.15484	-.906	.186	.093	.370
Valid N (listwise)	170								

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
ECP1	170	1.00	5.00	3.9706	.99363	-1.332	.186	1.905	.370
ECP2	170	1.00	5.00	4.1000	.88812	-1.839	.186	4.485	.370
ECP3	170	1.00	5.00	3.9647	.99045	-1.371	.186	2.153	.370
ECP4	170	1.00	5.00	4.2176	.88694	-1.627	.186	3.285	.370
ECP5	170	1.00	5.00	4.0941	.91177	-1.420	.186	2.572	.370
ENP1	170	1.00	5.00	3.9176	1.11697	-1.537	.186	1.821	.370
ENP2	170	1.00	5.00	4.0765	.98511	-1.282	.186	1.359	.370
ENP3	170	1.00	5.00	4.1000	1.13393	-1.578	.186	1.929	.370
ENP4	170	1.00	5.00	3.9941	.95767	-1.133	.186	.846	.370
ENP5	170	1.00	5.00	4.1118	1.15353	-1.625	.186	1.975	.370
SOP1	170	1.00	5.00	3.9059	1.06725	-1.347	.186	1.297	.370
SOP2	170	1.00	5.00	4.1588	.77196	-1.532	.186	3.928	.370
SOP3	170	1.00	5.00	4.2765	.81410	-1.615	.186	3.556	.370
SOP4	170	1.00	5.00	4.2176	.87350	-1.464	.186	2.652	.370
Valid N (listwise)	170								

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
OPP1	170	1.00	5.00	4.0706	.70983	-1.609	.186	5.702	.370
OPP2	170	1.00	5.00	4.3235	.68460	-1.411	.186	4.294	.370
OPP3	170	1.00	5.00	4.3412	.68893	-1.773	.186	6.576	.370
OPP4	170	1.00	5.00	4.2471	.69497	-1.232	.186	3.509	.370
OPP5	170	1.00	5.00	4.4471	.76159	-2.178	.186	6.914	.370
OPP6	170	2.00	5.00	4.3706	.76789	-1.460	.186	2.402	.370
Valid N (listwise)	170								